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M4 Corridor around Newport

Statement to Inform an Appropriate Assessment under the Conservation of Habitats and Species Regulations 2010

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M4CaN-DJV-EBD-Z3_GEN-RP-EN-0001

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Summary

S. 1. This report has been prepared to provide information to the Welsh Ministers ("the Competent Authority") in the form of a Statement to Inform an Appropriate Assessment (SIAA) of the implications of the M4 Corridor around Newport (M4CaN) for European Sites as required by Regulation 61 of the Conservation of Habitats and Species Regulations 2010 (as amended) (the 'Habitats Regulations').

S. 2. In line with guidance set out by the Design Manual for Roads and Bridges (DMRB) HD44/09 (Highways Agency, 2009), this document provides the necessary information for Welsh Ministers to undertake an Appropriate Assessment, including background and justification for the M4CaN project, project description, SIAA methodology, consultation undertaken to date with statutory nature conservation bodies, screening of likely significant effects (LSE) on qualifying features of European sites, and a full, detailed appropriate assessment of the effects on those sites and features, including mitigation and monitoring requirements.

S. 3. DMRB HD44/09 guidance (Highways Agency, 2009) recommends that, for the purposes of Regulation 61 of the Conservation of Habitats and Species Regulations 2010, answers to the following four questions (a to d) should be provided (based on the information presented) when concluding a SIAA. These are addressed in turn here.

(a) Is the proposal directly connected with or necessary to site management for nature conservation?

S. 4. The M4CaN project is neither connected with nor necessary to site management of any European sites.

(b) Is the proposal likely to have a significant effect on the features of the site of European Importance, alone or in combination with other plans and projects?

S. 5. The M4CaN AIES Stage 1: Screening concluded that LSEs could not be ruled out on qualifying features of the following European sites (summarised in Section 4 of this SIAA):

- River Usk SAC;
- Severn Estuary SAC;
- Severn Estuary SPA;
- Severn Estuary Ramsar Site; and
- Wye Valley and Forest of Dean Bat Sites SAC.

S. 6. It is therefore necessary for an Appropriate Assessment to be carried out for the M4CaN project on the qualifying features of these five sites. In line with DMRB HD44/09 guidance, it is therefore necessary to provide answers to questions (c) and (d) below.

(c) What are the implications of the effects of the proposal on the site's conservation objectives and will it delay or interrupt progress towards achievement of any of the objectives?

S. 7. The assessment concludes that, assuming the implementation of the mitigation measures outlined in Sections 5.2 to 5.6 of this SIAA, the proposals will not adversely affect the conservation objectives of the European Sites nor delay or interrupt progress towards achieving these.

(d) Can it be ascertained that the proposal will not adversely affect the integrity of the site beyond reasonable scientific doubt?

S. 8. As referred to above, the implementation of the mitigation measures described in this SIAA would ensure that the proposals would not adversely affect the integrity of the sites beyond reasonable scientific doubt.

S. 9. Therefore, for the purposes of Regulation 61 of the Conservation of Habitats and Species Regulations 2010, it is concluded that there would be no adverse effect on the integrity of the European sites considered in this SIAA either alone or in-combination with other plans and projects.

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1 Introduction and Purpose of the Assessment

1.1 Purpose of this report

1.1.1 This report has been prepared to provide the Welsh Ministers ("the Competent Authority") with a Statement to Inform an Appropriate Assessment (SIAA) with respect to the implications of the M4 Corridor around Newport (M4CaN) for European Sites as required by Regulation 61 of the Conservation of Habitats and Species Regulations 2010 (as amended) (the 'Habitats Regulations'). Prior to the production of this draft SIAA, Natural Resources Wales (NRW) was consulted on a draft Screening Assessment (Assessment of Implications on European Sites (AIES)) (Welsh Government, July 2015).

1.1.2 A draft SIAA for the Scheme was submitted with the draft Orders in March 2016. This has now been updated taking into account the findings of additional surveys carried out for relevant species in 2016 and 2017, and also changes to the Scheme which have been made since March 2016 where these are relevant to the SIAA.

1.2 Justification for the Project

1.2.1 The justification for the Project, as previously reported in the Strategic Habitats Regulations Assessment (SHRA) for the M4CaN Plan (Welsh Assembly Government, 2014), includes:

"The existing M4 is critical to the Welsh economy. It forms part of the Trans European Transport Network (TEN-T) and is the main gateway to South Wales, transporting people and goods to homes, industry and employment. It provides access to ports and airports and serves the Welsh tourism industry. The existing M4 Motorway between Magor and Castleton is the most heavily trafficked section of road in Wales, forming part of strategic routes to the Midlands and the South East of England. However, it does not meet modern motorway design standards. This section of the M4 is often congested, especially during weekday peak periods, resulting in slow and unreliable journey times, stop-start conditions, and with incidents frequently causing delays. Existing problems relate to capacity, resilience, safety and issues of sustainable development. Traffic forecasts show that the problems will worsen in the future."

1.2.2 Further detail on the background of the M4CaN Scheme, including further context and history, is provided in the March 2016 ES Chapter 1: Introduction.

1.3 Legislation

1.3.1 The Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna provides legal protection for habitats and species of European importance. The Directive is transposed into UK law by the Conservation of Habitats and Species Regulations 2010 (hereafter referred to as the 'Habitats Regulations'). Regulation 61 of the Habitats Regulations requires the competent authority, to consider whether the plan or project:

- is likely to have a significant effect on a European site (either alone or in combination with other plans or projects)

- is not directly connected with or necessary to the management of that site.

1.3.2 Where there is a Likely Significant Effect (LSE) (or such an effect cannot be discounted) and the plan or project is not connected with or necessary to the management of the site then the competent authority must make an 'appropriate assessment' of the implications for that site in view of its conservation objectives.

1.3.3 In the light of the conclusions of the assessment, the competent authority may agree to the plan or project only after having ascertained that the project will not, alone or in-combination with other plans and projects, adversely affect the integrity of the European site. The only exceptions are where there are no alternatives and there are imperative reasons of overriding public interest, in which case compensatory measures must be adopted if the Scheme is to proceed.

1.3.4 This SIAA report sets out a summary of the AIES Stage 1: Screening Report (Welsh Government, 2015; see Section 4 of this report) and describes the Stage 2: Appropriate Assessment of the M4CaN on European sites, with specific consideration of effects in relation to the conservation objectives of the features of European sites where a LSE was identified in Stage 1.

1.4 Report Structure

1.4.1 This report includes the following sections:

- Section 1: Introduction and Purpose of Assessment
- Section 2: The Project, including Aims and Goals and Project Description
- Section 3: Methodology
- Section 4: Stage 1: Screening, including summary of screening assessment
- Section 5: Stage 2: Appropriate Assessment (alone and in-combination effects)
- Section 6: Proposals for Monitoring and Reporting
- Section 7: Consultation
- Section 8: Conclusions

2 The Project

2.1 Aims and Goals for the M4 Corridor around Newport

2.1.1 The Welsh Government's aims for the M4 Corridor around Newport (M4CaN) are:

- To make it easier and safer for people to access their homes, workplaces and services by walking, cycling, public transport or road.
- To deliver a more efficient and sustainable transport network supporting and encouraging long-term prosperity in the region, across Wales, and enabling access to international markets.
- To produce positive effects overall on people and the environment, making a positive contribution to the overarching Welsh Government goals to reduce greenhouse gas emissions and to making Wales more resilient to the effects of climate change.

2.1.2 The Welsh Government, through the M4 Corridor Enhancement Measures Programme (M4 CEM) and the subsequent M4CaN draft Plan, identified 15 goals to address transport related problems in this area. These are as follows with the top four, as prioritised by the public, shown in italics:

1. Safer, easier and more reliable travel east-west in South Wales.

2. Improved transport connections within Wales and to England, the Republic of Ireland and the rest of Europe on all modes on the international transport network.

3. More effective and integrated use of alternatives to the M4, including other parts of the transport network and other modes of transport for local and strategic journeys around Newport.

4. Best possible use of the existing M4, local road network and other transport networks.

5. More reliable journey times along the M4 Corridor.

6. Increased level of choice for all people making journeys within the transport corridor by all modes between Magor and Castleton, commensurate with demand for alternatives.

7. Improved safety on the M4 Corridor between Magor and Castleton.

8. Improved air quality in areas next to the M4 around Newport.

9. Reduced disturbance to people from high noise levels, from all transport modes and traffic within the M4 Corridor.

10. Reduced greenhouse gas emissions per vehicle and/or person kilometre.

11. Improved travel experience into South Wales along the M4 Corridor.

12. An M4 attractive for strategic journeys that discourages local traffic use.

13. Improved traffic management in and around Newport on the M4 Corridor.

14. Easier access to local key services and residential and commercial centres.

15. A cultural shift in travel behaviour towards more sustainable choices.

2.2 Project Description

2.2.1 The project includes:

- A new section of 3-lane motorway, approximately 23 km in length, between Junctions 29 and 32 of the M4 south of Newport (between Castleton and Magor);
- In addition to the junctions at Castleton and Magor, there would be two additional junctions along the new section of motorway at Newport Docks and Glan Llyn (with new link roads to Docks Way and the A4810 respectively). New or diverted lengths of highway, public rights of way and private means of access would be provided to replace those affected by the Scheme;
- A new dual carriageway link between Junctions 23 and 23a at Magor;
- Road drainage provided by grass-lined channels in those sections of the new section of motorway though the Gwent Levels, and elsewhere through piped systems. In either case these would discharge into a series of water treatment areas and reed beds located along the new section of motorway. These water treatment areas would attenuate and treat the collected surface water prior to discharging it into existing watercourses; and
- Complementary measures which include:
    - Reclassification of the existing M4 between Junction 23A (Magor) and Junction 29 (Castleton) to a rural all-purpose trunk road.
    - Reclassification of the existing A48(M) between Junction 29 (Castleton) and Junction 29a (St Mellons) to a rural all-purpose trunk road.
    - Remodelling of Junction 25 and 25A on the existing M4 to improve access to Caerleon from the west.
    - Provision of non-motorised user friendly infrastructure,
    - Connection between M48, M4 and B4245

2.2.2 The new section of motorway is shown in Figure 1 in the context of the European Sites considered in this SIAA document. The following sections provide a summary description of the proposed route, with a more detailed description provided in Chapter 2 of the March 2016 ES, including information on junctions, new structures (including bridges and culverts) and modifications to existing features etc.

2.2.3 Changes and modifications to the design since publication of the draft Orders in March 2016 include:

- Lowering of the vertical alignment of the free-flowing west bound link and the roundabout at Junction 23 with the resultant realignment of Bencroft Lane and the provision of the Windmill Hill overbridge;
- Lowering of the proposed dual carriageway between Junction 23 and Junction 23A north of Magor and Undy;

- Change in discharge point from WTA 12B;
- Minor changes to NMU provision at Church Lane, Lighthouse Road and form of Percoed NMU overbridge;
- Minor changes to vertical and horizontal alignment of Docks Way Junction, including lowering slip and link roads, removal of secondary roundabout, change in main carriageway support structure from reinforced earth embankment to piers, and to Docks Link Road including changes to the provision of some retaining walls;
- Access to Tata land off Glan Llyn Link;
- Additional screening planting at Tatton Farm, Pye Corner and Rockfield Lane;
- South facing embankments to be species-rich grassland, and
- All of Tatton Farm included in SSSI Mitigation Strategy.

2.2.4 All of the above changes and modifications were described and assessed in the September 2016 Environmental Statement Supplement. In the December 2016 Environmental Statement Supplement three additional changes and modifications were made, viz:

- Increasing the vertical height of the Usk Crossing by 1.54 metres;
- Further changes to retaining walls on the Docks Link Road; and
- Additional borrow pit at Undy south of B4245.

2.2.5 The March 2017 Environmental Statement Supplement described and assessed the provision of an east facing off slip at Magor.

2.2.6 The April 2017 Environmental Statement Supplement described and assessed the provision of bridge protection measures at the Junction Cut between North Dock and South Dock within Newport Docks.

2.2.7 During the Public Local Inquiry held between 28th February 2017 and 18th July 2017 the following changes and modifications to the design were made:

- Increases in the size of some culverts to facilitate their use by bats; and
- Removal of lighting on the motorway approaches to the Glan Llyn junction, the junction itself and the link road remaining lit.

General Arrangement

2.2.8 Works on the existing M4 to the west of ch 1520 would consist solely of the installation of traffic control measures, such as changes to signage, lighting and changes to road markings.

2.2.9 The physical works associated with the new section of motorway would start at ch 1520. The existing Castleton junction on the M4 (J29) would be modified to incorporate the new section of motorway. The proposed junction has been designed to provide a free flowing interchange giving priority to the M4 motorway (including the new section of motorway) with three lanes in both directions. The layout would also provide access to and from the existing A48(M) and the existing M4 motorway to the east, which would both be reclassified following completion of the new section of motorway.

2.2.10 The works at the Castleton Interchange would include the construction of a number of new structures, including a replacement footbridge, three overbridges, two underbridges and provision for a high pressure buried gas pipe to cross the Scheme *in situ*. These works would require the demolition of three existing structures: the existing A48(M) overbridge, Park Farm footbridge and the Pound Hill overbridge.

2.2.11 The alignment would follow the centreline of the existing M4 as far as ch 3160 before curving away from the existing motorway corridor to the south east. From the modified Castleton junction, the new section of motorway would curve to the south east on an embankment, passing to the south of Berrhyill Farm.

2.2.12 The alignment would pass beneath a realigned Church Lane. Church Lane would be diverted from its current alignment to tie back into the existing highway to the north at a new roundabout junction. An overbridge would be provided to carry the realigned Church Lane (ch 4625).

2.2.13 To the south east of Church Lane, the alignment has been designed to follow the Duffryn Link Road corridor, where practicable. The proposed new section of motorway would pass over the South Wales to London Mainline at ch 6450.

2.2.14 To the east of the railway, the alignment would continue on a low embankment across the Wentlooge Levels. New overbridges would be provided at Lighthouse Road (ch 7350) and New Dairy Farm (ch 8030), the latter of which would accommodate the Wales Coast Path.

2.2.15 The new section of motorway would cross the River Ebbw (ch 8480) and pass to the south of the Docks Way Landfill site. The River Ebbw crossing is the point on the alignment which is closest to the Severn Estuary/ Môr Hafren SAC, SPA and Ramsar sites (0.3 km from the River Ebbw Crossing; see Figure 1). The River Ebbw Bridge would carry the new section of motorway over the River Ebbw. The bridge would consist of three separate structures, carrying the motorway mainline, the westbound merge slip and the eastbound diverge slip. The foundations of the bridge would be located outside the mean high water limits and the bridge deck would be 5.71 m above mean high water.

2.2.16 To the east of the River Ebbw, the alignment would continue across Newport Docks. A new junction would be provided in this location to connect with Docks Way (A48 Southern Distributor Road). The Docks Way Junction and Docks Way Link would provide a full movements, traffic signalised connection with the A48 Distributor Road and thus to Newport Docks and the south west and central parts of Newport. The connection to the A48 would be a dual two lane carriageway.

2.2.17 The River Usk Crossing would cross the Newport Docks between the South Dock and North Dock (at the Junction Cut), before crossing the River Usk. This part of the Scheme passes over the River Usk SAC although no structures or construction activity would be located within the wetted channel of the River Usk (discussed further below).

2.2.18 The crossing is proposed to take the form of a 2.15 km long elevated structure, extending from ch 9224 on the west side to ch 11376 on the east side, including a cable stayed bridge crossing of the River Usk. Details of the bridge are provided in the River Usk Crossing Approval in Principle (Doc. 6.2.24). Based on the details provided therein the clearance over the River Usk would be 37.6m above Mean High Water at the centre of the span). The bridge pylons would be

located outside the wetted channel of the river (defined as the channel within the limits of mean high water). The east pylon would be located within the boundary of the River Usk SAC, within an area of saltmarsh (not listed as a qualifying feature of the SAC) above mean high water. No construction works would occur within the wetted channel of the River Usk.

2.2.19 The structure can be divided into three main components as follows.

- The west approach viaduct, a 512m long structure consisting of seven spans.
- The cable-stayed bridge, a 752m long structure consisting of two back spans and a 440m long main span over the river.
- The east approach viaduct, a 888 m long structure consisting of twelve spans.

2.2.20 The structure would pass over the Wales Coast Path, which runs to the east of the River Usk. Immediately east of the docks area, the alignment would cross the quayside area around Corporation Road. The eastern part would cross over Uskmouth Railway line and pass to the south of the Solutia Chemical Works on a low embankment.

2.2.21 To the east of the River Usk Crossing, the alignment would continue across the Caldicot Levels towards Pye Corner. A new overbridge would be provided at Nash Road (ch 12,600). Continuing east, the alignment would follow a right hand curve across part of the Caldicot Levels towards the former steelworks. The highway would be supported on a low embankment as it runs to the east towards the former steelworks.

2.2.22 A new junction would be provided at Glan Llyn, in the form of a grade separated roundabout. This would provide a connection for the new section of motorway, via a link road, to the A4810. The new link road would connect with the existing A4810 roundabout via a remodelled southern arm.

2.2.23 From the new Glan Llyn junction, the new section of motorway would run in an easterly direction parallel to the A4810 and to the north of Whitson substation. A new bridge would be constructed at ch 17550 to carry the realigned North Row over the new section of motorway, and at ch 19800 an underbridge would take Bareland Street under the new road.

2.2.24 As the proposed alignment continued beyond the Caldicot Levels the vertical alignment would rise up on an embankment over the South Wales to London Mainline. The new section of motorway would cross over the railway on a new structure (the Llandevenny Railway Underbridge) at ch 20075. The structure would pass over the railway and a realigned public right of way.

2.2.25 The alignment would then run in a northerly direction towards Magor. New overbridges would be provided at Newport Road (ch 20860) and Knollbury Lane (ch 22025).

2.2.26 The existing St Bride's Road Underbridge (ch 21225) would be extended. The existing bridge has a clear span of 9.14 m and is approximately 40 m long. The Scheme proposals are to construct a new underbridge beneath the J23 to J23A trunk road link to extend the existing bridge.

2.2.27 In the vicinity of St Bride's Road to the north west of Magor, the new section of motorway would merge into the existing M4. Between approximately ch 21300 and the eastern end of the Scheme the new section of motorway would utilise the existing M4. A new section of dual carriageway would be constructed to the north of, and parallel with, the existing M4 from Junction 23A eastwards to a new Junction 23 (Magor Interchange) where connections would be provided to the M48 and the B4245.

2.2.28 The new dual carriageway would be accommodated by extending the existing overbridge at Knollbury Lane (ch 22025) and an underbridge at Rockfield Lane (ch 22700) to maintain access.

2.2.29 The new section of motorway would re-join the existing M4 at Junction 23a to the north of Magor. From here, the new section of road would run alongside the existing M4 to Junction 23, where connections would be provided to the M48 and the B4245. This is the point of the alignment closest to the Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC, the closest component of which is the Mwyngloddfa Mynydd Bach SSSI approximately 6.2 km from the eastern end of the proposed haul road to Ifton Quarry at the eastern end of the Scheme (see Figure 1).

2.2.30 The proposed highway works at the Magor Interchange would require the demolition of the existing Bencroft Lane Underbridge and the Wilcrick Maintenance Depot, with a new depot provided at Glan Llyn.

2.3 Key stages of the Project and Timescales

2.3.1 Key programme dates for the project include:

- Spring 2016: Publication of draft Orders and Environmental Statement
- Spring/Summer 2017: Public Local Inquiry
- Summer 2018: enabling works, including pre-construction ecological mitigation, e.g. creation of replacement habitats within SSSI and temporary fencing of sensitive areas.
- Summer 2019 to Autumn 2021: Main construction phase including major earthworks, structure and embankment construction and roadworks:
- May 2019 to Autumn 2021: Construction of River Usk and River Ebbw crossings with piling for the east pylon for the River Usk crossing timed to avoid the period of April to June inclusive.
- Installation of culverts would be undertaken early in the construction programme to maintain connectivity of the reen and ditch network, reduce potential disruption to ecology and reduce the risk of flooding in the area.
- Autumn 2021 to Spring 2022: End of construction of new section of motorway and start of reclassification works
- Autumn 2022: Completion of work associated with reclassification works.
- Autumn 2027: End of Aftercare.

2.4 Relationship between the Project and European/International Sites

2.4.1 The boundaries of the European/International sites in the vicinity of the Project are shown in Figure 1. The M4 Corridor passes over the River Usk/ Afon Wysg SAC (see paragraph 2.2.17-19) and passes near to the Severn Estuary/ Môr Hafren SAC, SPA and Ramsar sites (0.3 km from the River Ebbw Crossing).

2.4.2 All other European/International sites shown in Figure 1 are located at greater distances from the project boundary, including the Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC, the closest component of which is the Mwyngloddfa Mynydd Bach SSSI approximately 6.2 km from the eastern end of the proposed haul road to Ifton Quarry at the eastern end of the Scheme. The sites presented in Figure 1 are those considered within the Stage 1: Screening Assessment (see Section 4).

2.5 Physical land-take of the Project

2.5.1 Table 2.1 presents the land take for the M4CaN project for each of the habitats identified during Phase 1 mapping of the Scheme corridor (see Chapter 10 of the ES). Permanent land take is associated with the operational M4CaN project, while temporary land take may occur during construction (e.g. temporary construction compounds) or operation (e.g. use of easements for access). The new section of motorway would pass over the River Usk/Afon Wysg SAC. The eastern pylon of the bridge would be located within the SAC within saltmarsh habitat (not a qualifying feature of the SAC), with a small area (see Table 2.1) of saltmarsh habitat also lost within the Ebbw estuary, both during construction (temporary) and operation (permanent).

2.5.2 There would also be some loss/fragmentation of other habitats outwith the European/International sites that may support some qualifying features of the nearby Severn Estuary/Môr Hafren SPA and Ramsar sites, including the reen network along the Gwent Levels. As detailed in Chapter 3, paragraph 5.5.21 *et seq*. where reen or ditch habitats are lost or cut off, new reens and ditches would be provided, with the total length of replacement reens and ditches approximately equal to the length of those lost as a result of the Scheme.

2.5.3 There may also be some loss or severance of habitat (e.g. woodland habitats, grassland and hedgerows) that supports lesser and greater horseshoe bats, features of the Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC, the closest component of which is the Mwyngloddfa Mynydd Bach SSSI which is approximately 6.2 km from the eastern end of the proposed haul road to Ifton Quarry at the eastern end of the Scheme. The implications of the land take predicted to occur as a result of the Scheme on features of the European sites are considered in Section 5 of this report.

Table 2.1: Land take for the M4CaN Scheme.

Habitat	Permanent (Operational); (ha)	Temporary (Construction) (ha)	Total
Broad leaved semi-natural Woodland	6.01	1.86	7.87
Broad leaved plantation Woodland	37.30	0.89	38.19
Coniferous plantation Woodland	0.24	0.00	0.24
Mixed semi-natural Woodland	0.01	0.00	0.01
Mixed plantation Woodland	2.93	0.00	2.93
Scrub dense continuous	18.22	8.95	27.17
Scrub scattered	15.95	16.95	32.90
Broad-leaved Parkland	0.80	0.00	0.80
Allotment	0.23	0.00	0.23
Unimproved Neutral grassland	3.25	3.74	6.99
Semi-improved Neutral grassland	83.40	17.38	100.77
Improved grassland	67.22	39.83	107.15
Marsh/marshy grassland	4.98	1.47	6.45
Poor semi-improved	19.99	3.02	23.01
Tall ruderal	7.58	4.58	12.16
Swamp	3.24	3.35	6.59
Marginal/inundation	0.10	0.00	0.10
Standing water	0.35	0.31	0.66
Running water	0.00	0.68	0.68
Intertidal	0.02	0.00	0.02
Saltmarsh scattered plants	0.00	0.00	0.00
Saltmarsh dense/continuous	0.43	0.51	0.94
Hardstanding	13.64	8.39	21.54
Quarry	0.00	0.01	0.01
Artificial spoil	0.54	0.54	1.08
Arable	25.05	14.69	39.74
Amenity grassland	4.57	0.05	4.62
Cultivated/disturbed land ephemeral/short perennial	0.11	0.01	0.11
Introduced shrub	0.00	0.01	0.01
Caravan site	0.11	0.00	0.11
Buildings	0.38	0.65	1.02
Bare ground	13.08	31.93	45.02
Other habitats	0.00	0.20	0.20
No access	0.50	0.10	0.60
Orchard	6.09	0.01	6.10
Other	2.25	0.16	2.41
Urban	0.43	0.09	0.52

Habitat	Permanent (Operational); (ha)	Temporary (Construction) (ha)	Total
Total (all habitats combined)	**338.5**	**158.76**	**498.26**

2.6 Resource Requirements

2.6.1 Resource requirements are likely to include, but not be limited to:

- Materials for construction.
- Manpower.
- Water abstraction for dust suppression.

2.6.2 Imported material would include road construction aggregates together with reinforcement steel, concrete, cement, pipes and fencing materials.

2.6.3 Highway operation and maintenance procedures would be carried out during the lifetime of the M4CaN. Typical activities would include:

- Winter maintenance, such as de-icing/gritting.
- Painting (line and bridge).
- Resurfacing.
- Repairs to damage.
- Maintenance of the highway drainage network including the water treatment areas.
- Management and maintenance of roadside grass areas, woodland planting and other vegetation to comply with the environmental objectives.
- Management of nature conservation measures (habitats and protected species) in accordance with the Register of Commitments.

2.6.4 Other than the land take within the boundary of the River Usk SAC (although outside the wetted channel) no resources would be required to be taken from European sites.

2.7 Waste Products

Construction

2.7.1 The types and estimated quantities of waste likely to be generated during the construction phase have been identified in the Outline Site Waste Management Plan (Annex F to Appendix 3.2 of the March 2016 ES) based on experience from similar projects. The Plan sets out a series of measures for managing the waste, which are in accordance with the waste hierarchy principle, duty of care requirements and industry best practice. The Site Waste Management Plan is a live document that would be updated during the detailed design and construction process to document the management of waste.

Operation

2.7.2 The main operational 'waste' would be residues deposited on the road surface from traffic which would be carried in road drainage. Runoff from the new sections of motorway across the Gwent Levels would be intercepted into grass-lined channels in the road verge. These channels would transfer the runoff to water treatment areas. The grassed channels would be lined with a geosynthetic clay liner (and topsoil) to contain pollutants. The use of grassed channels would reduce the flow rate and would allow for some sediment to be deposited and oily residues and organic matter to be retained and broken down. Where the use of grassed channels is not possible, concrete channels would be utilised.

2.7.3 With the exception of discharges to the River Usk and the River Ebbw, all drainage would be treated through water treatment areas (full details of which, including receiving water courses, are provided in March 2016 ES Chapter 16: Road Drainage and the Water Environment). The first stage of the water treatment areas would be a forebay which would capture hydrocarbons and sediment prior to runoff entering the main attenuation lagoons. After passing through the attenuation lagoons, the water would pass thorough a reedbed prior to discharge to a reen.

2.7.4 The drainage of the River Usk Crossing would consist of kerb drainage to an outfall pipe that would run along the central reservation. On the west side of the River Usk, drainage would discharge into the River Ebbw via an oil separator. On the east side, in addition to an oil separator, drainage would discharge to the River Usk via a pollution control lagoon.

2.7.5 All drainage infrastructure for the new section of motorway would be designed to capture runoff from the carriageway for all events up to a 1 in 100 year rainfall event, with a 30% allowance for climate change.

2.8 Other Services

2.8.1 Services associated with the M4CaN would include, but not be limited to (and see March 2016 ES Chapter 2: Scheme Description and Chapter 3: Scheme Construction for further details):

- Road lighting: Lighting is proposed at the junctions/ interchanges at Castleton Interchange, Docks Way Junction and Magor Interchange) and over the full extent of the River Usk Crossing. The motorway approaches to the Glan Llyn Junction would not be lit.
- Gantries or traffic information equipment.
- Services (e.g. electricity, gas).
- A new motorway maintenance depot would be constructed close to the new Glan Llyn Junction. The proposed new depot is anticipated to be a like for like replacement for the facilities currently provided at Wilcrick (which would be demolished). This would include a workshop, salt barn, offices and concrete hardstanding areas for the parking of maintenance vehicles, and car parking for office staff, operatives and visitors. The Glan Llyn depot would also have space for the River Usk Crossing maintenance vehicles and offices.

2.8.2 Lighting columns are anticipated to be aluminium and to generally have the following characteristics.

- 15 metres high along the mainline of the new section of motorway;
- 12 metres high along slip roads; and
- 12 metres high on the River Usk Crossing.

2.8.3 Lighting of the operational M4CaN may have implications for European sites and species listed as qualifying features of those sites. Effects of lighting of junctions and the Usk and Ebbw crossings on qualifying features of European sites, including horseshoe bats at the Magor Interchange and otters, migratory fish and wintering birds at the River Usk and River Ebbw crossings, are fully considered in Section 5 of this report.

Existing Utilities

2.8.4 At a number of locations along the route, the alignment has been constrained by existing National Grid high voltage overhead power lines. The design has taken into account the required horizontal and vertical clearances and avoids the need for any diversions of National Grid infrastructure.

2.8.5 With respect to other utilities, a range of protection and below ground diversion works would be required during the construction phase. Details are provided in March 2016 ES Chapter 3: Scheme Construction.

2.8.6 In addition, a number of permanent above ground works would be required, including diversion of existing 132 kV and 11kV power lines at various points along the new section of motorway (see Section 2.3 of Chapter 2 of the ES for full details). The existing ‘clean’ and ‘dirty’ ditches, forming part of the existing drainage system for the Tata Steelworks site, would be diverted to accommodate the new section of motorway.

2.8.7 The consideration of these existing utilities would not affect any of the European sites considered within the SIAA.

3 Methodology

3.1.1 This section provides information on the methodology followed in carrying out the AIES Stage 1: Screening and Stage 2: Appropriate Assessment for the M4CaN Project on European sites where LSEs have been identified.

3.2 Policy and Guidance

3.2.1 Relevant policy and guidance documents have been taken into account in production of this report, including:

- Design Manual for Roads and Bridges (DMRB), Volume 11, Section 4, Part I, HD44/09 Assessment of implications (of highways and/or roads projects) on European Sites (including appropriate assessment) (Highways Agency, 2009).
- Welsh Government Technical Advice Note (TAN) 5: Nature Conservation and Planning, in particular Section 5: Development affecting designated sites and habitats (Welsh Government, 2009a).
- The Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (European Commission, 2001).
- Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC (European Commission, 2000).
- Insofar as lesser horseshoe bats are a qualifying interest of the Wye Valley and Forest of Dean Bat Sites SAC, the guidance of Interim Advice Note (IAN) 116/08(W) Nature Conservation Advice in Relation to Bats (Welsh Government, 2009b) has been used.

3.3 Data Sources

3.3.1 The following organisations' websites were used to gather information on the European protected sites that may be potentially affected by the M4CaN:

- Natural Resources Wales (NRW).
- Joint Nature Conservation Committee (JNCC).
- Natural England.

3.3.2 These data sources were utilised to obtain information on European/International Sites, including the Core Site Management Plans. These provide details of NRW's approach to managing the protected sites and sets out what needs to be achieved on the sites, as well as the results of monitoring and advice on the actions required.

3.3.3 The Geographical Information Systems (GIS) datasets for European Sites used were downloaded from the NRW and Natural England websites in September 2015 to ensure all relevant European sites and their updated boundaries were taken into consideration as part of this SIAA.

3.3.4 Information from the Strategic Habitat Regulation Assessment (SHRA) for the M4 Corridor around Newport (Draft Plan) (Welsh Government, 2014a) also provided

a valuable source of information on the Plan level approach to the AIES and SIAA and details of the consultation carried out to date.

3.4 Evidence Base

3.4.1 A number of ecological surveys were undertaken in 2007/08 which were used to inform the SHRA (Welsh Government, 2014a). An extensive programme of additional ecology surveys has since been undertaken to inform the Environmental Impact Assessment and this SIAA for the M4CaN. All survey methodologies were discussed with NRW.

3.4.2 A desk study was carried out by Arup in 2013 comprising a biodiversity information search from the South East Wales Biological Records Centre (SEWBReC) to inform and support the ecological survey methodology. The desk study is included in the Extended Phase 1 Habitat Survey Report (March 2016 ES Appendix 10.2). This included records of bats up to 5 km, other legally protected and priority species within 2 km, and species of conservation concern within 1 km of the study area at that time.

3.4.3 This desk study was updated by RPS in 2015 and extended to include the section of the existing M4 for which Complementary Measures are proposed as part of the Scheme. Further details of the methodology and the findings of the desk study are provided at March 2016 ES Appendix 10.17. Confidential Desk Study data are provided in March 2016 ES Appendix 10.36.

3.4.4 The surveys carried out in 2014 and 2015 which are relevant to the SIAA are:

- Phase 1 Habitat Survey (Appendix 10.19 of the March 2016 ES);
- Otter and Water Vole survey in 2014 (Appendix 10.8 of the March 2016 ES);
- Otter and Water Vole survey in 2015 (Appendix 10.25 of the March 2016 ES);
- Wintering bird surveys in 2007/08 and 2013/2014 (Appendix 10.12 of the March 2016 ES);
- Wintering bird surveys in 2014/2015 (Appendix 10.16 of the March 2016 ES);
- Bat surveys in 2007/8 and 2014 (Appendix 10.7 of the March 2016 ES);
- Bat Activity Surveys (Appendix 10.23 of the March 2016 ES); and
- Bat Roost Survey of Buildings and Trees (Appendix 10.24 of the March 2016 ES).

3.4.5 Data on migratory fish species were collected as part of the Aquatic Ecology Desktop Study (Appendix 10.18 of the March 2016 ES). It was agreed with NRW that no site-specific surveys were required for migratory fish as it was assumed that all of the qualifying migratory fish features of the River Usk SAC are present and would be passing through the Usk Estuary to reach spawning grounds.

3.4.6 Further wintering bird surveys were undertaken along the M4CaN corridor over the winter of 2015/16 and were reported in the September 2016 ES Supplement Appendix S10.4.

3.4.7 A bat hibernation roost survey was also carried out in 2016 and was reported in the September 2016 ES Supplement Appendix S10.7. Surveys of bat tree roosts

and building roosts were carried out in 2016 and reported in the December 2016 ES Supplement Appendices SS10.2 and SS10.3.

3.4.8 Further bat roost and activity surveys are being carried out in 2017 and will provide additional information to inform the application for any European Protected Species licence method statement in due course.

3.5 Assessment Methodology

3.5.1 This section sets out the applicable methodology and assumptions for the consideration of the M4CaN with regard to the requirements of the Habitats Regulations and the AIES (including SIAA) process as set out in DMRB HD44/09 guidance (Highways Agency, 2009).

AIES Process

3.5.2 The AIES is principally a five stage process (as explained below) involving one or more of the following sequential stages:

- Stage 1: Screening
- Stage 2: Appropriate Assessment
- Stage 3: Alternative Solutions
- Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)
- Stage 5: Compensatory Measures

3.5.3 Diagram 3.1 shows the relationship between these various stages in the overall AIES process.

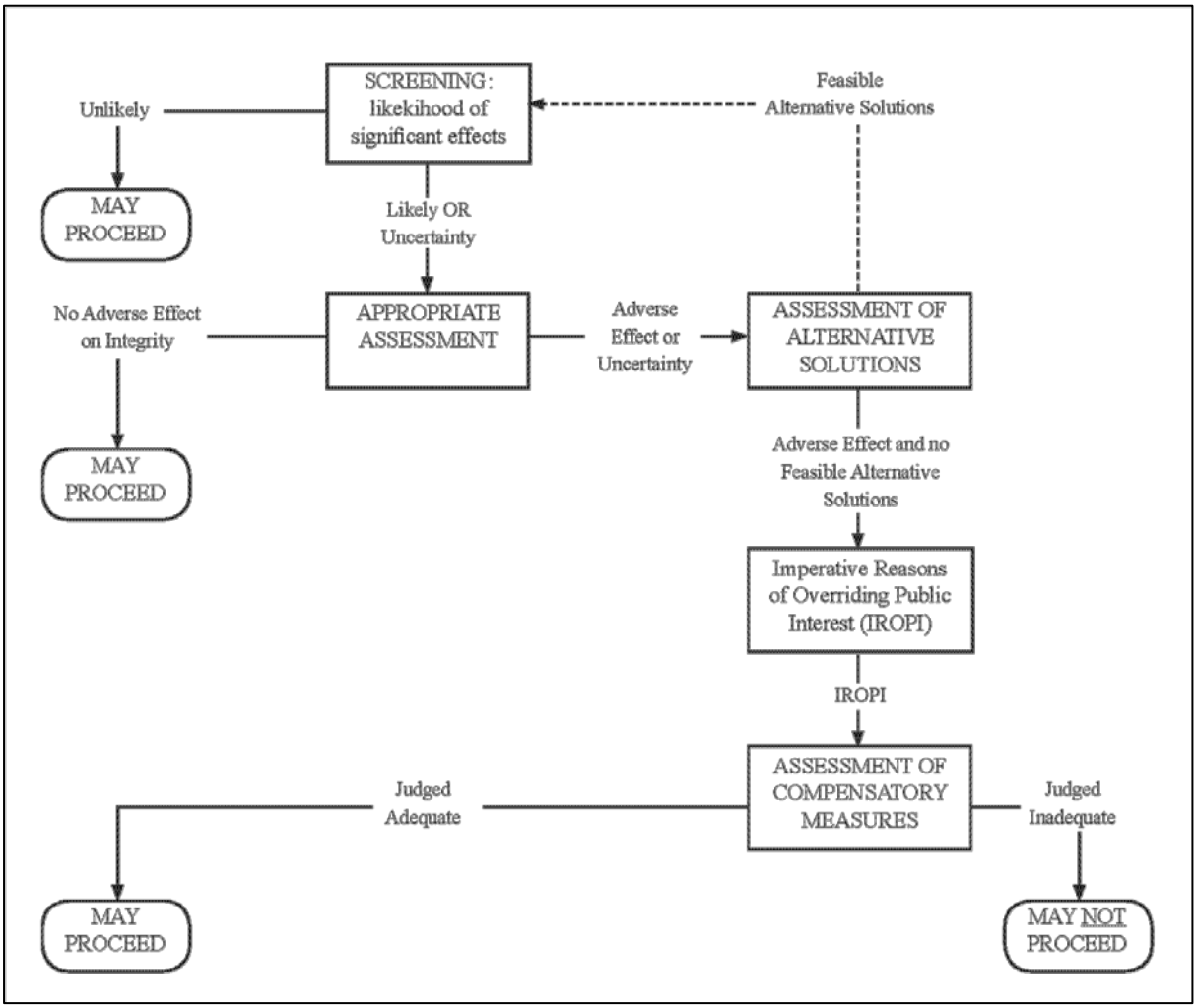

Diagram 3.1: Flow diagram of the stages of the AIES process

3.5.4 The first stage of the AIES process is Stage 1: Screening Assessment to determine whether LSEs on the features of European sites could occur. If the outcome of the Stage 1: Screening Assessment determines that there could be a LSE (or such an effect cannot be discounted), then Stage 2: Appropriate Assessment is triggered and a determination of whether there would be an effect on the integrity of the European site is undertaken.

3.5.5 For the M4CaN Project, the initial Stage 1: Screening Assessment was undertaken and, as LSEs could not be discounted for all qualifying features, Stage 2: Appropriate Assessment was triggered. Should the conclusion at the end of Stage 2 indicate that there would be no adverse effects on the integrity of the features of the European Sites, and achievement of the conservation objectives, and thus there would be no adverse effect on the overall integrity of European/International sites, then Stages 3 to 5 would be unnecessary. Stage 2 should include appropriate design and any mitigation necessary to ensure that

there would be no adverse effects on the integrity of European sites, beyond reasonable scientific doubt.

Summary of Stage 1: Screening Assessment on European /International Sites

3.5.6 The first step of the AIES (Stage 1: Screening Assessment) was to identify all of the European sites that could potentially be affected following DMRB HD44/09 guidance. These include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), and in accordance with Government policy in England and Wales, Wetlands of International Importance (Ramsar sites), potential SPAs (pSPA), candidate SACs (cSAC), and possible Ramsar sites should also be considered. The relevant sites were identified in the Strategic Habitats Regulations Assessment (SHRA) for the M4CaN draft plan (Welsh Assembly Government, 2014) and the draft M4CaN project level AIES Screening Assessment (Welsh Assembly Government, 2015).

3.5.7 Consultation also forms part of the process in ensuring that all appropriate sites and features are included. NRW and Natural England were consulted on the draft plan level SHRA (Welsh Assembly Government, 2014) and draft project level AIES Screening Assessment (Welsh Assembly Government, 2015) for the M4CaN.

Conservation objectives

3.5.8 Following identification of the European/International sites that could be potentially affected, the conservation objectives for each of the relevant qualifying features were obtained.

3.5.9 In Wales, the conservation objectives are considered to consist of the vision and performance indicators as stated in the relevant Core Management Plans available from the NRW website. For European Sites situated in England, conservation objectives are developed from the relevant Site of Special Scientific Interest (SSSI) objectives which are within the relevant site area.

Identification of plans or projects considered for in-combination effects

3.5.10 A requirement of the Habitat Regulations is to examine the potential for a plan or project to have a significant effect either alone or in combination with other plans and projects. These other plans and projects include those with spatial and/or temporal overlap with the M4CaN (based on DMRB HD44/09), namely:

- Trunk road and motorway plans or projects which have been confirmed.
- Developments and other projects which are currently under construction.
- Proposed developments which are currently under consideration with the local planning authority or other determining bodies.
- Local Plan commitments and indicative timescales for implementation.

3.5.11 Following guidance in Tyldesley (2011), the following criteria were also used to confirm the types of projects to be considered in the in-combination assessment:

- All projects started but not yet completed;
- All projects with consent but not yet started;

- All projects subject to ongoing review e.g. annual licences;
- All applications lodged but not yet determined;
- All refusals subject to appeal procedures not yet completed;
- All known projects that do not need consent;
- All proposals in adopted plans
- All proposals in draft plans formally published for consultation.

3.5.12 It was therefore not considered appropriate to include projects which have not yet been submitted for consent. In some instances, however, it may be the case that there are known to be projects that will inevitably and necessarily follow on from other projects which have been formally proposed, and in such cases it is necessary to consider these where they are necessary future requirements of the original development.

3.5.13 Following a judgment of the ECJ in October 2005, it is also necessary to include as part of in-combination checks, the following proposals:

- Allocations or other forms of proposals in adopted development plans; and
- Allocations or other forms of proposals in draft development plans which have been published for consultation purposes.

3.5.14 Plans and projects to be considered in-combination with the M4CaN were initially identified as part of the draft plan level SHRA and further refined in the project level AIES Screening Assessment (Welsh Assembly Government, 2015). These plans and projects are detailed in Section 4.

Test of Likely Significant Effect (LSE)

3.5.15 The screening stage assesses the potential effects produced by the proposed development against the interest features of each European site, to determine whether there is a LSE. This is essentially a risk-based process to decide whether a more detailed assessment is required (alone and in-combination).

3.5.16 The screening for LSE involves identifying whether the proposed development is a source of potential effects that might affect any of the interest features of the relevant European sites. If there is such an effect, it is then necessary to determine whether there is a potential pathway through which the proposed development could affect the interest features of the relevant European sites, the length of those pathways and what may reduce or prevent the potential effect reaching the relevant European sites. Where there is a source, a pathway and an effect that would reach the interest feature, it is judged that there is a LSE that requires more detailed assessment (i.e. appropriate assessment stage).

3.5.17 When carrying out screening at this LSE stage, account is taken of the avoidance and mitigation measures that have been built into the proposed design. Mitigation measures considered in this assessment are those which are plainly established and uncontroversial.

3.5.18 The screening for LSE identifies those aspects of the proposed development, and those interest features of each relevant European site, where there is confidence that they are not likely to be significantly affected, and which therefore need not be considered further. If it cannot be concluded with confidence that

LSEs are unlikely, then following the precautionary principle, it is assumed that the issue requires more detailed consideration.

SIAA (Stage 2: Appropriate Assessment)

3.5.19 Where Stage 2: Appropriate Assessment is triggered it is necessary to determine whether or not there would be an effect on the integrity of the European site of the project alone, or in combination with other plans or projects. For the M4CaN Project, the initial Stage 1: Screening Assessment was undertaken and as LSEs could not be discounted, a SIAA (Stage 2: Appropriate Assessment) has been initiated.

3.5.20 This has involved detailed consideration of the information collected, including the desktop information, historic surveys undertaken along the M4CaN and the most recent site-specific surveys (see Sections 3.3 and 3.4), with a specific focus on the interest features of the European Sites where LSEs were identified during Stage 1: Screening Assessment. The baseline information on the relevant qualifying features was then used to help in the prediction of adverse impacts on each feature, specifically on the delivery of its conservation objectives. This allowed consideration of the full range of potential impacts having particular regard to the potential of the project to impact upon the conservation objectives of the interest features of the European Site and consequently on the integrity of the European Site itself.

3.5.21 There were three potential outcomes from Stage 2: Appropriate Assessment:

- That evidence is sufficient and that it demonstrates beyond reasonable scientific doubt that there would be no adverse effects;
- That evidence is sufficient but that it indicates that there would be an adverse effect; or
- That there is insufficient information or evidence to make a determination.

3.5.22 Where the latter conclusion is reached then the ‘precautionary principle’ should be applied, and it should be assumed that adverse effects would result.

3.5.23 The principal considerations of Stage 2: Appropriate Assessment (to be undertaken by the competent authority using the information presented within the SIAA) are whether it has been concluded that the project, alone or in-combination with other plans or projects, may have adverse effects on the integrity of the qualifying features, and whether the relevant Statutory Environment Bodies (SEBs; i.e. NRW, Natural England and the relevant local planning authorities, Newport City Council and Monmouthshire County Council) are in agreement with the stated outcome. Where it can be concluded that the project will not adversely affect the integrity of the site, the normal approvals process can be followed and the requirements in terms of AIES are complete.

3.5.24 Where this cannot be concluded, and/or where the relevant SEB is not in agreement, then the potential for significant effects must be assumed. As such there is a need to proceed to the later stages of the AIES (i.e. Stages 3 to 5; see paragraph 3.5.2 *et seq*).

Professional Judgement

3.5.25 Professional judgement was used in carrying out this work where specific guidance was not available, and in the interpretation of results. Where there was insufficient information regarding the likelihood of qualifying interests being present, or of the risk of impacts, the assessment used the precautionary principle to inform the judgement. The precautionary principle has been applied to ensure that any assessment errs on the side of caution, without being overly cautious. This principle means that the conservation objectives should prevail where there is uncertainty or that harmful effects will be assumed in the absence of evidence to the contrary.

3.5.26 The authors of this report were Dr Kevin Linnane, with support from Nicole Price, and the report was reviewed by Dr Keith Jones. Surveys were carried out by a team of ecologists managed by Dr Keith Jones.

3.5.27 A further review of this report has been undertaken on the basis of the results of further surveys carried out during 2016 and 2017, and changes in the Scheme which have arisen since publication of the draft Orders and Environmental Statement in March 2016. This review has been carried out by Dr Keith Jones with advice from Jonathan Davies, Richard Green, Dr Simon Zisman and Joanne Wilson.

3.5.28 Dr Kevin Linnane is a Senior Marine Ecologist at RPS with over seven years' consultancy experience. He is a member of the Chartered Institute for Ecology and Environmental Management (CIEEM) and a Chartered Marine Scientist with the Science Council through the Institute of Marine Science, Engineering and Technology. His work includes undertaking EIAs and Appropriate Assessments for a range of terrestrial, coastal and estuarine projects, including cables and pipelines, offshore wind farms and ports and harbours. He has specific experience of working on AIES within the last three years. This has included undertaking impact assessments used to inform Appropriate Assessments for the Atlantic Array Offshore Wind Farm, with specific detailed assessments undertaken on the potential for construction operations to lead to disruption of fish migration (Severn Estuary SAC and Ramsar, River Usk SAC and River Wye SAC) and potential for adverse effects on protected reef habitats (Lundy SAC). He was also responsible for compiling the Report to Inform Appropriate Assessment for the Hornsea Project One onshore and offshore export cable (Humber Estuary SAC, SPA and Ramsar). He has experience, through these projects, of consultation with NRW and Natural England to agree appropriate measures to avoid adverse effects on integrity of these international sites.

3.5.29 Nicole Price was a Principal Ecologist with RPS with over 19 years of professional experience. For 10 years she worked for the Environment Agency, with positions held including fisheries scientist in the Northeast of England, Principal Marine Biologist for Wales, Southwest Regional Marine Biologist (with responsibility for the Severn Estuary) and a Research and Development post as a National Estuaries Project Officer. She was also the Environment Agency's national biodiversity coordinator for some Annex I habitats and Annex II species. She has specific experience of working on AIES within the last three years

3.5.30 As a consultant she has undertaken numerous projects and gained extensive experience of project managing, advising, coordinating and undertaking HRAs, EIAs and undertaking various studies/surveys for numerous developments in the

terrestrial and aquatic environment. For example she has worked on Great Yarmouth's Third River Crossing working to DMRB guidance and has undertaken numerous HRAs including maintenance works required for the existing M4. She has also been an expert witness for the defence and prosecution, with the provision of comprehensive report to the court.

3.5.31 Dr Keith Jones was a Senior Director (Environmental Sciences) at the RPS Oxford office. He is a Chartered Biologist with over thirty years' experience as an environmental consultant. He is responsible for the Oxford Ecology Team and is involved in environmental planning work, ecological assessments, management of EIAs and expert witness work. His work has included major projects for the Ministry of Defence, Highways Agency, Local Authorities and many property companies, surveyors and other clients. He has particular experience in undertaking and agreeing with NRW and Natural England Appropriate Assessments under the Habitats Regulations including the assessment of the Oakham Bypass (Rutland Water SPA and Ramsar Site), MoD's proposals for Warcop Training Area (Moor House-Upper Teesdale SAC, Helbeck and Swindale Woods SAC, North Pennine Moors SPA), the London Gateway Port (Thames Estuary and Marshes SPA and Ramsar Site) and Section 2 of the A465 Heads of the Valleys Road (Usk Bat Sites SAC, Cwm Clydach Woodlands SAC, River Usk SAC). He has specific experience of working on AIES within the last three years

3.5.32 Jonathan Davies is Head of Ecology at Arcadis Consulting (UK) Ltd.and has been an ecological consultant for over 20 years and is a Full Member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and a Chartered Environmentalist. He has been responsible for ecological impact assessments of a wide range of public and private sector development projects, including some of the largest national infrastructure schemes in the UK, including major road projects.

3.5.33 From 2005 to 2016, he was the Environmental Co-coordinator for the A40 Penblewin to Slebech Park Improvement in Pembrokeshire, responsible for coordinating, editing and compiling the Environmental Statement (ES) and the Assessment of Implication for European Sites (AIES). He has also provided the ecological inputs to a number of other road schemes in Wales, including the A470 Dolwyddelan to Pont-yr-Afanc Improvement in North Wales, the A470 Maes yr Helmau to Cross Foxes Improvement within Snowdonia National Park, and Sirhowy Enterprise Way near Blackwood. He is currently the Environmental Advisor to the Welsh Government on the A477 Red Roses to St Clears Improvement in Carmarthenshire.

3.5.34 He is the Environmental Advisor to the Welsh Government for the M4CaN Scheme, providing technical support to the project team, especially with regard to ecology, and has been responsible for technically reviewing all of the ecological inputs for both the EIA and AIES.

3.5.35 Richard Green is the owner and Director at Richard Green Ecology Ltd (RGEL). He is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and a Chartered Environmentalist. He has been a professional ecologist since completing his BSc Honours Degree in 1993. When previously employed with Halcrow Group Ltd he worked for the Highways Agency (HA), both as a seconded assistant environmental advisor for HA Areas 1 & 2 (for 3 years) and as lead ecologist for a research and development project on bats and highways (for 3 years). This project resulted in the production of a Design

Manual for Roads and Bridges (DMRB) Interim Advice Note on bats (IAN 116/08). He also undertook an ecological impact assessment for Welsh Assembly Government on the A487(T) Porthmadog, Minffordd and Tremadog Bypass scheme and co-ordinated the Habitats Regulations Assessment of the Welsh National Transport Plan.

3.5.36 In his current role as Director of RGEL, he continues to undertake ecological survey and assessment, specialising in bats. In 2010, RGEL was subcontracted to CH2M Hill (Halcrow) to undertake a review of bat mitigation in relation to highway severance for the HA, resulting in a report published in 2011. Since 2011 he has been working for RPS and Costain undertaking environmental assessment and mitigation design for bats in relation to improvements to Section 2 (Gilwern to Brynmawr) of the A465 Heads of the Valleys Road, part of which passes through the Usk Bat Sites SAC (designated in part for lesser horseshoe bats). He has been responsible for providing advice on bats as part of the M4CaN team since 2015.

3.5.37 Dr Simon Zisman is a Senior Director at RPS. He has worked as an environmentalist specialising in ornithology for over 20 years. His previous roles before joining RPS included Environmental Scientist at the Nature Conservancy Council, and Environmental Scientist at an international firm of consulting engineers (now part of Royal Haskoning DHV), where he worked primarily on coastal developments. He subsequently worked as Assistant Conservation Officer, then Conservation Officer for the Royal Society for the Protection of Birds (RSPB) from 1999 to 2006, protecting ornithological interests through planning casework, working on several developments in proximity to internationally designated estuarine wildlife sites. Whilst at RSPB, he was also responsible for delivering species conservation initiatives, including for farmland birds, and taking forward habitat creation and restoration projects on the Forth and Clyde estuaries.

3.5.38 He joined RPS in 2006 as Senior Ecologist, and took over responsibility for leading the Scottish Ecology team in 2007, subsequently becoming Senior Director. He has continued his specialist interest in birds, undertaking and over-seeing ornithological field work, carrying out pre- and post-construction monitoring, and providing ornithological advice to developers and public bodies on a variety of projects at the pre-planning, submission and construction phases. This work has included a variety of site sensitivity assessments, ornithology chapters for Environmental Statements, mitigation strategies, Habitat Management Plans, Breeding and Wintering Bird Protection Plans, background technical reports, Habitats Regulations Assessments and providing expert ornithological evidence at public inquiries.

3.5.39 Joanne Wilson is a Principal Ecologist at the RPS Oxford office. She is a Full Member of the Chartered Institute of Ecology and Environmental Management (CIEEM), a Chartered Ecologist and Chartered Environmentalist. She has been a professional ecologist for over fifteen years, the last ten of which have been as a consultant ecologist in the planning and development sector. After graduating she was employed in the Protected Species Licencing department of Natural England and as the assistant to the Director for Scotland of the Wildfowl and Wetlands Trust. From 2004 until 2007 she was employed as an agri-environment consultant (for the Farming and Wildlife Advisory Group (FWAG) until 2005 and then as an independent consultant). Since joining RPS at the beginning of 2007 she has been responsible for ecological impact assessments of a wide range of

public and private sector development projects in the United Kingdom, including road projects. These have included the Weymouth Relief Road, for which she managed a team of ecology surveyors and produced method statements for licence applications and species mitigation strategies; the Church Village Bypass scheme, for which she carried out hazel dormouse surveys; and Section 2 of the A465 Heads of the Valleys Road, for which she carried out preliminary ecology surveys.

3.5.40 Recent major national infrastructure schemes that have received consent and for which she was the Terrestrial Ecology Project Manager include the Burbo Bank Extension Offshore Wind Farm in north Wales (an 11 km cable route and substation) and the Hornsea Offshore Wind Farms in Lincolnshire, Projects I and II (40 km cable routes and substations).

3.5.41 For the M4CaN Scheme, she has managed the ecology survey team from 2015 and has contributed to the ecological aspects of the EIA and Appropriate Assessment, and is involved in the on-going consultations with statutory and non-statutory nature conservation bodies.

4 Stage 1: Screening

4.1 Summary of Screening Assessment

4.1.1 A screening exercise was carried out in October 2015 (Welsh Government, 2015), which identified five International/European sites that required consideration in the SIAA (Appropriate Assessment), these were:

- River Usk/Afon Wysg SAC;
- Severn Estuary/Môr Hafren SAC;
- Severn Estuary/Môr Hafren SPA;
- Severn Estuary/Môr Hafren Ramsar site; and
- Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC.

4.1.2 The full conservation objectives for these sites are provided in in Appendix C.

4.1.3 The Screening Report considered all the possible impacts, pathways and effects on European sites from the M4CaN. Impacts considered included land take, physical presence, hydrological changes, dust deposition, discharge of pollutants to watercourses, aerial emissions (including effects on air quality), changes to traffic flows/speeds, noise and vibration, and visual disturbance and lighting impacts. The possible pathways for effects on European sites (i.e. SACs, SPAs and Ramsar sites) were fully considered including effects on mortality, disturbance and displacement of qualifying species, and loss or degradation of supporting habitats of those qualifying features.

4.1.4 A summary of the LSEs predicted to occur as a result of the M4CaN and the sites and features affected is provided in Table 4.1. Screening tables (following the DMRB recommended format) for the sites where LSEs were predicted to occur are presented in Appendix B.

4.1.5 Representations on the draft AIES Stage 1: Screening Report were invited from NRW, as the appropriate Nature Conservation Body under the Habitat Regulations on 6th October 2015 (see Section 7: Consultation). The NRW response to the AIES Stage 1: Screening Report is presented in Appendix A1, with Welsh Government responses to the NRW comments presented in Appendix A2.

4.1.6 The only significant area of disagreement with NRW on the Screening Assessment was the ruling out of LSE on migratory fish features of the River Usk SAC due to direct land take/habitat loss/fragmentation and Physical Presence-displacement/ barrier/collision. NRW stated in their response to the Screening Assessment "*We agree that this is likely to be the case during the operational phase but as yet we have not seen details of how the bridge will be constructed and so are unable to agree with respect to the construction phase situation. We may be able to revise this position on receipt of further detail. We agree with the conclusion for all other impact pathways for the migratory fish features of the River Usk SAC.*"

4.1.7 The methods of construction of the River Usk Bridge are described in March 2016 ES Chapter 3: Scheme Construction. This confirms that construction

operations would not be undertaken within the wetted channel of the River Usk. Consequently, LSE on migratory fish features of the River Usk SAC due to direct land take/habitat loss/fragmentation and physical presence-displacement/barrier/collision during the construction phase are ruled out.

4.1.8 The LSEs on European sites presented in Table 4.1 below therefore represent those LSEs which have been identified in the AIES Stage 1: Screening Report and agreed during consultation with NRW (see Section 7 and 0).

Table 4.1: Likely Significant Effects on European sites and features resulting from the M4CaN project (without mitigation)

Site	Feature	Likely Significant Effect
River Usk SAC	Sea lamprey River lamprey Twaite shad Allis shad Atlantic salmon	Release of pollutants leading to water quality changes - physiological/behavioural and barrier effects on features during construction and operation.
		Noise and vibration - disturbance and barrier effects during migration, during construction.
		Lighting - behavioural and barrier effects during construction and operation.
	European Otter	Land take - habitat loss/fragmentation of otter habitat (e.g. resting areas) during construction.
		Physical presence - barrier to the movement during construction and operation.
		Risk of injury on construction site/becoming trapped in excavations during construction and potential vehicle collision effects.
		Release of pollutants leading to water quality changes-physiological effects which in turn could affect otters and/or their prey populations during construction and operation.
		Noise and vibration - disturbance and barrier effects during construction and operation.
		Visual and lighting - disturbance and barrier effects during construction and operation.
Severn Estuary SAC	River lamprey Sea lamprey Twaite shad	Release of pollutants leading to water quality changes in the River Usk SAC - physiological/behavioural/ barrier effects in features as they migrate during construction and operation.
		Noise and vibration - disturbance and barrier effects, outside of the SAC, during construction.
		Lighting - disturbance/behavioural and barrier effects, during bridge construction and operation.
Severn Estuary SPA	Ringed plover (during passage)	Direct land take leading to habitat loss/fragmentation of roosting and foraging areas of features outside the

Site	Feature	Likely Significant Effect
	Bewick's swan Dunlin Redshank Shelduck Curlew Pintail Assemblage of nationally important populations of wintering waterfowl	Severn Estuary SPS during construction and operation.
		Physical presence leading to disturbance/ displacement/interruption of flight lines/collision risk during construction and operation.
		Change in traffic flows/speeds and use of the area - disturbance and displacement of species and interruption of flight lines outside the site during construction and operation.
		Noise and vibration - disturbance/displacement and barrier effects.
		Visual and lighting - disturbance of behavioural patterns during construction and operation.
Severn Estuary Ramsar Site	Bewick's swan Wintering European white-fronted goose Dunlin Redshank Gadwall Shelduck Assemblage of nationally important populations of waterfowl.*	Direct land take - habitat loss /fragmentation of roosts and foraging habitat outside the Severn Estuary Ramsar Site during construction and oepration.
		Physical presence - leading to interruption of flight lines/collision risk outside the Ramsar Site during construction and operation.
		Change in traffic flows/speeds and use of the area - disturbance and displacement of species and interruption of flight lines outside the Ramsar Site during construction and operation.
		Noise and vibration - disturbance to roosting and foraging areas outside the Ramsar Site during construction and operation.
		Visual and lighting - disturbance to normal behavioural patterns outside the Ramsar Site during construction and operation.
	Assemblage of migratory fish: Salmon Sea trout Sea lamprey River Lamprey Allis shad Twaite shad European eel	Land take-habitat loss/fragmentation of eel habitat across the Gwent Levels, outside of the Ramsar site, leading to barrier effects during construction and operation.
		Physical presence - barrier effects to the passage of eels across the Gwent Levels and outside of the Ramsar site.
		Release of pollutants leading to water quality changes in the River Usk - physiological/behavioural/barrier effects in features outside of the Ramsar site, during construction and operation.
		Noise and vibration - disturbance and barrier effects to migratory species, outside of the Ramsar site, during

Site	Feature	Likely Significant Effect
		construction.
		Lighting - behavioural and barrier effects, during construction and operation.
Wye Valley and Forest of Dean Bat Sites SAC	Lesser horseshoe bat	Land take - habitat loss/fragmentation (foraging habitat) during construction.
		Land take - habitat loss/fragmentation (severance of flight lines) during construction.
		Physical presence - collision risk and increased predation during construction and operation.
		Lighting - disturbance to species/severance of flight lines during construction and operation.
		Noise and vibration leading to disturbance of species during construction and operation.
		Release of pollutants leading to water quality changes which could affect prey populations during construction and operation.

4.2 In combination assessment

4.2.1 The AIES Screening Assessment (Welsh Government, 2015) identified a number of plans and projects which were to be considered in-combination with the M4CaN in the SIAA.

Plans

4.2.2 Table 4.2 lists the plans identified in the AIES Stage 1: Screening Report (Welsh Government, 2015) which have been considered in the in-combination assessment. The approach to the in-combination assessment, including identification of plans to be considered in-combination with the M4CaN, was presented for consultation to NRW and Natural England as part of the AIES Stage 1: Screening Report. Table 4.2 below sets out the sites and features affected by each plan, as identified in the relevant Habitats Regulations Assessment (HRA) reports for those plans.

4.2.3 It should be noted that due to the outline nature of the plans, these assessments are often at a strategic level and do not provide sufficient detail to undertake a detailed in-combination assessment for the M4CaN project. Furthermore, the conclusions of plan level HRAs do not remove the requirement for project-level HRAs for specific projects associated with these plans. When these projects come forward, these will need to undertake specific, detailed assessments of the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment.

4.2.4 Sites allocated for development in the Cardiff, Newport and Monmouthshire County Council Local Development Plans are presented in March 2016 ES Chapter 17: Assessment of Cumulative Effects and Inter-relationships. These included sites allocated for residential development located along the banks of the River Usk, which are further discussed in paragraph 4.2.8 below.

Table 4.2: Plans considered as part of the in-combination assessment at the Screening Stage

Name of Plan	Summary European sites and features affected
Wales Spatial Plan Update (WSPU) (2008)	The HRA screening process for the WSPU (Welsh Assembly Government, 2008) concluded that it was not possible to confirm that the Wales Spatial Plan (WSP), alone or in combination with other plans or projects, would not have a significant effect on European and international sites in Wales, its offshore waters and across the border in England. Although an Appropriate Assessment was carried out, the aspirational and non-locational nature of the WSP meant that it was not amenable to the identification of the WSPU's implications for the sites with any great degree of precision. Therefore, it was concluded that HRAs will be carried out in greater detail in relation to the lower tier plans, action plans, programmes which enable the delivery of the WSP. The level of detail within those plans and programmes should be sufficient to enable the assessment process to be carried out with a greater degree of confidence. The HRA also identified proposed avoidance and mitigation actions and accounting for these, it was possible to conclude that the WSP will not adversely affect the integrity of the European and international sites, either alone or in combination with other plans or projects. The National Development Framework for Wales, under the Planning (Wales) Act 2015, will replace the WSP, with a focus on development and land use issues of national significance. It is currently at an early stage in development, with no information on potential effects on European sites currently available.
National Transport Plan (2010) and the Prioritised National Transport Plan (2011)	The NTP identified LSEs associated with water quality and flow changes to the River Usk SAC (Sea lamprey; Brook lamprey; River Lamprey; Twaite shad; Atlantic salmon; Bullhead; European otter; and Allis shad) and the Severn Estuary SAC (Sea lamprey; River Lamprey; and Twaite shad). Avoidance and mitigation measures were identified in the SIAA (Welsh Government, 2014b) which would ensure that the potential adverse effects (whether from construction or operation) identified would be avoided or mitigated and therefore it was concluded that the NTP, if adopted, when considered either alone or in combination with other plans or projects, would not adversely affect the integrity of any European Sites.
Newport City Council LDP 2011 – 2026 Revised Deposit Plan	The HRA screening report (Newport City Council, 2015) concluded that with mitigation there would be no LSE of the Newport Deposit LDP on any of the internationally designated sites within Newport or within a 15 km radius of the Newport boundary, including the River Usk SAC and Severn Estuary SAC, SPA and Ramsar. This conclusion was reached following consultation with NRW and the subsequent incorporation

Name of Plan	Summary European sites and features affected
	of minor changes into the HRA Screening Report.
Blaenau Gwent Local Development Plan (2011)	The HRA (Blaenau Gwent County Borough Council, 2011) identified that, before the consideration of mitigation measures, four European sites could potentially be affected by the delivery of the LDP when considered on its own, although none of these were the sites predicted to be affected by the M4CaN. After the introduction of mitigation measures no adverse effects on integrity were predicted to occur.
Caerphilly County Borough LDP up to 2021: (2010)	The HRA (Caerphilly County Borough Council, 2010) concluded that there was the potential for significant effects at the one European Site; the Aberbargoed Grasslands SAC. This site was screened out of the M4CaN AIES Screening Assessment (Welsh Government, 2015). The HRA concluded that no adverse effects on integrity of this SAC were predicted to occur alone or in-combination with the LDP.
Cardiff Council Deposit Local Development Plan (2013)	The Habitats Regulations Appraisal (City of Cardiff Council, 2015) concluded that the LDP would not have a LSE on the European sites considered as part of the HRA screening and would therefore not require full Appropriate Assessment under the Habitats Regulations.
Monmouthshire Local Development Plan 2011-2021 (Monmouthshire County Council, 2014)	The HRA (Monmouthshire County Council, 2014) identified that there is the potential for adverse effects on the integrity of the Usk Bat Sites SAC and Wye Valley and Forest of Dean Bat Sites SAC through habitat fragmentation and loss as a result of the Deposit LDP acting in combination with development proposed in surrounding areas. To address this issue the AA recommended a policy safeguard to ensure that development proposed through the Deposit LDP does not result in the loss or damage of linear habitat features. The HRA concluded that the Deposit LDP would not have adverse in-combination effects on the two identified European sites through habitat loss and fragmentation, if the recommended policy safeguards are incorporated into the Plan.
Powys Local Development Plan 2011-2026. Deposit Draft (2014)	Powys County Council (2015) concluded that based on the information considered as part of the HRA screening process, the implementation of the Deposit Powys LDP will not have a LSE on the Natura 2000 sites considered as part of the HRA screening and therefore does not require Appropriate Assessment under the Habitats Regulations.

Name of Plan	Summary European sites and features affected
Torfaen County Borough Council Local Development Plan: (2011)	The HRA Screening (Torfaen County Borough Council, 2012) identified a LSE for the River Usk SAC. The subsequent Appropriate Assessment concluded that with the monitoring and mitigation measures in place, the implementation of the Deposit Plan will not result in adverse in-combination effects on the integrity of the River Usk SAC.
Vale of Glamorgan Local Development Plan (2013)	The HRA Screening (Vale of Glamorgan Council, 2013) identified LSEs associated with seven European sites, including the River Usk SAC and the Severn Estuary SAC, SPA and Ramsar. The subsequent AA concluded that the LDP would not have adverse in-combination effects on the integrity of the identified European sites based on the mitigation contained within the LDP Policies and the incorporation of recommendations made by the AA.
Brecon Beacons National Park Authority Local Development Plan 2007-2022	The HRA screening (Brecon Beacons National Park Authority, 2013) identified potential for LSE on five European sites, including the River Usk SAC, though a number of policy safeguards and monitoring measures were identified and incorporated into the LDP in order to avoid LSEs on these sites. The HRA screening therefore concluded that with the recommended policy safeguards and monitoring measures incorporated into the Plan, the Deposit LDP would not have LSEs on European sites either alone or in combination with other plans or projects.
Newport City Council – River Usk Strategy (2009)	The HRA Report for the River Usk Strategy (Newport City Council, 2009) concluded sufficient mechanisms are in place to avoid a significant effect on the integrity of the River Usk and Severn Estuary SACs. Any proposals that emerge from the Strategy will be subject to further appropriate assessment, if considered necessary, at the planning application stage or as part of other statutory controls on the River Usk. Appropriate avoidance measures will therefore be finalised and agreed when detailed plans are submitted and implemented through appropriate planning conditions or licences and permits, or refused on the basis that avoidance measures identified are inadequate.
Wye and Usk Catchment Flood Management Plan (Environment Agency Wales, 2010)	There is currently insufficient information on actual activities or locations associated with this plan to allow identification of impacts.

Name of Plan	Summary European sites and features affected
South East Valleys Catchment Flood Management Plan (2010)	There is currently insufficient information on actual activities or locations associated with this plan to allow identification of impacts.
Taff and Ely Catchment Flood Management Plan (2010)	There is currently insufficient information on actual activities or locations associated with this plan to allow identification of impacts.
Shoreline Management Plan for the Severn Estuary (SMP2) (2010)	The HRA for SMP2 (Severn Estuary Coastal Group, 2010a) was carried out considering the likely effects of the implementation of high level policies identified in the Severn Estuary SMP2 alone and in-combination, on site integrity of a number of European sites, including the Severn Estuary SAC, SPA and Ramsar and the River Usk SAC. These policies are by their nature high level and lack detail with regards to changes which will be caused by the delivery of the SMP2 and the specific areas that will be affected. Therefore, only a high level assessment of the adverse impacts on sites was undertaken. In the majority of cases, adverse impacts are likely to occur as a result of coastal squeeze (particularly for habitat and ornithological features of the Severn Estuary SAC, SPA and Ramsar), or increased tidal inundation of freshwater habitats. The SMP2 also identified potential for in-combination effects on otter in the River Usk SAC due to habitat severance from loss of intertidal habitats. There is a high degree of uncertainty associated with the SMP2 and as such, only a high level assessment was presented within SMP2, making it difficult to undertake a detailed in-combination assessment with the M4CaN project. However, substantial habitat creation measures (such as those at Steart Marshes, on the English side of the Estuary) have already been implemented in order to off-set the potential implications of coastal squeeze on the qualifying habitats and species of the Severn Estuary. Projects associated with SMP2, and their potential effects on European sites, are considered in paragraph 4.2.9 below).
Severn Estuary Flood Risk Management Plan (SEFRMS; 2014)	The SEFRMS provides a long term plan for sustainable flood risk management for the Severn Estuary following the SMP2. This provides some detail on the improvements to sea defences in the Severn Estuary and surrounding tributaries to ensure the Welsh Government policy to “Hold the Line” in line with the SMP2 (discussed above). This includes improvements to coastal defences within the River Usk SAC (e.g. the SEFRMS refers to improvements to flood defences at the Newport Transporter Bridge) which

Name of Plan	Summary European sites and features affected
	may have an in-combination effect with the M4CaN. Furthermore, as detailed above for the SMP2, based on the "Hold the Line" policy, the current extent of the grazing marshes on the Gwent Levels would be maintained, but it is likely that there would be loss of intertidal habitats through "coastal squeeze". This would result in loss of qualifying habitats of the Severn Estuary SAC and Ramsar and supporting habitats (e.g. roosting and feeding habitats) for the qualifying species of the Severn Estuary SPA and Ramsar (none of which are affected by the M4CaN project), leading to adverse effects on integrity of these European sites (as detailed above for the SMP2). As detailed above for the SMP2, substantial habitat creation measures (such as those at Steart Marshes, on the English side of the Estuary) have already been implemented in line with the SEFRMS in order to off-set the potential implications of coastal squeeze on the qualifying habitats and species of the Severn Estuary. Projects associated with SMP2/SEFRMS, and their potential effects on European sites, are considered in paragraph 4.2.9 below).
Countryside Council for Wales – Habitats Regulation Assessment of a proposal for a continuous coastal path between Cardiff and Chepstow (2011)	The conclusion of the HRA for the All Wales Coastal Path was that the Project will not have an adverse effect on the integrity of Natura 2000 sites (including the Severn Estuary SAC, SPA and Ramsar) and that effect can be reduced to *de minimis*, provided all proposed mitigation measure are fully implemented.
Dwr Cymru – Final Water Resources Management Plan (2013)	The HRA for this plan (Dwr Cymru, 2013) concluded that the Final Plan will not have any significant adverse effects on any European Site (alone or in combination with other plans and programmes) as a result of its implementation, since the preferred options will either: (a) Have no significant or adverse effect as they stand; or (b) Can be implemented using established and reliable best-practice mitigation/ avoidance measures to ensure no significant or adverse effects; or, (c) can be replaced by options that have no LSE or adverse effects from the feasible options list, should scheme-specific investigations demonstrate that adverse effects are certain and cannot be avoided or mitigated. All options are to be subject to project-level HRAs, as a matter of legal requirement, which provides an

Name of Plan	Summary European sites and features affected
	additional safeguard.

Projects

4.2.5 The AIES Stage 1: Screening Report identified the Cardiff and Newport Tidal Lagoon Developments for inclusion within the in-combination assessment, should sufficient detail become available prior to the production of the SIAA. In their response to consultation on the Screening Report (letter of 5 November 2015 at Appendix A1), NRW advised that while the scale and significance of these projects should be recognised, the M4CaN project team should consider whether "*sufficient detail has yet been developed, in relation to the tidal lagoon project proposals, to enable you to undertake meaningful in-combination assessment at this stage*". The only information on these projects was the Scoping Report for the Cardiff Tidal Lagoon Development (Tidal Lagoon Cardiff Ltd., 2015). Likely effects from these projects are expected to comprise loss of estuarine habitats (e.g. mudflats and sandflats), with consequent effects on SPA bird populations which depend on these, disruption of fish migration during construction (e.g. underwater noise) and potentially during operation (e.g. changes in the hydrodynamic regime of the Severn Estuary SAC and River Usk SAC).

4.2.6 At this stage in these developments (i.e. scoping), it was not possible to quantify these effects and therefore it was not considered appropriate to include these projects within the in-combination assessment due to lack of information (following guidance in Tyldesley (2011); see paragraph 3.5.11). However there is the potential for both these projects to affect the same species of wintering birds listed as features of the Severn Estuary SPA and Ramsar Site as the M4CaN. An in-combination assessment of these projects and the M4CaN will be required to be undertaken by the developers of the Tidal Lagoon Developments at the time of submission the relevant Development Consent Order applications.

4.2.7 As part of the Cumulative Effects Assessment, a number of other projects were considered for the purposes of the EIA (see Chapter 17 of the ES). The projects relevant to this SIAA are summarised in Table 4.3, including information on the features likely to be affected and whether or not these should be considered further in the SIAA based on the information available on these projects. In some circumstances, project information was not adequate to make an assessment of whether LSEs were likely to occur in-combination with the M4CaN, due to the project being at an early stage in the planning process (e.g. EIA screening or scoping). In these instances, these were not considered further in the in-combination assessment, in line with the methods outlined in paragraph 3.5.11 *et seq*. Full details of these projects, including their location relative to the M4CaN project (Volume 2 of the ES), are presented in Chapter 17 of the ES.

4.2.8 Two of the residential developments associated with the Newport LDP were particularly relevant to the in-combination assessment for the River Usk SAC, namely *City Vizion Development Site, Phase 4, Rodney Road, Newport* and *Land at part of ORB works and land known as Monkey Island, Corporation Road, Newport*. These developments have the potential to affect features of the River Usk SAC, including migratory fish and otter, and are therefore discussed further in Section 5.2, although no adverse effects on integrity of the River Usk were predicted due to the conditions applied to the planning approval.

4.2.9 The list of other projects was updated to include the period up to 24 August 2016 and an updated list provided as September ES Supplement (Appendix R17.2). Only one additional relevant application was identified. This was an application for the continued use of a site for motor racing on a limited number of days per

year. The land has been used for this purpose under a series of temporary consents and had therefore been considered as part of the baseline within the assessments undertaken to date.

4.2.10 In-combination effects may also occur as a result of a number of NRW flood defence projects within the River Usk and the Severn Estuary (i.e. associated with the SMP2). Within the River Usk, construction of new flood defences at Crindau Pill and works associated with construction of the Riverside flood defences have the potential to result in LSEs on otter and migratory fish features of the River Usk SAC as a result of noise disturbance and water quality impacts. Adverse effects on the integrity of the River Usk SAC were not predicted to occur due to appropriate design of these projects and the implementation of appropriate mitigation to avoid or minimise these effects such that the achievement of conservation objectives of the River Usk SAC would not be delayed, interrupted or disrupted. Therefore, there was no potential for LSEs in-combination with the M4CaN.

4.2.11 Within the Severn Estuary SAC, SPA and Ramsar sites, the works associated with the Portland Grounds flood defence (i.e. raising a stretch of approximately 2 km of existing earth flood defence embankment) and Tabb's Gout flood defence (i.e. raising a stretch of approximately 700 m of existing earth flood defence embankment) have the potential to affect overwintering bird features of the Severn Estuary SPA and Ramsar. LSEs were not predicted to occur as a result of these projects, however, due to the avoidance of construction operations during the overwintering period and therefore there was no potential for LSEs in-combination with the M4CaN.

Table 4.3: Projects considered as part of the in-combination assessment at Screening Stage (see March 2016 ES Chapter 17: Assessment of Cumulative Effects and Inter-relationships for further details of these projects)

Name of Project (Location)	Description	Summary European sites and features affected	LSE In-combination with M4CaN
Site 3 Land West Of The Grange, Whitson Road, Whitson, Newport	Scoping Opinion for a proposed solar farm and grid yard	Scoping report and opinions identify potential for effects of land take potentially on bats and birds. CCW (now NRW) recommended that ecology surveys are required, including bat and overwintering birds to determine potential for effects.	Not enough information (Scoping Report only)
Fair Orchard Farm, Lighthouse Road, Newport, NP10 8SF	EIA Screening for 7.5 MW Solar Farm	Newport City Council Ecology officer requested that the project should state that potential effects on the Severn Estuary SPA should be considered.	Not enough information (EIA Screening only).
Land To South Of South Dock And Adjacent to River Usk, East Way Road, Alexandra Docks, Newport	EIA Screening opinion for a single turbine (2.3 MW)	No LSE on Severn Estuary SPA, due to absence of records of SPA qualifying features on the site.	No LSE in-combination with M4CaN.
11, East Way Road, Alexandra Docks, Newport, NP20 2NQ	Erection of one wind turbine height to tip 125 meters, and new substation	No LSE on Severn Estuary SPA. No adverse effects on migratory fish due to seasonal restriction on construction activities (e.g. piling).	No LSE in-combination with M4CaN.
Sewage Treatment Works, West Nash Road, Nash, Newport, NP18 2YH	Erection of single wind turbine and associated works.	Potential for collision risk of SPA species, though this was not considered significant. SPA species considered were black-headed gull and herring gull (species screened out of the M4CaN assessment; see Section 5.4).	No LSE in-combination with M4CaN.
Land to North Of Longlands Farm, Longlands Lane, Magor, Caldicot	Screening opinion for a single wind turbine	Collision Risk Modelling supplied with Screening showed potential for effects on herring gull, black-headed gull and lapwing (screened out of the M4CaN assessment; see Section 5.4), with no significant effects predicted on these species.	No LSE in-combination with M4CaN.

Name of Project (Location)	Description	Summary European sites and features affected	LSE In-combination with M4CaN
Land To North Of Longlands Farm, Longlands Lane, Magor, Caldicot	Scoping opinion request for a single wind turbine (73.25 m high, 99.7 m to tip)	Collision Risk Modelling supplied with Scoping showed potential for effects on herring gull, black-headed gull and lapwing (screened out of the M4CaN assessment; see Section 5.4), with no significant effects predicted on these species.	No LSE in-combination with M4CaN.
Land To The North Of Little Longlands, Longlands Lane, Magor, Caldicot	Scoping Opinion for the erection of 2 wind turbines and associated access tracks , hardstandings area and switch room	Scoping opinion presented limited information on effects of proposal on the Severn Estuary SPA.	Not enough information (Scoping Report only)
Land to The North of Little Longlands, Longlands Lane, Magor, Caldicot	Erection of 1 wind turbine (1.5 MW) with a maximum height to tip of 100m, together with ancillary development including electrical sub station kiosk and electrical transforming kiosk, underground cabling, onsite access tracks, access to the public highway, crane hardstandings, tempory construction compound and site signage.	No LSE predicted on SPA qualifying features due to low abundances of wintering bird species recorded and for those who are present (mallard and shelduck), low flight heights and therefore negligible risk of collision.	No LSE in-combination with M4CaN.
North Court Farm, North Row, Magor, Caldicot, NP26 3DX	Scoping Opinion request for the erection of 3 wind turbines	Scoping opinion stated that no wintering bird surveys or collision risk modelling were required due to low potential for effects. No LSE for SPA bird species.	No LSE in-combination with M4CaN.
Mead Lane, Magor	Screening and Scoping opinion request in relation to a wind farm development (Option A 10 turbines, Option B 6 turbines)	Potential for LSE on SPA qualifying features, although full information on project, including collision risk modelling, not currently available.	Not enough information (Scoping Report only)

Name of Project (Location)	Description	Summary European sites and features affected	LSE In-combination with M4CaN
Mead Lane, Magor	Screening and scoping opinion for erection of up to 3 wind turbines (126.5 m high) affecting PROW 404/3	Limited information on potential LSE on SPA qualifying features, other than scoping opinion which states that wintering bird surveys and collision risk modelling will need to be undertaken to support any application.	Not enough information (Scoping Report only)
Sewage Treatment Works, West Nash Road, Nash, Newport, NP18 2YH	Scoping Opinion request for the erection of 3 wind turbines	Limited information on potential LSE on SPA qualifying features.	Not enough information (Scoping Report only)
Land to North East And Forming Part of C, Whitson Road, Whitson, Newport	Screening Opinion request for solar farm	Not enough information to undertake an assessment, but CCW (now NRW) highlighted potential for effects on SPA qualifying features due to overhead cables and glare.	Not enough information (EIA Screening only).
Land to West of Greenfield House, Cock Street, Magor, Caldicot	Screening Opinion request for solar farm	Not enough information to undertake an assessment, but CCW (now NRW) highlighted potential for effects on SPA qualifying features due to overhead cables and glare.	Not enough information (EIA Screening only).
Land near Great House FarmUndyMonmouthshire	2 three-bladed wind turbines of up to 100m tip-height; An electrical substation kiosk at the base of each turbine; An electricity transformer kiosk at the base of each turbine; Crane hard-standing areas; On-site access track; Access to the public highway; Underground cabling; temporary construction compound; and site signage	Wintering bird surveys recorded two SPA qualifying features at abundances great enough to be considered in an impact assessment: lapwing and mallard. Mallard were screened out due to very low collision risk.	No LSE in-combination with M4CaN.

Name of Project (Location)	Description	Summary European sites and features affected	LSE In-combination with M4CaN
City Vizion Development Site - Phase 4, Rodney Road, Newport	Residential development of 36 dwellings together with riverside path and associated works affecting PROW 411/1	Concerns raised by CCW (now NRW) regarding potential for effects on otter, and. Mitigation to be implemented as a condition of the planning permission to avoid adverse effects on integrity of the River Usk SAC (e.g. retention and improving of otter habitat along riverbank, and otter fencing and avoidance of March to June for construction activities that may lead to vibration into water column). Through the implementation of these measures, no adverse effects on integrity of the River Usk SAC.	No LSE in-combination with M4CaN.
Land at part of ORB works and land known as Monkey Island, Corporation Road, Newport	Redevelopment of land for residential development including open space, landscaping and roads and paths	Potential effects on otters and the River Usk SAC, including water quality effects and potential disturbance to otters. Planning permission granted with conditions which will safeguard conservation objectives of the River Usk SAC. Through the implementation of these measures, no adverse effects on integrity of the River Usk SAC.	No LSE in-combination with M4CaN.
Land North East of Chesnut Tree Farm, Whitson Road, Whitson, Newport	Screening Opinion for development of a solar farm	Not enough information to undertake an assessment. Newport City Council Ecologist stated that features of SACs, SPAs and Ramsar (including the Severn Estuary) would need to be considered.	Not enough information (EIA Screening only).
11 East Way Road, Alexandra Docks, Newport, NP20 2NQ	EIA Screening for erection of solar farm (4MW)	Not enough information available to undertake an assessment as only a screening opinion lodged.	Not enough information (EIA Screening only).
Mead Lane, Magor	Screening opinion for installation of single wind turbine	Not enough information available to undertake an assessment, although potential for effects on Severn Estuary SPA species identified by CCW (now NRW)	Not enough information (EIA Screening only).

Name of Project (Location)	Description	Summary European sites and features affected	LSE In-combination with M4CaN
Land to South of South Dock And Adjacent to River Usk, East Way Road, Alexandra Docks, Newport	Installation of wind turbine 2.3MW	Potential for LSE on qualifying features of the River Usk SAC, including migratory fish. Planning permission granted with conditions including restriction on certain construction activities (e.g. piling) during particularly sensitive periods for fish migration (i.e. March to June) and pollution prevention measures to prevent impacts on the water quality of the River Usk SAC. Through the implementation of these measures, no adverse effects on integrity of the River Usk SAC.	No LSE in-combination with M4CaN.

5 Stage 2: Appropriate Assessment

5.1.1 As explained in Section 4, on the basis of the draft Screening Assessment five International /European sites were taken forward to the SIAA (Appropriate Assessment). These were:

- River Usk/Afon Wysg SAC.
- Severn Estuary/Môr Hafren SAC.
- Severn Estuary/Môr Hafren SPA.
- Severn Estuary/Môr Hafren Ramsar site; and
- Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC.

5.1.2 The full conservation objectives for these sites are provided in in Appendix C.

5.2 River Usk/Afon Wysg SAC

5.2.1 The AIES (screening assessment) identified the potential for LSEs on migratory fish species (i.e. sea lamprey, river lamprey, twaite shad, allis shad and Atlantic salmon), all Annex II qualifying species of the River Usk SAC. The LSEs on migratory fish were:

- Release of pollutants into water courses leading to water quality changes and potential physiological/behavioural/barrier effects (construction and operation);
- Noise and vibration leading to disturbance/barrier effects to migratory fish (construction); and
- M4CaN bridge lighting shining on water causing behavioural/barrier effects (construction and operation).

5.2.2 The AIES (screening assessment) also identified potential for LSEs on European otter, an Annex II qualifying species of the River Usk SAC. The LSEs on European otter were:

- Direct land take - habitat loss/fragmentation of otter habitat (e.g. resting areas) during construction.
- Physical presence/barrier to the movement of otters during construction and operation.
- Risk of injury on construction site/becoming trapped in excavations during construction and potential vehicle collision effects.
- Release of pollutants into watercourses leading to water quality changes and potential for physiological changes (e.g. toxicological) which in turn could impact upon otters and/or their prey during construction and operation.
- Noise and vibration leading to disturbance/displacement and potential barrier effects during construction and operation.
- Visual disturbance and lighting impacts leading to barrier effects during construction and operation.

Migratory Fish (i.e. sea lamprey, river lamprey, twaite shad, allis shad and Atlantic salmon)

Baseline

5.2.3 Chapter 10 of the March 2016 ES describes the baseline for the migratory fish species occurring within the River Usk and wider Severn Estuary (see Section 10.4 of Chapter 10 to the ES and Appendix 10.18: Aquatic Environmental Baseline Study to the ES). A summary is provided here. No site-specific surveys were undertaken for migratory fish and therefore the baseline is based on desk study information only. This was considered to be appropriate due to the availability of information and data on fish migration (particularly timing of migrations) from a range of sources around the Severn Estuary and River Usk, including long term monitoring at the Hinkley Power Station (e.g. Claridge *et al*., 1986; EDF, 2011) and the information presented within the Severn Tidal Power reports (DECC, 2008), and also on the basis that this SIAA assumes that all of the qualifying migratory fish features of the River Usk SAC are present and would be passing through the Usk Estuary to reach spawning grounds.

5.2.4 The Bristol Channel/Severn Estuary provides a transitory route for several diadromous fish species, which primarily move between marine feeding grounds and their natal freshwater rivers, in this context notably the River Usk. Diadromous species are either anadromous (adults of anadromous species migrate from coastal marine areas to freshwaters to spawn but most growth occurs at sea), or catadromous (adults migrate from freshwaters to marine waters to spawn, but most growth occurs within freshwaters). Seven diadromous fish species are known to occur in the vicinity of the M4CaN study area: Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey, sea trout and European eel (the latter two are not features of the River Usk SAC, but are features of the Severn Estuary Ramsar Site - see paragraph 5.4.1). All of these species are anadromous with the exception of the catadromous European eel.

Sea and river lamprey

5.2.5 The River Usk supports a healthy population of river lamprey and is considered to provide exceptionally good quality habitat likely to ensure the continued survival of the species in this part of the UK. The River Usk has the greatest *Lampetra* spp. ammocoete (river and brook lamprey ammocoetes cannot be distinguished apart in the field and as such are termed collectively as *Lampetra* spp.) population across all British SAC rivers designated for the species (DECC, 2008).

5.2.6 Adult river lamprey generally enter UK rivers in late autumn and peaks in abundance of juvenile river lamprey migrating downstream have been recorded between October and January (Claridge *et al*., 1986; see Table 5.1). Sea lamprey migrate upstream and enter rivers such as the Usk and Wye in early spring (Table 5.1). The survey of juveniles and observation of spawning adults indicates that sea lamprey are mainly restricted to the lower reaches of the River Usk catchment. Being poor swimmers, migrating lampreys generally move in shallow waters, along the edges of the main stream, particularly when the river current is strong (Kelly and King, 2001).

Twaite and allis shad

5.2.7 The River Usk is one of only four remaining rivers in the UK which are known to support a spawning population of twaite shad; the others are the Rivers Wye, Tywi and Severn (including its tributary the River Teme).

5.2.8 Allis shad are rare in the UK, and although formerly known to spawn in several British river systems, the only recently-confirmed spawning site is in the Tamar Estuary (Plymouth Sound and Estuaries cSAC). There is probably a spawning population in the Solway Firth area, but rivers in the Severn catchment may no longer support viable breeding populations (Carstairs, 2000). Sites in the UK, such as the River Usk SAC have been selected where allis shad has been reliably recorded as present, where there is previous evidence of breeding, and where there still appear to be favourable conditions for breeding.

5.2.9 The upstream migration of allis and twaite shad to spawning areas in the River Usk occurs between March and June, reaching a peak in May. Spawning is dependent on temperature but usually occurs between May and July for twaite shad (Aprahamian *et al*., 1998). The 0+ fish remain in fresh and/or estuarine waters during the summer, juveniles colonise the Severn Estuary from July, before migrating seaward in autumn (Table 5.1).

Atlantic salmon

5.2.10 Adult Atlantic salmon migrate upstream primarily between July and September, but also in earlier months of the year (EDF, 2011). The females excavate hollows in the gravel of the streambed, and the males lie alongside and fertilise the eggs as they are laid. Adult Atlantic salmon may die after spawning, but unlike other salmon, a large number of the adults often survive, making their way back to the open sea emaciated and exhausted. Atlantic salmon smolts migrate downstream towards marine feeding grounds between April and June; evidence suggests that this migration occurs largely during the night in the surface waters (Moore *et al*., 1998).

5.2.11 The River Usk is famous for its salmon, with a high proportion (c. 30–40%) of multi sea winter fish recorded in the rod catch. In 1999, the Usk had highest estimated egg deposition of any British river south of Cumbria, and was one of the few rivers in England and Wales to exceed its spawning target for salmon.

Table 5.1: Summary of migration periods (upstream ↑ and downstream ↓) for diadromous species within the Severn Estuary and River Usk.

Note: Sea trout and European eel are features of the Severn Estuary Ramsar Site only.

Common Name	J	F	M	A	M	J	J	A	S	O	N	D
Allis and twaite shad			↑	↑	↑	↑						
Allis and twaite shad (juv.)			↓	↓	↓		↓	↓	↓			
Atlantic salmon			↑	↑	↑	↑	↑	↑	↑			
Atlantic salmon (juv.)				↓	↓	↓						
River lamprey	↑		↑	↑				↑	↑	↑	↑	
River lamprey (juv.)	↓	↓	↓	↓	↓					↓	↓	↓
Sea lamprey					↑	↑	↑					
Sea lamprey (juv.)	↓									↓	↓	↓
Sea trout			↓	↓	↑	↑	↑	↑	↑			
European eel									↓	↓	↓	
European eel elvers				↑	↑	↑	↑					

Potential Effects on Conservation Objectives

5.2.12 The conservation objectives for the features of the River Usk SAC are provided in Appendix C1, including the vision for the migratory fish species features of the SAC, i.e. that these are to be in a favourable conservation status where all the conditions set out below are satisfied. Appendix C1 also includes details of performance indicators for each of the migratory fish species which are part of the conservation objective and therefore may be relevant to the assessment. The favourable conservation status components for migratory fish in the River Usk SAC are summarised here:

- The conservation objectives for the River Usk watercourse must be met. This includes the sufficiency of the ecological status of the water environment to maintain a stable or increasing population of each feature/species, with elements of water quantity, quality, physical habitat and community composition and structure.
- The population of the features in the SAC is stable or increasing over the long term.
- 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.
- 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.

5.2.13 The following sections provide an assessment of the effects of the Scheme on the conservation objectives above, with the assessment undertaken under headings for the LSEs listed in paragraph 5.2.1. The assessments also consider mitigation to be implemented as part of the project for migratory fish (paragraph 5.2.67 *et seq*.). The effects on conservation objectives for the relevant migratory fish features of the River Usk SAC (and thereby potential for adverse effects on the integrity of the River Usk SAC) are then considered for each conservation objective individually using the information presented within the assessments below (see paragraph 5.2.78 *et seq*.). Effects on the integrity of the River Usk SAC are considered in paragraph 5.2.183, with consideration of effects on the conservation objectives of both migratory fish and otters.

Release of pollutants into watercourses leading to water quality changes and potential physiological/behavioural/barrier effects

Construction

5.2.14 Chapter 10 of the March 2016 ES assesses the impacts of releases of pollutants during the construction phase leading to water quality changes and potential physiological/ behavioural/barrier effects. With respect to the migratory fish listed as qualifying features of the River Usk SAC, these include pollution from inappropriate storage of chemicals and run-off from the construction area resulting in particulate pollution of watercourses (March 2016 ES Chapter 10, Section 10.8).

Potential effects of pollution from inappropriate storage of chemicals or spillages on nearby or more distant receptors

5.2.15 Accidental spillage of chemicals and substances from construction compounds and activities (including vehicles and equipment operating near to watercourses and the drilling mud plants) may impact on migratory fish species, resulting in behavioural effects such as avoidance of affected areas and barriers to migration. Chemical spills may also have sub-lethal to lethal effects dependent on the spatial and temporal extent of the exposure and the level of toxicity. However, the risk of such events occurring would be minimised through adherence to the measures outlined in the CEMP, specifically the Pollution Prevention Plan and the Surface Water Management Plan, which would adhere to standard best practice guidance and NRW Pollution Prevention Guidelines (PPGs; see paragraph 5.2.68) and would significantly reduce the likelihood and magnitude of an accidental pollution incident occurring (see March 2016 ES Chapter 16: Road Drainage and the Water Environment).

5.2.16 The sensitivity of migratory fish species varies depending on a range of factors including the pollutant, the species affected and life stage involved, with fish eggs and larvae likely to be particularly sensitive (Westernhagen, 1988). As only adult and juvenile migratory fish species are likely to be in the vicinity of the construction works for the River Usk crossing, and in most cases only transiting during this time, they are less likely to be affected by marine pollution due to their increased mobility.

5.2.17 In the unlikely event that pollutants did enter these watercourses during the construction phase (noting that best practice measures would minimise the likelihood and magnitude of such a spill) they would be rapidly dispersed on the surface and in the water column, and subject to twice daily tidal flushing, and so

any effects on river water quality, and in turn migratory fish, are likely to be limited.

Potential effects of run-off from the construction area resulting in particulate pollution of watercourses.

5.2.18 Excessive fine sediment, in suspension or deposited, can have damaging impacts on all life stages of fish. As with effects associated with contamination and pollutants, the effects of particulate pollution (i.e., increased suspended solid concentrations) on migratory fish as a result of run-off from construction areas near the River Usk and River Ebbw varies depending on life stage, time of year, size of fish, the composition of the particulates and the availability of unaffected habitat (Bash *et al*., 2001). Suspended sediments are not expected to be released during construction as all works within the River Usk SAC would be undertaken outside the wetted channel. The only operations which would occur within the River Usk SAC would be construction of the east pylon of the River Usk crossing Since all works associated with this structure would be entirely enclosed within a sheet piled coffer dam, it is not expected that sediments from these construction operations would be discharged into the River Usk (see Appendix SR3.1: Buildability Report, to the December 2016 ES Supplement).

5.2.19 Effects associated with particulates are especially damaging for fish eggs and larvae/fry (Robertson *et al*., 2006) and therefore have implications for spawning success for migratory fish species (although effects on spawning habitats are not expected). With respect to the adult life and juvenile stages transiting through the estuaries of the River Usk and River Ebbw, it is known that fish exhibit avoidance reactions and move away from the vicinity of adverse sediment conditions if refuge conditions are present (Sigler *et al*., 1984; Bash *et al*., 2001) and could therefore potentially move to avoid any unfavourable discharges of particulate matter (Robertson *et al*., 2006). High exposure rates to sediment loads may halt fish migration, particularly upstream, although it should also be noted that the Regulation 33 advice for the Severn Estuary SAC, SPA and Ramsar Site, which should also apply to the River Usk at the point where the M4CaN crosses it, states that "*Given the extremely high background levels of turbidity, it is unlikely that any changes in turbidity will have any significant impact on shad and lamprey while in estuarine waters*".

5.2.20 Effects of particulate matter on migratory fish are expected to be short term and temporary as these species transit through the estuaries of the River Usk and River Ebbw. Suspended matter from the M4CaN, should these be released at all, would be rapidly dispersed and given the high sediment load of the Usk and Ebbw estuaries, effects on migratory fish are expected to be limited.

5.2.21 In addition to the measures designed into the M4CaN Scheme, a Surface Water Management Plan (SWMP) would be developed and implemented to consider all drainage required during the construction phase. This would reference all industry and regulatory pollution prevention guidelines (see paragraph 5.2.69 and March 2016 ES Chapter 16: Drainage and the Water Environment). The SWMP would consider all construction related discharges into all waterbodies, including the River Usk, River Ebbw and Gwent Levels, to ensure negative effects on water quality of these features are minimised during construction.

Operation

5.2.22 Chapter 10 of the March 2016 ES assesses the impacts of releases of pollutants during the operational phase of the M4CaN leading to water quality changes and potential physiological/behavioural/barrier effects. These include pollution from highway drainage during normal operation of the M4CaN and potential pollution events resulting from collisions or other traffic incidents on the M4CaN (March 2016 ES Chapter 10, Section 10.9).

Effects of highway drainage

5.2.23 The sensitivity of migratory fish to pollutants and suspended sediment is as described previously in paragraphs 5.2.16 and 5.2.19.

5.2.24 Contaminants, including fuel and oils as well as particulate matter (i.e. silts), associated with routine road run-off have the potential to impact migratory fish, should these substances enter the River Usk or River Ebbw through the highway drainage system during the operation of the Scheme. As explained in the March 2016 ES Chapter 16: Road Drainage and the Water Environment, highway runoff from the proposed bridged sections crossing the River Ebbw, River Usk and Alexandra Docks would be discharged to outfalls on the River Ebbw and River Usk. As the Usk and Ebbw are tidal, discharges to do not require flood compensation lagoons. The Ebbw outfalls would benefit from treatment in the form of oil interceptors. Since the Usk is an SAC, the Usk outfall would also include the provision of a pollution control lagoon to capture and retain significant pollution resulting from road accidents that may otherwise flow uncontrolled to the Usk Estuary. No significant effects would arise from chloride within road runoff due to the Rivers Usk and Ebbw being tidal and therefore already brackish or saline in nature. The risk associated with pollution from spillages would be mitigated to below 0.5% as prescribed by the DMRB and, as such, can be considered to have negligible magnitude of impact on both watercourses.

Potential for pollution events resulting from collisions/other traffic incidents on the new road

5.2.25 Collisions or other traffic incidents may result in oil, fuel and/or chemical spills which could have impacts on migratory fish if they enter the River Usk or River Ebbw. As described above (paragraph 5.2.23), discharges to both the Usk and Ebbw would be provided with oil interceptors and for the Usk additional protection would be provided in the form of a pollution retention basin to protect the river in the event of a significant pollution event on the carriageway. In the unlikely event that pollutants did enter these watercourses they would be rapidly dispersed on the surface and in the water column, and subject to twice daily tidal flushing, and so any effects on river water quality would be limited.

5.2.26 The sensitivity of migratory fish to pollutants, including oil and chemicals, is described previously in paragraph 5.2.16. The effects of release of pollution during construction and operation of the M4CaN on the conservation objectives of the migratory fish features of the River Usk are considered in paragraph 5.2.79.

Noise and vibration leading to disturbance/barrier effects to migratory fish (construction)

5.2.27 Chapter 10 of the March 2016 ES assesses the impacts of underwater noise and vibration during construction of the M4CaN River Usk Crossing (see Chapter 10 of the ES, Section 10.8). No construction works associated with the River Usk Crossing would take place within the wetted channel of either the River Usk or the River Ebbw. Therefore, noise would not be generated as a result of piling directly within the marine environment. There would however be the potential for noise from the installation of piles on land on the banks of these rivers, and in the vicinity to transmit through the ground to the water column of the estuarine environment. These pathways are less well understood than those in which sound is generated directly into the water. Furthermore, evidence that onshore piling may impact fish is limited. Therefore, as on a precautionary basis, the impact assessment in Chapter 10 of the March 2016 ES (and presented here) was undertaken on the basis that the sound generated would not be moderated by the ground conditions (i.e., as though the piling were taking place in water).

5.2.28 The requirements for restrictions on piling for the River Usk crossing to avoid effects on migratory fish have been discussed with NRW. The agreed position is set out in Commitment 95 (previously 63) which states:

"Piling to install the cofferdam and pylon piles for the east pylon of the River Usk Crossing would be scheduled to avoid the period of highest sensitivity for underwater noise related impacts on migratory fish in the River Usk (April to June inclusive). Outside of the period 1st April to 30th June there would be no restrictions on the timing of piling activities. In the exceptional circumstance that piling is required within the period 1st April to 30th June piling activities would not take place during the period 3 hours before high water to one hour after high water."

5.2.29 No other restrictions on piling were deemed to be necessary.

Underwater noise levels associated with construction of the M4CaN

5.2.30 For the construction of the River Usk and Ebbw Crossing, piles would be required for:

- East and west pylon cofferdams;
- East and west pylons themselves;
- West and east approach viaducts; and
- River Ebbw bridge foundations.

5.2.31 The process of installing these piles would have the potential to result in underwater noise and vibration effects on migratory fish species, including potential barrier effects to migration.

5.2.32 The main construction operations which have the potential to result in underwater noise related behavioural effects on migratory fish species relate to the construction of the east and west pylons for the River Usk Crossing cable stayed bridge. Vibropiling would be used to install a coffer dam for the east pylon in coastal saltmarsh on the east bank of the River Usk (outside the wetted channel) and the west pylon. Based on the current (Summer 2017) construction design

this would be undertaken over a period of 32 days for each coffer dam, although vibropiling would only occur intermittently during this period. Construction of the east and west pylons for the River Usk Crossing cable stayed bridge would require installation of 26 x 2.1 m piles for each pylon via a combination of vibropiling (for the insertion of the temporary casings) followed by boring/drilling used to excavate the contents of the temporary casings.

5.2.33 Vibropiling of temporary casings is likely to take approximately 15 – 20 minutes (and similar for subsequent casing extraction). For all piling works associated with the east and west pylons, noise and vibration associated with these activities would represent intermittent occurrences over five months within a single year (currently planned for the end of 2018 and spring 2019). It is anticipated that approximately 2 to 3 piles would be installed per week for the east and west pylons, with vibropiling of pile casings representing only 1-2 hours during that period (i.e. 15-20 minutes per casing). While boring within the casings would be expected to be of longer duration, noise levels associated with this activity are expected to be considerably lower than those for vibropiling (see paragraph 5.2.36). Piling would primarily take place during daylight hours, although some piling operations may occur after dark (i.e. 10 hour working days, so there is the potential for piling to occur after dusk during winter months). Therefore, noise and vibration effects associated with vibropiling would be generated for approximately 35 hours over the five month pylon installation period, equating to <1% of this 5 month period.

5.2.34 The installation of piles for the west and east approach viaducts, especially those closest to the River Usk, would also have the potential to result in underwater sound and vibration effects on migratory fish species. As above for the cable stayed bridge pylons, all viaduct piles would be installed via a combination of vibropiling (for the insertion of the temporary casings) followed by boring/drilling used to excavate the contents of the temporary casings. Piling operations for these elements of the Scheme would represent intermittent occurrences over one year as follows: for the west approach viaduct 180 piles would be installed over several periods of between three and six months duration; and for the east approach viaduct 283 piles would be installed over several periods of between one and six months duration. On the basis that each casing would be installed using vibropiling, with each casing taking approximately 15-20 minutes to install, it is expected that the total duration of vibropiling for the east and west approach viaducts would be up to 310 hours over this 1 year period. As described above, piling would take place primarily during daylight hours.

5.2.35 In the same way as for the construction of the Usk Crossing, for the River Ebbw Underbridge, bored *in-situ* reinforced concrete piles would be installed for the pylons and abutments, and temporary sheet piling would be installed using a vibrohammer for the associated pilecaps. These works would comprise the installation of 180 bored piles, with 12 piles installed per week per rig.

5.2.36 As part of the project design, a variable moment, frequency vibrator, has been selected to drive the piles for the cofferdam and the pile casings. This type of vibrator has an advantage over a fixed moment unit in that no low frequency vibrations are generated at any time during the work cycle. Vibropiling generates continuous broadband sound; the Compendium of Pile Driving Sound Data (CPSD) (Illinworth and Rodkin, 2007) reports on sound levels measured during vibratory driven sheet piling (such as would be used for the cofferdams), for a port project in water approximately 12 to 14 m deep, as approximately 173 dB

r.m.s re µPa m at frequencies of 400 to 2,500 Hz. Although considerable variation is likely based on location and equipment used, on this basis, construction of the cofferdams using vibropiling may not generate r.m.s underwater sound levels significantly greater in magnitude than an individual small watercraft, although it should be noted that the overall duration would be longer in any given day. This is supported by noise monitoring during vibropiling at Red Funnel's Southampton Terminal in Southampton Water, where source levels of the vibrohammer could not be discerned from the background level of vessel noise (approximately 150 dB re 1 µPa) in the area (Nedwell *et al*., 2003).

5.2.37 Bored foundation piling is considered unlikely to generate significant underwater sound levels. Although measurements for bored piling are not reported in the CPSD, the 'Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry' (REDUSPOG; Wyatt, 2008) provides received sound levels from an oil and gas exploratory drilling ship in water 110 m deep, which may be considered to be an over-estimate of sound emissions for a land-based bored piling site. These data indicate source levels could be in the order of 141 dB r.m.s re 1 µPa m, which may generate received levels below ambient levels in the river; even at short distances.

5.2.38 In summary vibropiling would represent short term, intermittent occurrences over the construction phase. Although pile boring would be of longer duration, noise levels associated with this are expected to be below ambient levels, even using the highly precautionary assumption of piling in water.

5.2.39 As explained at paragraph 5.2.28, restrictions on the timing of piling for the east pylon of the River Usk crossing have been agreed with NRW. On the basis that coffer dams and pile casings would be installed using vibropiling methods and the main piles would be bored, no other timing restrictions were considered necessary.

Sensitivity of migratory fish to underwater noise

5.2.40 All five migratory fish species listed as features of the River Usk SAC (twaite and allis shad, Atlantic salmon, sea and river lamprey) have the potential to be impacted by piling related noise during construction (noting the precautionary assumptions within the assessment; paragraph 5.2.27).

5.2.41 The impacts of noise on fish can broadly be split into lethal and physical injury, auditory injury and behavioural response. Hearing loss can be permanent or comprise a temporary reduction in hearing sensitivity (i.e., temporary threshold shift (TTS)). Permanent hearing loss may be mitigated by the addition over time of new hair cells and for TTS, normal hearing often returns after cessation of the sound causing the TTS. At sound levels lower than those that may cause physical injury or mortality, noise may cause behavioural effects on a species, for example, avoidance of an area or changes in swimming speed (Mueller-Blenke, 2010). This may be significant if it causes, for example, a migratory species to be delayed or diverted from their course, although it should be noted that any potential behavioural effects on fish species is likely to depend on a range of factors including the type of fish (discussed further below), its sex, age and condition as well as other stressors which the fish may have been exposed to. The response of the fish would also depend on the reasons or drivers for being in the area, with spawning migration likely to be a strong motivation for the species being considered.

5.2.42 Most fish species are capable of hearing within a frequency range of 50 Hz up to 500 to 1,500 Hz. A smaller number of species can detect sounds to over 3 kHz while a very few species (notably clupeids) can detect sounds to well over 100 kHz (Popper and Hastings, 2009). Fish can be grouped into the following categories based on the presence or absence of a swim bladder and on the potential for that swim bladder to improve the hearing sensitivity and range of hearing (Popper *et al*., 2014):

- Fishes with no swim bladder or other gas chamber (e.g., lampreys, elasmobranchs, dab and other flatfish). These species are less susceptible to barotrauma and only detect particle motion, not sound pressure. However, some barotrauma may result from exposure to sound pressure;
- Fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume (e.g., Atlantic salmon). These species are susceptible to barotrauma although hearing only involves particle motion, not sound pressure; and
- Fishes in which hearing involves a swim bladder or other gas volume (e.g., Atlantic cod, herring and relatives). These species are susceptible to barotrauma and detect sound pressure as well as particle motion

5.2.43 As discussed in paragraph 5.2.36, most acoustic energy from vibropiling is emitted at frequencies of 400-2,500 Hz producing an effectively continuous sound (rather than impulsive as generated during impact piling for example); the sensitivity of fish species to higher frequencies is not therefore likely to be as relevant to the impact assessment as sensitivity to mid frequency ranges (i.e. <1,500 Hz).

5.2.44 The migratory fish species/life stages with the greatest sensitivity to underwater noise are adult twaite shad and adult allis shad (both species are fish in which the swim bladder is involved in hearing) during their upstream migrations in March to June (see Table 5.1), and juvenile Atlantic salmon (fish with swim bladders in which hearing does not involve the swim bladder) during their downstream migration in April to June. This migration of Atlantic salmon smolts into the marine environment is thought to be a particularly critical stage in the life cycle of salmon, as they are vulnerable to marine predators and changes to environmental conditions which may affect food availability (Potter and Dare, 1993). Atlantic salmon post smolts also make limited use of estuarine environments as they migrate to offshore feeding grounds (Malcolm *et al*., 2010).

5.2.45 Although these species are present in the estuary at other life stages (e.g. juvenile shad migrating downstream and adult Atlantic salmon), the aforementioned life stages are considered to be the most sensitive to potential barrier effects/disruption to migration as a result of noise and vibration. Adult Atlantic salmon and juvenile shad have less restricted upstream and downstream migration periods than the aforementioned life history stages. In addition, juvenile shad are known to use estuaries (e.g. the lower River Usk and Severn Estuary) as nursery habitats (OSPAR Commission, 2009). The implication of any potential short term disruption of downstream juvenile shad migration at the M4CaN Usk crossing would therefore be less significant than disruption to downstream migration of Atlantic salmon smolts, which make little use of estuarine environments when migrating to offshore feeding grounds. Atlantic salmon undertaking upstream migration, sea lamprey (upstream and downstream migration) and river lamprey (all life history stages) and allis and twaite shad

(juvenile downstream migration and feeding), also have reduced sensitivity (although it should be noted that these species are still considered to be sensitive at these life stages).

5.2.46 The period of highest sensitivity for underwater noise related impacts on migratory fish in the River Usk is considered to be April to June (inclusive; see Table 5.1). Therefore, although the source levels associated with the vibropiling and bored piling are anticipated to be low, based on a precautionary approach, as explained at paragraph 5.2.28, restrictions on the timing of piling for the east pylon of the River Usk crossing have been agreed with NRW. On the basis that coffer dams and pile casings would be installed using vibropiling methods and the main piles would be bored, no other timing restrictions were considered necessary.

5.2.47 This assessment has been based on the interim sound exposure guidelines for continuous sounds proposed by Popper *et al*. (2014) using current information. In some cases, such as for recoverable injury and TTS in fish possessing swim bladders involved in hearing, numerical guidelines are provided. In most instances, numerical guidelines do not exist because of lack of data and therefore the relative likelihood of effects occurring for three distances from the source - near (i.e., tens of metres), intermediate (i.e., hundreds of metres), and far (i.e., thousands of metres) - were assessed in Popper *et al*. (2014). For the purposes of this assessment, the near field can be assumed to be those piles associated with the east pylon on the bank of the River Usk, whereas the intermediate field can be assumed to include the remaining piles required for the River Usk Crossing (i.e., piles associated with the east and west approach viaducts and the east and west abutments).

5.2.48 On the basis of the Popper *et al*. (2014) guidelines, together with the magnitude of the noise likely to be generated as a result of vibro and bore piling, the risk to all fish, including migratory fish, from mortality and potential mortal injury as a result of the continuous sound produced by the vibratory piling, even in close proximity to the source (i.e., tens of metres) is considered to be low.

5.2.49 According to the relative likelihood of behavioural effects occurring, as proposed by Popper *et al*. (2014), the risk of twaite and allis shad experiencing behavioural effects in the near field (i.e., vibropiling for the east pylon and cofferdam) is high and for Atlantic salmon is moderate. It should be stressed however, that the duration of this piling would be short term and intermittent (i.e. 15-20 minutes vibropiling per pile casing) over the entire construction phase and therefore although short term effects may occur, piling would not represent a barrier to migration over the whole construction period. During vibropiling at Red Funnel's Southampton Terminal in Southampton Water, monitoring of caged trout revealed no evidence that trout reacted to vibropiling even at a close range of less than 50 m. It should be noted however that trout are expected to be less sensitive to piling than salmon (Nedwell *et al*., 2003).

5.2.50 Sea lamprey have been reported to respond to low frequencies (20-100 Hz) (Lenhardt and Sismour, 1995), though it has been suggested that sound may not be relevant to lamprey species at all (Popper, 2005). Therefore, although uncertain, the sensitivity of lamprey species to underwater noise and vibration is likely to be less than that for shad and Atlantic salmon.

5.2.51 Newport is a key port for freight and during 2013 a total of 806 ships were received at Newport, the majority of which (84%) were cargo (DfT, 2015). As the noise likely to arise from the vibropiling is predicted to be of a similar nature to that of a small work boat and noise associated with larger cargo vessels would be higher (Wyatt, 2008), then some habituation to noise may be anticipated for the fish assemblage in the area. However, this may not be true of migratory species and the sound levels generated by the piling for the M4CaN, albeit intermittent, may occur more frequently than those associated with vessel traffic.

Summary of effects of noise

5.2.52 Based on the information provided above (and in Chapter 10 of the March 2016 ES), effects on river and sea lamprey are considered to be limited. This is on the basis that the hearing frequencies for sea and river lamprey are unlikely to overlap with those generated by the proposed piling activities.

5.2.53 With respect to allis and twaite shad and Atlantic salmon, the noise levels produced within the water column are likely to be low and piling operations would be intermittent occurrences during the construction phase. However, since the pathways by which noise generated on land may transmit through the ground to the water column are not well understood, a precautionary approach has been made to the assessment (i.e. assuming that piling noise would be introduced directly into the marine environment; see paragraph 5.2.27). Mitigation has been proposed to reduce the risk of behavioural effects on these species/life history stages (see paragraph 5.2.73 and Chapter 10 of the March 2016 ES, Section 10.9).

5.2.54 Commitment 95 (previously 63) sets out the position regarding the timing of piling for the east pylon of the River Usk Crossing. Piling to install the cofferdam and pylon piles for the east pylon of the River Usk Crossing would be scheduled to avoid the period of highest sensitivity for underwater noise related impacts on migratory fish in the River Usk (April to June inclusive). Outside of the period 1st April to 30th June there would be no restrictions on the timing of piling activities. In the exceptional circumstance that piling is required within the period 1st April to 30th June, piling activities would not take place during the period from 3 hours before high water to one hour after high water.

5.2.55 The implementation of a seasonal restriction on piling activities for the east pylon of the River Usk crossing, as set out in paragraph 5.2.28, would ensure the avoidance of any behavioural effects, including potential disruption of migration or barrier effects, on allis and twaite shad during their spawning migration and Atlantic salmon smolts during their seaward migration. This restriction would also reduce effects on juvenile allis and twaite shad during their downstream migration and adult Atlantic salmon during their spawning migration, as the migration periods for these life history stages also coincide with the seasonal restriction. In addition, the designed in measures to reduce the duration of piling (i.e. piling primarily daylight hours and short term duration of vibropiling) would ensure that piling during the construction phase occurs intermittently and would not represent a barrier to migration over the whole construction period (should any barrier effects occur at all).

5.2.56 The effects of noise during construction on the conservation objectives of the migratory fish features of the River Usk are considered in paragraph 5.2.80.

M4CaN bridge lighting shining on water causing behavioural/barrier effects

5.2.57 Chapter 10 of the March 2016 ES assesses the impacts of artificial lighting on fish migration through the River Usk during the construction phase (Section 10.8) and the operational phase (Section 10.9).

Construction

5.2.58 As explained in Chapter 10 of the March 2016 ES, lighting would be used during the construction phase both to illuminate required works, as necessary, and to mark structures for public safety. There is thus the potential for light spillage onto the River Usk and River Ebbw during construction. This could have effects on fish behaviour, including disruption or disorientation during migration, and potential barrier effects.

5.2.59 In the absence of light, migratory fish, such as salmonids, travel quickly through large rivers (Økland *et al*., 2001) that are more likely to have sub-optimal temperatures or increased pollutants, but the disorientation caused by urban lights could increase the time these fish spend in polluted environments and, as a result, increase their risk of mortality (McCormick *et al*., 1998). In salmonids, the downstream smolt migration usually takes place during the night, which is likely to be an anti-predator tactic (Riley *et al*., 2002). The dispersal of fry has however shown to be both delayed and disrupted by 12 lux intensity street lamps (Riley *et al*., 2013) and also at lower intensity light levels of 1 to 8 lux (Riley *et al*., 2015).

5.2.60 The area in the vicinity of the River Usk crossing currently includes industrial docklands and Newport city centre, and the Transporter Bridge and Southern Distributor Road bridge (both of which are lit at night), and therefore there is existing lighting in the vicinity of the River Usk and to a lesser extent the River Ebbw. However due to the sensitivity of the migratory fish features of the River Usk during their migratory period, there is potential for additional disruption to migration as a result of the Scheme.

5.2.61 As explained in paragraph 5.2.74 below, as part of the CEMP, lighting required during the construction of the Scheme would be designed and located to ensure that the working areas are precisely lit with minimal light spill to watercourses including the Rivers Usk and Ebbw, as well as reens and ditches. This is further considered with respect to the Severn Estuary Ramsar Site in Section 5.5).

5.2.62 The careful design and siting of construction lighting to avoid directly illuminating the waters of the River Usk and the River Ebbw would reduce the potential for adverse behavioural effects on migratory fish species during the construction phase.

Operation

5.2.63 As detailed in paragraph 2.8.1 of this document and Chapter 2: Scheme Description of the March 2016 ES, lighting is proposed on the approaches to the Docks Way Junction and over the full extent of the River Usk Crossing. The clearance between the mean high water level and the centre of the Usk crossing bridge will be 37.6 m at the centre of the span, with lighting columns a further 12 m above the deck level. The use of LED luminaires is proposed and these would be designed to ensure light spillage is minimised, particularly over the River Usk.

5.2.64 As discussed in paragraph 5.2.59 above, artificial lighting has the potential to disorient migrating fish and create a barrier to migration. This may be of particular relevance for the downstream migration of salmonids which is known to occur primarily at night.

5.2.65 The careful design and siting of lighting on the River Usk Crossing to ensure the channel and banks of the River Usk and the River Ebbw are not directly illuminated would reduce the potential for adverse behavioural effects to migratory fish during operation of the Scheme.

5.2.66 The effects of light during construction and operation of the M4CaN on the conservation objectives of the migratory fish features of the River Usk are considered in paragraph 5.2.80.

Mitigation Measures

5.2.67 The following mitigation measures would be implemented as part of the M4CaN project to ensure the project does not adversely affect the conservation objectives for the migratory fish features of the River Usk SAC. These measures are either embedded, i.e. designed into the M4CaN Scheme, or additional, i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Chapter 10, Section 10.5 for further detail of embedded and additional measures). These measures (both embedded and additional) are considered, together with the supporting information in the preceding paragraphs, in the context of the conservation objectives for the River Usk SAC in paragraph 5.2.78 *et seq.*

Water Quality

5.2.68 Implementation of appropriate measures within the CEMP, specifically the Surface Water Management Plan and Pollution Prevention Plan which would detail measures to reduce any potential increases of sediment and/or prevent the release of any contaminants into the River Usk.

5.2.69 The Pollution Prevention Plan would follow best practice guidance and NRW Pollution Prevention Guidelines (PPGs) when working near watercourses including:

- PPG1 General Guide to the Prevention of Pollution.
- PPG2 Above ground oil storage tanks
- PPG5 Works and Maintenance in or near water.
- PPG6 Working Construction and Demolition Sites.

5.2.70 Specific measures in the Pollution Prevention Plan would be in accordance with Ciria Technical Note C648 (Control of water pollution from linear construction projects) and would include:

- General good practice with regard to storage of pollutants.
- Appointment of an environmental manager whose responsibility would be to ensure that pollution control is managed and a construction Project Manager who would ensure correct procedures are followed.
- Emergency procedures for spill events, including training of construction staff.

- Training and auditing of all staff and contractors to ensure they are able to respond appropriately to pollution events.
- Implementation of pollution incident control procedures including fuel spills and chemical spills by deployment of oil booms and filtration systems, including straw bales and silt traps.

5.2.71 The Surface Water Management Plan (SWMP) would consider all drainage required during the construction phase and would reference all industry and regulatory pollution prevention guidelines (see Chapter 16: Drainage and the Water Environment). The SWMP would describe the design of each element of the surface water management system required to manage surface water run-off during construction and potential risks to surface waters. This would include temporary storage and settlement requirements to manage sediment load of waters by capturing surface runoff and conveying these to these temporary water treatment areas. The SWMP would define the water quality criteria to ensure any discharge to receiving water courses meets regulatory requirements. The SWMP would also define an appropriate monitoring regime to ensure water quality would be protected to the satisfaction of the regulatory authorities. The SWMP would consider discharges to reens and tidal water as required (see Section 6 for details of monitoring). Should settlement not be sufficient to meet standards for discharge, additional mitigation that may be required periodically to achieve acceptable discharge quality includes the use of pumps, flocculation devices, filtration media, other specialist treatment equipment or off-site disposal as a worst case contingency.

Noise and Vibration

5.2.72 Design of the crossings of the rivers Usk and Ebbw has avoided construction within the wetted channels of the rivers.

5.2.73 Commitment 95 (previously 63) sets out the position regarding the timing of piling for the east pylon of the River Usk Crossing. Piling to install the cofferdam and pylon piles for the east pylon of the River Usk Crossing would be scheduled to avoid the period of highest sensitivity for underwater noise related impacts on migratory fish in the River Usk (April to June inclusive). Outside of the period 1st April to 30th June there would be no restrictions on the timing of piling activities. In the exceptional circumstance that piling is required within the period 1st April to 30th June piling activities would not take place during the period from 3 hours before high water to one hour after high water.

Lighting

5.2.74 Lighting required during the construction of the Scheme would be inward facing at all construction compounds and located to ensure that the working areas are precisely lit with minimal light spill to watercourses including the Rivers Usk and Ebbw as well as reens and ditches. Details of the implementation of these measures would be presented in the CEMP.

5.2.75 Lighting of the operational M4CaN is described in Section 2.8 and in Chapter 2 of the March 2016 ES. Implementation of an effective lighting strategy for the operational M4CaN would include directional lighting to minimise spillage onto the River Usk and other watercourses (e.g. River Ebbw and reens and ditches of the Gwent Levels).

5.2.76 Luminaires would be designed to emit no light above the horizontal level. LED luminaires are proposed, as these can be aimed more precisely, reducing light spill.

5.2.77 Warm white LEDs would be favoured where practicable.

Effects of the M4CaN on the Conservation Objectives for migratory fish

5.2.78 Adverse effects (including barrier effects) on the qualifying migratory fish species of the River Usk SAC are not predicted to occur as a result of the M4CaN during construction or operation. Potential effects on the relevant conservation objectives (as presented in paragraph 5.2.12) are discussed in turn below, including consideration of whether the Scheme has the potential: to interrupt progress or cause delays towards achieving these conservation objectives; to disrupt the factors which help maintain favourable condition; and/or to interfere with the balance, distribution and density of key indicator species of favourable condition of the River Usk SAC. Each of the favourable conservation status components (in italics) are considered in turn.

The conservation objectives for the River Usk watercourse must be met. This includes the sufficiency of the ecological status of the water environment to maintain a stable or increasing population of each feature/species, with elements of water quantity, quality, physical habitat and community composition and structure.

5.2.79 The conservation objectives for the River Usk water course (including sufficiency of the ecological status of the water environment, with elements of water quantity, quality, physical habitat and community composition and structure) would not be affected by discharges from the M4CaN due to the low levels of any potential contaminants and suspended sediments which would be discharged into the River Usk and River Ebbw, and the high dilution from the points of discharge.

5.2.80 This conservation objective would not be affected by lighting of the M4CaN during construction or operation of the M4CaN Scheme or construction-related or operational underwater noise associated with the M4CaN Scheme.

The population of the features in the SAC is stable or increasing over the long term.

5.2.81 The ability of the population of the migratory fish features in the SAC to be stable or increasing over the long term would not be affected by release of pollutants from the M4CaN.

5.2.82 The ability of the populations to be stable or increasing over the long term would not be affected by underwater noise associated with construction or operation of the M4CaN, as delays, interruption or disruption to migration are not predicted to occur due to the low noise levels predicted, the intermittent and short term duration of construction noise and the precautionary mitigation to be implemented, avoiding piling of the east pier of the River Usk crossing during the most sensitive migration periods.

5.2.83 The ability of the populations to be stable or increasing over the long term would not be affected by lighting of the M4CaN, due to implementation of appropriate measures during construction and operation to minimise light spillage onto the River Usk and River Ebbw, avoiding any disruption to migratory behaviour.

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.

5.2.84 By avoiding construction in the wetted channel of the River Usk, the M4CaN Scheme would not affect the hydrological or geomorphological processes and forms of the river which provide suitable habitat to maintain the natural ranges of the migratory fish features of the River Usk SAC.

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.

5.2.85 The M4CaN Scheme would not affect the extent of the habitat of the River Usk, nor its ability to support the migratory fish features of the SAC on a long term basis.

In-combination Assessment

5.2.86 The plans and projects considered within this in-combination assessment are presented within Section 4.2. As explained in Section 4.2, the outline nature of the plans and the strategic nature of the plan-level assessments (due to insufficient detail on projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN.

5.2.87 The plan-level HRAs concluded that the plans will not have an adverse effect on the conservation objectives of the migratory fish features of the River Usk SAC, particularly when the appropriate avoidance and mitigation measures identified in the plan-level HRAs are implemented.

5.2.88 When the projects under these plans come forward, these will need to undertake specific, detailed assessments of the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment. This was the case for the two residential developments discussed in paragraph 4.2.8 which, along with a number of wind turbine projects listed in Table 4.3 and the two flood defence schemes within the River Usk (see paragraph 4.2.10), had the potential to have LSEs on migratory fish features of the River Usk SAC (i.e. effects of noise or water quality). However, with appropriate mitigation measures of a similar nature to those described above for the M4CaN, LSEs or adverse effects on the integrity of these features of the SAC are not predicted to occur.

5.2.89 As explained in paragraph 4.2.5, the Cardiff and Newport Tidal Lagoon projects also have the potential to affect migratory fish species listed as features of the River Usk SAC (and Severn Estuary SAC and Ramsar). Effects may include disruption to migration through construction noise or changes in the hydrodynamic regimes of the Severn Estuary and River Usk. Due to the early nature of the development plans for these projects, however, it is not possible to undertake an in-combination assessment of these projects with the M4CaN.

European Otter

5.2.90 Potential for LSEs on European otter include:

- Habitat loss/fragmentation if otter habitats (i.e. breeding sites, resting sites, foraging areas and commuting routes) are present along or in the vicinity of the M4CaN route (construction);
- Physical presence of the M4CaN Scheme leading to displacement/barrier effects and a temporary (construction) or long term (operation) restriction in movement;
- Risk of injury/becoming trapped in excavations during construction and potential vehicle collisions (construction and operation);
- Release of pollutants into watercourses leading to water quality changes and potential for physiological changes (e.g. toxicological) which in turn could impact upon otters and/or their prey (construction and operation);
- Noise and vibration leading to disturbance/displacement and potential barrier effects (construction and operation); and
- Visual disturbance and lighting leading to barrier effects and restriction to movement (construction and operation).

Baseline

5.2.91 Otters were widespread throughout the UK up until the 1950s when they underwent a rapid decline through to the 1970s. This was largely the result of the use of organochlorine pesticides, exacerbated by hunting and habitat fragmentation. There has since been a significant recovery in the number and range of otters in England and Wales and environmental improvements attributed to this recovery have included a ban on the harmful pesticides and improvements in pollution control and water quality, which in turn have benefitted fish prey.

5.2.92 The Third Report by the United Kingdom under Article 17 on the implementation of the Habitats Directive from January 2007 to December 2012 reported the UK-wide population size to be an estimated maximum of 13,314.

5.2.93 In 2003, the Natura 2000 Standard Data Form for the River Usk SAC reported the estimated size of the resident otter population to be between 11 and 50, or up to 0.34% of the 2012 UK population.

5.2.94 Locally, otter numbers are believed to be increasing and populations are known to utilise the Rivers Usk, Ebbw and Rhymney as well the reens of the Gwent Levels SSSIs and the Monmouthshire-Brecon Canal (Newport Biodiversity Partnership, 2015).

5.2.95 Since 2000, otters have inhabited most stretches of the River Usk upstream of Newport, and several tributaries further upstream and north of Newport, including the Honddu, Senni and Crai (Strachan 2015). The otter survey of Wales completed between 2009 and 2010 as part of the national otter survey (Strachan 2015) covered a total of 62 survey sites along the River Usk. Results of the survey confirmed the presence of otters at 55 or 88.7% of the survey sites, an increase of 7 sites or 8.7% since 2002. Currently there is no method of estimating the density of an otter population based on the density of otter field signs (Strachan 2015) and, therefore, an increase in the number of sites where otter signs were recorded may not necessarily mean an increase in otter numbers. However, the methodology of the survey was designed to detect trends in relative abundance, and the results clearly indicate a relative increase in the size of the otter population in the River Usk SAC.

5.2.96 The ecology desk study undertaken in 2015 to inform the Environmental Impact Assessment of the M4CaN Scheme (Appendix 10.17 of the March 2016 ES) identified numerous records of otters throughout the study area, which comprised the M4CaN site and a 2 km wide surrounding buffer zone. The records focused around the main rivers (Usk, Ebbw and Rhymney) and were scattered across the Gwent Levels.

5.2.97 In 2014, an otter survey was undertaken of the physical extent of the 2007/2008 Scheme, which overlaps the existing M4CaN Scheme, with a 500 m wide surrounding buffer zone (Appendix 10.8 of the March 2016 ES). Of the 1,442 waterbodies that were included in the study area, otter field signs were located along 18 surveyed waterbodies, or approximately 1 in 80 watercourses surveyed. Field signs recorded included otter slides and footprints on the banks of waterbodies adjacent to the River Usk. No other signs were recorded close to or along the River Usk; however, changing water-levels along this tidal river are likely to have impacted upon on the durability of field signs such as footprints.

5.2.98 In 2015, a further survey was undertaken of previously unsurveyed watercourses within the boundaries of the M4CaN development site plus a 100 m wide surrounding buffer zone (Appendix 10.25 of the March 2016 ES). A total of 58 previously unsurveyed waterbodies were inspected for signs of otter presence; however, no field signs were recorded, despite there being an abundance of suitable habitat.

5.2.99 The relatively low number of waterbodies in which evidence of otter activity was recorded in 2014 and 2015 surveys (Appendices 10.8 and 10.25 of the March 2016 ES) indicates that although otters are present, they are widely dispersed and at low densities.

5.2.100 NRW had reported the presence of a potential otter holt on the Docks Way Landfill site adjacent to the eastern bank of the River Ebbw, and this reflected the desk study information for this area. An otter survey of the landfill was completed during 2016 (as reported in the September 2016 ES Supplement), with follow up surveys in early 2017. Although spraints were recorded, no breeding or resting sites were found. Many of the areas shown on earlier aerial imagery as being of potential value to otters were found to have been infilled and/or were located within the areas of recent disturbance. Therefore, although there is continued evidence of otter presence in this area, it is now unlikely to support a breeding site owing to the level of disturbance and limited vegetation cover.

Potential Effects on the Conservation Objectives

5.2.101 The conservation objectives for the features of the River Usk SAC are provided in Appendix C1, including the vision for European otter (i.e. that it is to be in a favourable conservation status, where all the conditions detailed below are satisfied). The favourable conservation status components for European otter in the River Usk SAC are summarised here:

- 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.
- 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 River Usk SAC is considered to form potentially suitable breeding habitat for otters. 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.

- 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.

5.2.102 The following sections provide an assessment of the effects of the Scheme on the conservation objectives above, with the assessment undertaken under headings for the potential LSEs listed in paragraph 5.2.90 above. The assessments also consider mitigation to be implemented as part of the project for otter (paragraph 5.2.134 *et seq*.). The effects on conservation objectives for otters of the River Usk SAC (and thereby potential for adverse effects on integrity of the feature) are then considered for each conservation objective in turn using the information presented within the assessments below (see paragraph 5.2.166 *et seq*.). Effects on the integrity of the River Usk SAC are considered in paragraph 5.2.183, with consideration of effects on the conservation objectives of both migratory fish and otters.

Land take - habitat loss/fragmentation of otter habitat (construction)

5.2.103 In order to construct the eastern pylon for the crossing of the River Usk, there would be some land take along the margins of the river, which would reduce the width of the corridor available for commuting otters. Therefore, the working area would be reduced as much as practicable in order to minimise the land take.

5.2.104 The western pylon of the river bridge would be located on existing developed land in the adjacent Alexandra Docks and, therefore, would be outside of the river channel.

5.2.105 Otters from the River Usk SAC are also considered likely to utilise habitat within the adjacent Gwent Levels and, therefore, loss of habitat from the Gwent Levels could impact upon individual otters from the SAC or individuals that otters from the SAC could interact with.

5.2.106 The total extent of habitat within the Gwent Levels of potential value to otters that would be lost to construction would include 2,755 m of reens, 9,373 m of field ditches and 6.59 ha of reed beds. Across the scheme as a whole, 49 ha of woodland and 35.8 km of hedgerows would be lost. The mitigation proposed for the Scheme (as shown on the EMP, Figure R2.6 of the September 2016 ES Supplement and described in Section 10.5 of Chapter 10 of the March 2016 ES) would result in replacement and for some habitats substantial increases in extent of habitat of potential value to otters. As explained in the Supplementary File note on the Reen Mitigation Strategy (September 2016 ES Supplement Appendix S2.1) 2,826 m of new reens and 10,594 m of new ditches would be established. This gives a ratio of new to lost of approximately 1:1 for reens and ditches. 9.9 ha of new reedbeds would be established, principally in the water treatment areas (a replacement ratio of 1.5:1) The extent of woodland planting would be 104.4 ha (a ratio of 2.1:1). NRW have indicated that hedgerow planting would not be appropriate within the Gwent Levels SSSIs. This is because hedgerows

along the field boundaries can result in overgrowth/shading of the reens and field ditches with adverse effects on aquatic macrophytes and invertebrates which are the important features of the SSSIs.

Physical presence - barrier to the movement of otters

5.2.107 The east pylon and associated construction areas would be located on the east bank of the River Usk and would extend to the wetted channel (defined as Mean High Water). Although otters would be able to move along the river channel at and below Mean High Water, in order to minimise the impact of potential disruption to movement and provide a passage for otter movement above Mean High Water, two tunnels would be constructed beneath the access roads to the east pier construction compound (as shown on the plan at Annex 21 of the Buildability Report which is Appendix SR3.1 of the December 2017 ES Supplement). The tunnels would comprise pipes of 900 mm diameter, and would be 10 m and 12 m in length, respectively. They would be laid straight to allow good air flow and encourage use by otters, as recommended in the DMRB (Highways Agency 2001a). The construction site boundary would be fenced with mammal exclusion fencing suitable for otters (as described in Highways Agency 2001a) and the fence line would be located to direct otters into the 900 mm tunnels.

5.2.108 This assessment has taken into account that otters from the River Usk SAC do use watercourses/waterbodies and associated terrestrial habitat on the Gwent Levels and could interact with otters from the Levels. However, there would be only limited interaction. This is not only because there is only limited connection between the SAC and the Levels (most likely via Julian's Reen in Newport and from the estuary (through the Newport Wetlands SSSI on the eastern side, where there have been several records of otter activity), but also because the majority of the River Usk's otter population is located to the north of Newport (where by far the greatest proportion of the SAC occurs). Given that the Scheme would not impact upon movement of otters along the river, it would not compromise the ability of the otters from north of Newport to access the Levels, should they wish to. It also would not affect the ability of the small proportion of the population that is south of Newport to access the Levels.

5.2.109 The construction and operational corridors of the Scheme could present a barrier to the movement of some otters from the SAC across the Gwent Levels, and/or affect the ability of otters from the Gwent Levels to interact with otters in the SAC. Therefore, reens crossed by the M4CaN route would be retained and culverted using box culverts. An adjacent dry culvert would be provided at each reen crossing, for use in times of flood, and otter ledges would also be provided where practicable. In addition, dry mammal crossings/underpasses would be constructed at other locations along the route of the new road (as shown on the EMP (Figure R2.6 of the September 2016 ES) and on Figure 2 of this report, and as described in Chapter 2 of the March 2016 ES). Details of the culvert provisions on watercourses where otters have been recorded are provided in Table 5.2.

Table 5.2: Culverts and Reen Bridges across watercourses where otters have been recorded

Ref	Chainage	Name of crossing, Figure 2	Details
SBR 0580	5,775	Percoed NMU Bridge	Proposed structure to carry the Newport/Cardiff cycle way over the proposed new section of motorway. Structure consists of multi-span steel structure supported on bearings on reinforced concrete piers. Length of spans would vary between 12 m and 13 m. Overall length of structure: 188 m.
SBR 0590	N/A	Percoed Reen NMU Bridge	Proposed structure to carry the Newport/Cardiff cycle way over Percoed Reen. Structure consists of single span steel and timber structure. Bridge would have clear span of 11.6 m.
SMN 0775	7,750	Old Diary Reen Culvert	Structure carries realigned Old Dairy Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 2.1 m x 3.0 m x 62 m.
SBR 1480	14,900	Monk's Ditch Bridge	Structure carries Monk's Ditch. New section of motorway would pass over this structure. Single span box culvert. Internal dimensions 4.2 m x 2.1 m x 95 m.
SBR 1755	N/A	Middle Road Reen Bridge	Structure carries realigned Middle Road Reen. The realigned North Row would pass over this structure. Single span box culvert. Internal dimensions 4.2 m x 2.1 m x 18 m.
SBR 1770	N/A	North Row Middle Road Diversion Reen Bridge	Structure carries realigned Middle Road Diversion Reen. The realigned North Row would pass over this structure. Single span box culvert. Internal dimensions 4.2 m x 2.1 m x 25 m.
SBR 2140	21,375	Mill Reen Culvert	Proposed extension to existing culvert carrying Mill Reen. New section of motorway would pass over this structure. Existing structure is an *in situ* reinforced concrete arch roof structure. Proposed extension would be similar in form and appearance. Proposed structure would have a clear span of 6 m, a clear height of 4 m above the right of way and a length of 135 m.

5.2.110 The culverts, dry underpasses and mammal crossings would be constructed early on during construction (see paragraph 2.3.1) to help minimise the impact on aquatic species movement across the Scheme. Temporary pipes would be installed within the existing reens and ditches early in the construction programme to maintain connectivity of the watercourses, and these would be replaced by permanent culverts once the haul road has been constructed. The

sequence of construction of culverts across the Gwent Levels is shown in the plans at Annex 7 to the Buildability Report, which is Appendix SR3.1 of the December 2017 ES Supplement.

5.2.111 In order to help guide otters into culverts and dry mammal crossings, mammal exclusion fencing suitable for otters would be installed around the operational boundaries of the M4CaN route and up to entrances to culverts, underpasses and mammal crossings, in accordance with guidelines in the Design Manual for Roads and Bridges (DMRB) (Highways Agency 2001a).

Risk of injury on construction site/becoming trapped in excavations during construction and potential collision effects

5.2.112 Taking into account the extent of the M4CaN construction corridor, the nature of construction works (including major works such as piling and major excavation), and the amount, size and/or type of vehicles, machinery and equipment that would be required, construction works could present a risk of injury or fatality to any otters that might enter the site.

5.2.113 Although the River Usk would be crossed by a bridge, there would be the potential for otters to enter the construction corridor or the new road either side of the bridge. In addition, taking into account the fact that the Scheme would cross several watercourses where signs of otter activity were recorded in 2014 and 2015 (Appendices 10.8 and 10.25 of the March 2016 ES), the M4CaN across the adjacent Gwent Levels could present a risk of vehicle collision during construction or operation.

5.2.114 Otter fatalities due to collisions with road vehicles are on the increase (Strachan 2015). A study by Philcox *et al*. (1999) reported a rapid increase in road deaths since 1983. The study recorded a significant bias towards males (56%) and highlighted a correlation with river flow or rainfall. The majority (67%) of fatalities were recorded within 100 m of fresh water or the coastline and 91% of accidents were recorded where a road crossed a watercourse.

5.2.115 Although the continuing increase in the national otter population implies the increase in road fatalities is not having a significant effect on national populations (Chanin, 2006; Grogan *et al*., 2013), vehicle collisions could nevertheless have an impact on the local population, depending on the number, sex, age and breeding status of the otter population.

5.2.116 A means of escape from larger excavations (i.e. greater than 0.5 m deep) would be provided as necessary, such as the provision of a plank of wood against the walls of an excavation to act as a ladder, or the profiling of at least one wall of an excavation to provide a gentle slope that otters could use to walk out of the excavation.

5.2.117 Toxic or otherwise potentially harmful stored materials or equipment would be secured against possible access by otters.

5.2.118 An emergency procedure in the event of encountering an otter or potential otter rest/holt would be given to contractors. An appropriately qualified and experienced ecologist (who could be the ECoW) would attend the site as soon as practicable in order to confirm reports of otter activity, and to assess the need for further surveys to confirm the presence of otter holts/resting places and/or the need for a development licence for otters to enable works to recommence.

Release of pollutants leading to water quality changes/physiological effects which in turn could affect prey populations

5.2.119 Construction would result in the production of dust and run-off, and the installation of culverts and connection of new watercourses to existing watercourses would result in direct physical disturbance of watercourses, which in turn could result in an increase in sediment load and a potential temporary reduction in water quality and flow. These impacts could affect both the watercourses and potential otter prey that may be present.

5.2.120 Therefore, with regard to the handling and storage of potentially hazardous liquids, response to spillages, provisions for surface water drainage (including interception of oil and sediment) and dust control, construction would be undertaken in accordance with the:

- Pollution Control and Prevention, Ground and Surface Water, Materials and Site Waste Outline Management Plans;
- Outline Construction Environmental Management Plan;
- Legislative requirements; and
- NRW best practice guidelines.

5.2.121 Measures would include the appropriate locating of soil, equipment and vehicle storage sites away from sensitive areas, including the River Usk and other main watercourses and reens.

5.2.122 As explained in Chapter 16: Road Drainage and the Water Environment of the March 2016 ES, Re-use Target Concentrations have been developed that ensure no unacceptable impact to surface water quality would occur. The Re-use Target Concentrations for soils developed for the new section of motorway would be presented in the Remediation Strategy for the Scheme. This would ensure that infiltrating water through the permanent works would have a negligible impact on water quality of the surface water within the Gwent Levels.

5.2.123 Surface water run-off from the new motorway would be managed via grassed verge channels and Water Treatment Areas (including reed beds), in order to remove particulate and chemical pollutants before discharging in to main reens.

5.2.124 With the above pollutant management measures in place, there would be no significant adverse effect on water quality in the River Usk SAC and across the Gwent Levels during construction or operation and, therefore, no impact on otters, their population size and range, would be expected as a result of changes in water quality.

Noise and vibration - disturbance and barrier effects

5.2.125 Although otters have been observed on construction sites during the daytime, measures would be set in place to limit the potential impact of noise during construction, and would include:

- Measures to control noise and vibration during construction would be included in the CEMP and these are referred to in section 6.8 of the pre-CEMP (Appendix SR3.2 of the December 2016 ES Supplement).

- Normal working hours would be 07:00 to 19:00 Monday to Friday and 07:00 to 17:00 on Saturdays, excluding public holidays. The majority of construction activities would be undertaken within this period. In certain circumstances, specific works may have to be undertaken outside the normal working hours. Night working would also be required in some cases but. whenever practicable, construction would be limited to day-time hours, when typically otters are not moving around.
- Use of silenced or quieter plant where available and turning off plant when not in use.

5.2.126 These measures would ensure that the impacts of construction noise on otters are minimised. As concluded at paragraph 5.2.82, underwater noise associated with construction of the River Usk crossing would not have a significant long term adverse effect on the fish population in the River Usk SAC, a source of food for the SAC otter population.

Visual disturbance and lighting impacts - barrier effects

5.2.127 Although otters are known to travel through built-up areas, lighting can result in a disturbance impact on otters (Highways Agency 2001a).

5.2.128 During the construction period, lighting would be provided as necessary during normal working hours in the autumn and winter and for night time working. Night working could be undertaken along the M4CaN route including in the River Usk SAC. Security lighting would be provided at construction compounds on a 24-hour basis.

5.2.129 During the operational phase of the Scheme, lighting would be installed along sections of the M4CaN route as shown on Figure 2.

5.2.130 As described in Chapter 2 of the ES, operational lighting would be installed at the following locations:

- The approaches to and throughout the Castleton Interchange;
- The approaches to the Docks Way Junction and over the full extent of the River Usk Crossing;
- The Glan Llyn Junction roundabout and the new link road connecting the new section of motorway with the A4810 and the A4810 junction; and
- The approaches to and throughout the Magor Interchange.

5.2.131 Lighting columns are anticipated to be aluminium and generally to be as described below:

- 15 metres high along the mainline of the new section of motorway;
- 12 metres high along slip roads; and
- 12 metres high on the River Usk Crossing.

5.2.132 In order to minimise the impact of light spill on otters: lighting for specific construction tasks would be set at low level wherever practicable; inward-facing security lighting would be provided at construction compounds; and construction and operational light fittings would be directed towards the road and away from other habitats of potential value to otters (including the River Usk, areas of

woodland and scrub along the banks of the River Usk and in the surrounding Gwent Levels, and culverted reens and dry underpasses along the M4CaN route).

5.2.133 The need for screen fencing around the works area would be considered within 100 m of any holt (that might be identified during pre-construction surveys) to provide additional protection against disturbance from movement during construction.

Mitigation Measures

5.2.134 The following mitigation measures would be implemented as part of the M4CaN project to ensure the project does not have the potential to adversely affect the conservation objectives for European otter of the River Usk SAC. These measures are either embedded (i.e. designed into the M4CaN Scheme) or additional (i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Chapter 10, Section 10.5 for further detail of embedded and additional measures)). These measures (both embedded and additional) are considered with the supporting information in the preceding paragraphs, and in the context of the conservation objectives for the River Usk SAC in paragraph 5.2.166 *et seq.*

Habitat Loss/Fragmentation (construction):

5.2.135 The works area within the boundary of the River Usk SAC would be kept to the minimum required.

5.2.136 An underpass would be installed under the works area on the eastern bank of the River Usk, as described below under *Physical presence*.

5.2.137 Site inductions and toolbox talks would include all relevant measures required to protect retained habitat of potential value to otters in the SAC, including the measures to ensure that otters can move past the construction site for the east pylon of the River Usk crossing.

5.2.138 All reens in the adjacent Gwent Levels that would be crossed by the new road would be retained or diverted and culverted with box culverts, as described below (*Physical presence*). Some 2,755 m of reen would be in-filled or culverted. However, these would be replaced by approximately 2,826 m of new reen.

5.2.139 Approximately 9,373 m of field ditches would be in-filled; however, these would be replaced by approximately 10,594 m of new field ditches.

5.2.140 Post-construction habitat replacement would include 104.4 hectares of woodland and linear planting, and 9.9 hectares of reed beds (as shown on Figure R2.6 of the September 2016 ES Supplement and described in Section 10.5 of Chapter 10 of the March 2016 ES).

5.2.141 Retained habitat surrounding any holts and other resting places (if recorded during 2017 and pre-cnstruction surveys) would be protected through works-free buffer zones, fenced as necessary.

5.2.142 Although currently not required to replace any exisiting feature, artificial holt sites would be provided if and where considered necessary or appropriate (in consultation with NRW).

Physical Presence - barrier to movement:

5.2.143 Implementation of appropriate measures within the CEMP (e.g. site inductions and toolbox talks) would include all relevant measures required to protect otters in the River Usk SAC.

5.2.144 Two tunnels would be installed beneath the access roads to the east pier construction compound (as shown on the plan at Annex 21 of the Buildability Report which is Appendix SR3.1 of the December 2017 ES Supplement).. The tunnels would comprise pipes of 900 mm diameter (and 10 m and 12 m in length, respectively) laid straight to allow good air flow and encourage use by otters. The construction site would be fenced and the fence line would be located to direct otters into the tunnels.

5.2.145 Reens would be retained and culverted, with box culverts designed in accordance with guidelines published in Volume 10, Section 4 of the DMRB (Highways Agency 2001a). A separate dry underpass of 900 mm diameter would also be constructed alongside each culvert within the Gwent Levels at a sufficient heightto not be at risk of flooding.

5.2.146 During the further development of the Scheme design, some of the culverts have been icreased in size to increase the likelihood of their use by a range of bat species. Several culverts would also be provided with mammal ledges principally for water voles. These would be at:

SMN-0550	Ch 5,525	Percoed Reen Culvert
SBR-1480	Ch 14,900	Monk's Ditch Bridge
SBR-1780	Ch 17,875	M4 Middle Road Diversion Reen Bridge
SBR-2140	Ch 21,375	Mill Reen Culvert

5.2.147 Both of these measures would further improve access for otters across the Scheme.

5.2.148 Other dry mammal crossings/underpasses would be constructed at locations shown in the EMP within the Gwent Levels (Figure R2.6 of the September 2016 ES). These crossings would be 900mm pipes as explained in March 2016 ES paragraph 10.5.35. Precise locations would be determined at the detailed design stage.

5.2.149 Mammal exclusion fencing suitable for otters would be installed around the construction sites if and where considered necessary.

5.2.150 The operational road would be fenced to prevent otters accessing the highway and to guide them to culverts and mammal crossings in accordance with guidelines published in the DMRB (Highways Agency 2001a). The ECoW would approve the design and installation of the otter fencing.

Risk of injury on construction site/becoming trapped in excavations, vehicle collision risk during construction and operation:

5.2.151 A means of escape from larger excavations (i.e. greater than 0.5 m deep) would be provided, as necessary. Measures could include the provision of a plank of wood against the walls of an excavation to act as a ladder, or the profiling of at

least one wall of an excavation to provide a gentle slope that otters could use to walk out of the excavation.

5.2.152 Toxic or otherwise potentially-damaging stored materials or equipment would be secured against possible access by otters.

5.2.153 An emergency procedure in the event of encountering an otter or potential otter breeding/resting site would be given to contractors. An appropriately qualified and experienced ecologist (who could be the ECoW) would attend the site as soon as practicable to confirm reports of otter activity, and to assess the need for further surveys to confirm the presence of otter breeding/resting sites and/or the need for a development licence for otters to enable works to recommence.

5.2.154 If an NRW licence for otters is required for works to continue, works within a defined area around the breeding resting site would be halted until a licence had been granted. Once a licence has been obtained, works in the area would then be completed in accordance with the requirements of the licence.

5.2.155 If a dead or injured otter is located, the ECoW (or appropriately experienced ecologist instructed by the ECoW) would determine the cause of death, where possible (e.g. through speaking to site workers, inspecting the body and/or investigating site conditions). If the death is considered likely to be a result of construction, the ecologist would assess the need for, and ensure the implementation of, further mitigation.

5.2.156 A report of the findings of the site visit and implications for construction would be produced by the ECoW and provided to the Contractor's Site Manager and to NRW as soon as practicable.

5.2.157 The ECoW would monitor the effectiveness of any new mitigation measures to ensure that any amendments or additional measures are implemented as soon as practicable.

Water Quality

5.2.158 Water protection measures would be implemented in accordance with the CEMP (see 5.2.68 *et seq*).

5.2.159 With regard to the handling and storage of potentially hazardous liquids, response to spillages, provisions for surface water drainage (including interception of oil and sediment) and dust control, in order to reduce the likelihood and likely impact of pollutants, construction would be undertaken in accordance with:

- Pollution Control and Prevention, Ground and Surface Water Management, Materials Management and Site Waste Management Plans;
- the CEMP;
- legislative requirements; and
- NRW best practice guidelines.

Noise and vibration - disturbance and barrier effects).

5.2.160 Although otters have been observed on construction sites during the daytime, the following measures would be set in place to limit the potential disturbance impact:

- Measures to control noise and vibration during construction would be included in the CEMP.
- Whenever practicable, construction would be limited to day-time hours, when, typically, otters are not moving around.
- Use of silenced or quieter plant, where available, and turning off plant when not in use.

5.2.161 Should an otter breeding/resting site or young be found in a location likely to be subject to noise disturbance an appropriately qualified and experienced ecologist (who could be the ECoW) would attend the site as soon as practicable in order to assess the risk of disturbance and to determine whether a development licence for otters would be required to enable works to recommence.

5.2.162 If a licence for otters is required for works to continue, works within a defined area around the breeding/resting site would be halted until a licence has been granted. Once a licence had been obtained, works in the area would then be completed in accordance with the requirements of the licence.

5.2.163 Once construction has been completed, should an otter choose to breed in the vicinity of the new road, it would be considered that the noise and vibration of the new road does not present a significant adverse deterrent and no further mitigation measures would be required.

Visual disturbance and lighting impacts - barrier effects

5.2.164 Measures to prevent light spill would be implemented to avoid lighting of habitats of value to otters including the River Usk, River Ebbw and other watercourses, and areas of woodland and scrub.

5.2.165 Inward-facing security lighting would be provided at construction compounds.

Effects of the M4CaN on the Conservation Objectives for Otter

5.2.166 As described in paragraph 5.2.108, this assessment has taken into account that otters associated with the River Usk SAC could also utilise a proportion of the Gwent Levels that would be affected by the Scheme.

5.2.167 Potential effects on the relevant conservation objectives for otter (as presented in paragraph 5.2.90) are discussed in turn below, including consideration of whether the Scheme has the potential to interrupt progress, or cause delays, towards achieving these conservation objectives, disrupt the factors which help maintain favourable condition, and/or interfere with the balance, distribution and density of key indicator species of favourable condition of the River Usk SAC.

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.

5.2.168 Otter prey abundance would not be adversely affected by potential pollutant events (as described above and concluded for the assessment of effects on migratory fish, paragraph 5.2.78 *et seq*). Mitigation measures would help to ensure the protection of watercourses against any significant effects of pollution during construction and throughout operation and, therefore, would also protect potential otter prey within the River Usk and other watercourses.

5.2.169 As concluded at paragraph 5.2.80, underwater noise associated with construction of the River Usk crossing would not have a significant adverse effect on the fish population in the SAC, a source of food for the SAC otter population.

5.2.170 Taking into account the limited habitat loss within the River Usk SAC that would result due to construction, the installation of underpasses in order to enable otters to continue to access the full length of the SAC during construction, and the commitment to replace reens and ditches of potential value to otters and to maintain their connectivity (paragraph 5.2.107 *et seq*), it is not expected that territories would be significantly impacted upon in the long term.

5.2.171 The Scheme would not, therefore, have any effects that would reduce the carrying capacity of the SAC for otters.

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 River Usk SAC is considered to form potentially suitable breeding habitat for otters. 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.

5.2.172 Taking into account the fact that the River Usk SAC otter population is known largely to inhabit stretches of the river to the north of Newport, and considering the mitigation measures described above (including the medium- to long-term provision of additional habitat of potential value to otters, including breeding otters), it is not expected that land take would result in an adverse effect on the natural range of otters in the SAC.

5.2.173 No otter breeding site is known to be located within the footprint of the M4CaN Scheme, nor in the immediate surrounding area.

5.2.174 Mitigation measures to limit construction and operational light-spill onto surrounding habitat of potential value to otters, including the banks of the River Usk, would ensure that lighting would not impact upon the range of otters in the SAC.

5.2.175 The construction of a bridge over the River Usk and underpasses along the M4CaN route (including beneath working areas along the eastern bank of the River Usk), and the use of mammal exclusion fencing to direct otters towards these safe crossings, would ensure that the road does not represent a barrier to the movement of otters.

5.2.176 The natural range of otters in the SAC would not therefore be affected by the Scheme.

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.

5.2.177 The safe movement and dispersal of otters along the River Usk during construction would be facilitated by the installation of two underpasses beneath the access roads to the working area for the east pylon of the River Usk bridge. Associated mammal fencing would direct otters towards the underpasses. Otters

would also be able to continue to use the open river corridor for movement and dispersal along the river. Therefore, construction would not impact significantly on the movement and dispersal of otters around the SAC.

5.2.178 The safe movement and dispersal of otters along the River Usk in the long term would be facilitated primarily by the construction of a bridge over the River Usk and, should otters from the SAC enter the adjacent Gwent Levels, the maintenance of suitably-designed culverts and underpasses at appropriate locations along the M4CaN route, and the installation of permanent mammal exclusion fencing along the operational boundary of the site to prevent access onto the new road and direct otters towards the safe crossings.

5.2.179 Thus, the SAC otters would continue to be able to move freely within this part of their range, both during the construction and operation of the Scheme.

In-combination Assessment

5.2.180 The plans and projects considered within this in-combination assessment are presented within Section 4.2. As explained in Section 4.2, the outline nature of the plans and the strategic nature of the plan-level assessments (due to insufficient detail of projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN.

5.2.181 It should be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments of the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessments. This was the case for the two residential developments discussed in paragraph 4.2.8 which, along with the two flood defence schemes within the River Usk (see paragraph 4.2.10), had the potential to have LSEs on otters of the River Usk SAC (i.e. effects of noise and habitat fragmentation). However, with appropriate design of these developments and appropriate mitigation measures during the construction phase, LSEs or adverse effects on the integrity of these features of the SAC are not predicted to occur.

5.2.182 With respect to otters as a feature of the River Usk SAC, the Shoreline Management Plan (SMP2) for the Severn Estuary identified potential adverse effects on integrity for otter due to loss of intertidal habitats (i.e. due to coastal squeeze) in the lower River Usk. In order to compensate for this adverse effect on integrity, one of the actions of the SMP2 is to create compensatory habitat to replace the relevant habitats, to maintain the integrity, structure and function of the site and the species it supports (i.e. including otter), and help achieve the relevant conservation objectives of the site/features (Severn Estuary Coastal Group, 2010b).

Effect on Site Integrity

5.2.183 Based on the information presented above, no adverse effect on the integrity of the River Usk SAC (with specific regard to the qualifying fish and otter populations) is predicted as a result of the M4CaN, either alone or in-combination with other plans and projects (accounting for the compensatory measures discussed above for the SMP2).

5.3 Severn Estuary/Mor Hafren SAC

5.3.1 The Screening Assessment identified potential for LSEs on migratory fish species (i.e. sea lamprey, river lamprey and twaite shad), Annex II qualifying species of the Seven Estuary SAC. The LSEs on migratory fish were predicted to occur outside the boundaries of the Severn Estuary SAC (i.e. adults migrating upstream through the Severn Estuary to spawning grounds in the River Usk and juveniles migrating downstream to the Severn Estuary from spawning/nursery grounds in the River Usk) and were identical to those described in paragraph 5.2.1 for the River Usk SAC, namely:

- Release of pollutants into water courses leading to water quality changes and potential physiological/behavioural/barrier effects (construction and operation);
- Noise and vibration leading to disturbance/barrier effects to migratory fish (construction); and
- M4CaN bridge lighting shining on water causing behavioural/barrier effects (construction and operation).

Baseline

5.3.2 The baseline characterisation for migratory fish associated with the Severn Estuary SAC is described in paragraph 5.2.3 *et seq.*, with a summary of migration periods for the migratory fish interest features provided in Table 5.1.

Potential Effects on the Conservation Objectives

5.3.3 The conservation objectives for the migratory fish interest features of the Severn Estuary SAC are provided in Appendix C2. The conservation objectives for these interest features are to maintain the feature in a favourable condition. Appendix C2 provides details of the specific attributes, measures and targets for determining favourable condition for the relevant migratory fish interest features. In summary, the interest features will be considered to be in a favourable condition when, subject to natural processes, the following conditions are met:

- The migratory passage of both adult and juvenile stages of the interest feature is not obstructed or impeded by physical barriers, changes in flows or poor water quality.
- The size of the interest feature's population within the Severn Estuary and rivers draining into it is at least maintained and is at a level which is sustainable in the long term.
- The abundances of prey species forming the interest feature's food resource within the estuary are maintained.
- Toxic contaminants in the water column and sediment are below levels which would pose a risk to the ecological objectives described above.

5.3.4 The following sections provide an assessment of the effects of the Scheme on the conservation objectives above, with the assessment undertaken under headings for the LSEs listed in paragraph 5.3.1. The assessments also consider mitigation to be implemented as part of the project for migratory fish (i.e. those to be implemented for the River Usk SAC; paragraph 5.2.67 *et seq*.). The effects on conservation objectives for the relevant migratory fish features of the Severn

Estuary SAC (and thereby potential for adverse effects on the integrity of the Severn Estuary SAC) are then considered for each conservation objective individually using the information presented within the assessments below (see paragraph 5.3.18 *et seq*.). Effects on the integrity of the Severn Estuary SAC are considered in paragraph 5.3.34.

Release of pollutants into water courses leading to water quality changes and potential physiological/behavioural/barrier effects

Construction

5.3.5 The assessment of the effects of release of pollutants from the M4CaN on migratory fish features of the River Usk SAC (which includes the three species listed as features of the Severn Estuary SAC) during construction is presented in paragraphs 5.2.14 *et seq*.

5.3.6 Chapter 10 of the March 2016 ES presents the assessment of the potential effects of accidental release of pollutants on the estuarine fish assemblage (i.e. including prey species of the qualifying migratory fish species of the River Usk and Severn Estuary SACs). As set out in paragraph 5.2.17, this concluded that effects on these species would be unlikely to occur due to the low likelihood of a spill occurring (noting that best practice measures would minimise the likelihood and magnitude of such a spill) and the rapid dispersion and large dilution of pollutants by the tidal river.

Operation

5.3.7 Effects of release of pollutants on the estuarine fish assemblage during operation of the new section of motorway as a result of routine runoff and pollution events as a result of collisions, were considered in in Chapter 10 of the March 2016 ES. As set out in paragraph 5.2.22 *et seq*. if pollutants did enter these watercourses they would be rapidly dispersed on the surface and in the water column, and subject to twice daily tidal flushing, and so any effects on river water quality would be limited.

5.3.8 The Ebbw outfalls would benefit from treatment in the form of oil interceptors. Since the Usk is an SAC, the Usk outfall would also include the provision of a pollution control lagoon to capture and retain significant pollution resulting from road accidents. These measures would ensure that pollution events associated with collisions are not expected to result in significant effects on estuarine fish populations.

5.3.9 The effects of release of pollution during construction and operation of the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary SAC are considered in paragraph 5.3.19.

Noise and vibration leading to disturbance/barrier effects to migratory fish (construction)

5.3.10 The assessment of the effects of noise and vibration during construction of the M4CaN on migratory fish features of the River Usk SAC (which includes the three species listed as features of the Severn Estuary SAC) is presented in paragraphs 5.2.27 *et seq*.

5.3.11 Chapter 10 of the March 2016 ES also assessed the impacts of underwater noise on the estuarine fish assemblage (i.e. including prey species of the qualifying migratory fish species of the River Usk and Severn Estuary SACs) during construction of the M4CaN. As explained at paragraph 5.2.28, Commitment 95 (previously 63) sets out the position regarding the timing of piling for the east pylon of the River Usk Crossing. Piling to install the cofferdam and pylon piles for the east pylon of the River Usk Crossing would be scheduled to avoid the period of highest sensitivity for underwater noise related impacts on migratory fish in the River Usk (April to June inclusive). Outside of the period 1st April to 30th June there would be no restrictions on the timing of piling activities. In the exceptional circumstance that piling is required within the period 1st April to 30th June piling activities would not take place during the period from 3 hours before high water to one hour after high water.

5.3.12 The effects of noise during construction of the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary SAC are considered in paragraph 5.3.20.

M4CaN bridge lighting shining on water causing behavioural/barrier effects

5.3.13 The assessment of the effects of lighting of the M4CaN Usk crossing during construction and operation on migratory fish features of the River Usk SAC (which includes the three species listed as features of the Severn Estuary SAC) is presented in paragraphs 5.2.57 *et seq*.

5.3.14 Chapter 10 of the March ES considers the effect of bridge lighting on the estuarine fish assemblage (i.e. including prey species of the qualifying migratory fish species of the River Usk and Severn Estuary SACs) during construction (Chapter 10, Section 10.8) and operation (Chapter 10, Section 10.9). Effects on the estuarine fish assemblage are predicted to be limited due to the appropriate design of lighting over the River Usk and River Ebbw crossings to ensure estuarine habitats, i.e. the channel and banks of the River Usk and the River Ebbw, are not directly illuminated.

5.3.15 The effects of lighting of the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary SAC are considered in paragraph 5.3.21.

Mitigation Measures

5.3.16 Mitigation measures would be implemented as part of the M4CaN project to ensure the project does not adversely affect the conservation objectives of the migratory fish features of the Severn Estuary SAC. These measures are either embedded, i.e. designed into the M4CaN Scheme, or additional, i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Chapter 10, Section 10.5 for further detail of embedded and additional measures). These measures are considered in the context of the conservation objectives for the Severn Estuary SAC in paragraph 5.3.18 *et seq.*

5.3.17 As the potential impacts on migratory fish features of the Severn Estuary SAC are the same as those described for fish in the River Usk the same mitigation measures are proposed (see paragraph 5.2.68 *et seq* for water quality, paragraph 5.2.72 et seq for noise and vibration and paragraph 5.2.74 *et seq* for

lighting) and these would also mitigate effects on the fish populations of the Severn Estuary SAC.

Effects of the M4CaN on the Conservation Objectives for Migratory Fish

5.3.18 Potential effects on the relevant conservation objectives (as presented in paragraph 5.3.3) for migratory fish are discussed in turn below, including consideration of whether the Scheme has the potential to interrupt progress or cause delays towards achieving these conservation objectives, disrupt the factors which help maintain favourable condition and interfere with the balance, distribution and density of key indicator species of favourable condition of the Severn Estuary SAC:

The migratory passage of both adult and juvenile stages of the interest feature is not obstructed or impeded by physical barriers, changes in flows or poor water quality.

5.3.19 The migratory passage of both adult and juvenile stages of the interest feature would not be obstructed or impeded by discharges from the M4CaN (i.e. poor water quality), due to the low levels of any potential contaminants and suspended sediments to be discharged into the River Usk and River Ebbw and the high dilution from the point of discharge.

5.3.20 The migratory passage of both adult and juvenile stages of the interest feature would not be obstructed or impeded by construction-related underwater noise, due to the avoidance of the key migration period for the piling works for the east pylon of the River Usk crossing, and to the fact that only short term, intermittent and highly localised impacts would be experienced outside the key migration period.

5.3.21 The migratory passage of both adult and juvenile stages of migratory fish would not be obstructed or impeded by light shining onto the River Usk or River Ebbw, due to implementation of appropriate measures during construction and operation to minimise light spillage onto the River Usk and River Ebbw.

The size of the interest feature's population within the Severn Estuary and rivers draining into it is at least maintained and is at a level which is sustainable in the long term.

5.3.22 The size of the interest feature's populations within the Severn Estuary and particularly the River Usk and River Ebbw, which flow into the Severn, would not be negatively affected by potential release of pollutants.

5.3.23 The size of the interest feature's populations within the Severn Estuary, and the Rivers Usk and Ebbw which drain into the Severn Estuary, would not be affected by underwater noise during construction of the M4CaN as significant effects on migration (upstream or downstream) are not predicted to occur.

5.3.24 The size of the interest feature's populations within the Severn Estuary, and the River Usk and River Ebbw which drain into the Severn Estuary, would not be affected by lighting of the River Usk and River Ebbw crossing.

5.3.25 Thus the ability of the interest feature's populations to be at least maintained and be sustainable in the long term would not be affected.

The abundances of prey species forming the interest feature's food resource within the estuary are maintained.

5.3.26 The release of pollutants from the Scheme would not affect the estuarine fish assemblage in the River Usk and River Ebbw. Thus the abundances of prey species forming the interest feature's food resource within the Severn Estuary would not be adversely affected.

5.3.27 No significant effects on the abundances of prey species of the estuarine fish assemblage of the River Usk and River Ebbw are predicted as a result of construction noise from the M4CaN Scheme due to the avoidance of piling works for the east pylon of the River Usk crossing during the most sensitive period for fish migration (April – June), the low noise levels associated with the piling methods, the consequently limited area of behavioural effects, and the short term and intermittent nature of the impact.

5.3.28 The abundances of prey species forming the interest feature's food resource within the estuary would not be affected by construction or operational lighting, through sensitive design of lighting avoiding light spillage onto estuarine habitats.

Toxic contaminants in the water column and sediment are below levels which would pose a risk to the ecological objectives described above.

5.3.29 Toxic contaminants in the water column and sediment would not be increased by discharges arising from construction or operation of the M4CaN and would therefore not result in an increase in levels which would pose a risk to the ecological objectives described above.

In-Combination Assessment

5.3.30 The plans and projects considered in this in-combination assessment are presented in Section 4.2 (and are also referred to in the in-combination assessment in paragraphs 5.2.180 *et seq*. for the River Usk SAC). As explained in Section 4.2, the outline nature of the plans and the strategic nature of the plan-level assessments due to insufficient detail of projects mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN.

5.3.31 The plan level HRAs concluded that the plans will not have an adverse effect on conservation objectives of the migratory fish features of the Severn Estuary SAC, particularly when the appropriate avoidance and mitigation measures identified in the plan level HRAs are implemented. It should also be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments on the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment.

5.3.32 As explained in paragraph 4.2.5, the Cardiff and Newport Tidal Lagoon projects also have the potential to affect many of the qualifying features of the Severn Estuary SAC, including estuarine habitats which would not be affected by the M4CaN Scheme, and migratory fish species, on which LSEs were predicted for the M4CaN. There is potential for an in-combination LSE between these projects and the M4CaN as a result of construction noise and disturbance. However, due

to the early nature of the development plans for these projects, it is not possible to undertake an in-combination assessment of these with the M4CaN.

5.3.33 The Shoreline Management Plan (SMP2) for the Severn Estuary identified potential adverse effects on the integrity of the Severn Estuary SAC due to loss of intertidal habitat (with the creation of compensatory habitat to replace this; see paragraph 5.2.182). The M4CaN project would not have any effects on habitat features of the Severn Estuary SAC (see AIES Stage 1: Screening Report; Welsh Government, 2015) and therefore there is no in-combination effect.

Effect on Site Integrity

5.3.34 Based on the information presented above, no adverse effects on the integrity of the Severn Estuary SAC are predicted as a result of the M4CaN Scheme, alone or in-combination with other plans or projects.

5.4 Severn Estuary SPA

5.4.1 The Screening Assessment determined there was potential for LSEs on the qualifying bird features of the Severn Estuary SPA. These are Bewick's swan, European white-fronted goose, dunlin, redshank, shelduck, gadwall, and an internationally important assemblage of waterfowl (henceforth referred to as "the assemblage"). The M4CaN Scheme would not directly affect land within the boundary of the Severn Estuary SPA, and therefore any LSEs would be predicted to occur outside the Severn Estuary SPA within land that is potentially used by birds from the SPA at certain times of the year, and therefore linked to the SPA. These are:

- Direct land take leading to habitat loss of roosting, foraging or refuge sites, in the vicinity of the route (construction and operation).
- Physical presence of the new section of motorway leading to potential disturbance/ displacement of features, interruption of flight lines and/or potential collision risk, depending on the design of the bridges (construction and operation).
- Noise and vibration resulting in disturbance to/displacement from roosting, foraging or refuge sites within close proximity to the new section of motorway (construction and operation); and
- Disturbance to night behaviour patterns by construction and highway lighting (construction and operation).

Baseline

5.4.2 The Severn Estuary ranks among the top ten British estuaries for the size of visiting waterfowl populations that it supports over winter (Musgrove *et al*., 2013). It is also of particular importance as a staging area in autumn and spring for migratory waterfowl species as it lies on the East Atlantic Flyway route. This factor is covered more within the Ramsar Site designation (see Appendix C2). Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species, and these behaviours are typical of any estuarine site.

5.4.3 The wintering and passage populations of birds in the Severn Estuary are designated features of the SPA. The SPA supports in excess of 80,000 birds in winter. Table 5.3 provides a summary of the species for which the site is designated and records of these made during surveys carried out for the M4 CaN Scheme. These include internationally and nationally important populations of key bird species for which the UK has particular importance in both European and global contexts. The data for the latest available counts for the SPA are based on desk study information in Hyder's 2014/15 wintering bird report (Appendix 10.16 of the March 2016 ES). This used WeBS data from 2008/09 to 2012/13.Chapter 10 of the March 2016 ES (Section 10.4) presents the findings of the ecology desk study undertaken in 2015 and the results of bird surveys in 2007/8, 2014 (Appendix 10.12 of the ES) and 2014/15 (Appendix 10.16 of the ES). A further wintering bird survey was carried out along the M4CaN Scheme between September 2015 and March 2016. The findings of this survey were reported in the September 2016 ES Supplement Appendix S10.4.

Table 5.3: The qualifying bird interest features of the Severn Estuary SPA and Ramsar Siteand summary of maximum counts during M4CaN transect surveys.

Species	Status in Severn Estuary SPA Citation	Recorded in Study Area (winter 2013/2014, 2014/2015 and/or 2015/2016)	Study Area Maximum Count (winter 2013/2014, 2014/2015 and/or 2015/2016)	Severn Estuary SPA Population Estimate at Citation	Severn Estuary SPA Population Latest Available	GB Population Estimate	% of Latest Avaialable SPA Population Recorded in Study Area (Maximum Count)
Bewick's Swan	Named	N	0	289	Unknown	7,000	0.00%
European White-fronted Goose	Named	N	0	3,002	Unknown	16,000	0.00%
Dunlin	Named	Y***	0	41,683	26,412	350,000	0.00%
Redshank	Named	Y	130	2,013	2,536	120,000	5.13%
Shelduck	Named	Y	19	2,892	3,330	61,000	0.57%
Gadwall	Named	Y	33	330	241	25,000	13.69%
Pintail	Named assemblage	Y	25	-	511	29,000	4.89%
Wigeon	Named assemblage	Y	43	3,977	7,837	440,000	0.55%
Teal	Named assemblage	Y	165	1,998	4,459	210,000	3.70%
Pochard	Named assemblage	Y	28	1,686	569	38,000	4.92%
Tufted Duck	Named assemblage	Y	21	913	793	110,000	2.65%
Ringed Plover*	Named assemblage	Y***	0	227	1,335	34,000	0.00%
Grey Plover	Named assemblage	Y***	0	781	Unknown	43,000	0.00%
Curlew	Named assemblage	Y	16	3,096	3,768	140,000	0.42%
Whimbrel	Named assemblage	N	0	246	Unknown	30	0.00%
Spotted	Named assemblage	Y***	0	3	Unknown	98	0.00%

Species	Status in Severn Estuary SPA Citation	Recorded in Study Area (winter 2013/2014, 2014/2015 and/or 2015/2016)	Study Area Maximum Count (winter 2013/2014, 2014/2015 and/or 2015/2016)	Severn Estuary SPA Population Estimate at Citation	Severn Estuary SPA Population Latest Available	GB Population Estimate	% of Latest Avaialable SPA Population Recorded in Study Area (Maximum Count)
Redshank							
Lapwing**	Named assemblage	Y	217	-	10,471	620,000	2.07%
Mallard**	Named assemblage	Y	252	-	2,713	680,000	9.30%
Shoveler**	Named assemblage	Y	22	-	448	18,000	4.91%

* Ringed plover is a passage component, all other listed components are wintering.

** Species was not included in SPA at the time of citation, therefore no population estimate at citation presented.

*** Recorded in vantage point surveys only.

5.4.4 Chapter 10 of the March 2016 ES considered all species recorded during surveys of the M4CaN corridor and discussed these in relation to the assessment of impacts. The maximum transect survey counts are cross-referenced against the SPA citation species and latest available counts in Table 5.4 in order to determine which of the named features only (i.e. not including the assemblage species) had the potential to be affected by the M4CaN Scheme at a population level.

Table 5.4: Summary of study area maximum counts, latest Severn Estuary SPA and GB population estimates for named SPA and Ramsar components seen during winter 2014, 2014/2015 and 2015/2016 transect surveys.

Species	Study Area Maximum Count	Severn Estuary SPA Population	% of SPA Population in Study Area (Maximum Count)	GB Population Estimate
Bewick's Swan	0	289*	0.00%	7,000
European White-fronted Goose	0	3,002*	0.00%	16,000
Dunlin	0	26,412	0.00%	350,000
Redshank	130	2,536	5.13%	120,000
Shelduck	19	3,330	0.57%	61,000
Gadwall	33	241	13.69%	25,000
* Original SPA populations at citation				

5.4.5 Of the named qualifying bird species of the Severn Estuary SPA, only three (redshank, gadwall and shelduck) were recorded during M4CaN Scheme surveys. Bewick's swan, European white-fronted goose and dunlin were not recorded within the survey area. Flocks of redshank and gadwall were recorded, with the maximum count of redshank during site surveys representing over 5% of the latest SPA population and the maximum count of gadwall representing over 13% of the latest SPA population. Maximum shelduck numbers recorded during the M4CaN surveys were well below 1% of the latest SPA population. These species are discussed further below.

5.4.6 Named species have been considered further if over 1% of the SPA populations were recorded as maximum counts during transect surveys of the M4CaN corridor. This percentage is based on professional judgement and is considered precautionary given that the M4CaN is outwith the boundary of the Severn Estuary SPA, and occurs on land which can be considered largely suboptimal for the species in the SPA citation. Based on this criterion, the following named/qualifying species have not been considered further in the SIAA:

- Bewick's swan;
- European white fronted goose;
- Dunlin; and
- Shelduck.

5.4.7 In addition to the species listed in Table 5.4, a further list of species are considered under the heading of species 'assemblage'. This part of the Severn Estuary SPA citation relates to the species assemblage as a whole, rather than simply referring to each individual species. The assemblage is discussed in Chapter 10 of the ES, and Table 5.5 presents the maximum transect survey counts for each assemblage species (other than the above six species) during M4CaN surveys, relative to the latest available Severn Estuary SPA population figures.

Table 5.5: Summary of study area maximum counts, latest Severn Estuary SPA and GB population estimates for named SPA and Ramsar assemblage components seen during winter 2014, 2014/2015 and 2015/2016 transect surveys.

Assemblage species	Study Area Maximum Count	Severn Estuary SPA latest Population	% of SPA latest Population in Study Area (Maximum Count)	GB Population Estimate
Pintail	25	511	4.89%	29,000
Wigeon	43	7,837	0.55%	440,000
Teal	165	4,459	3.70%	210,000
Pochard	28	569	4.92%	38,000
Tufted Duck	21	793	2.65%	110,000
Ringed Plover	0	1,335	0.00%	34,000
Grey Plover	0	781*	0.00%	43,000
Curlew	16	3,768	0.42%	140,000
Whimbrel	0	246*	0.00%	30
Spotted Redshank	0	3*	0.00%	98
Lapwing	217	10,471	2.07%	620,000
Mallard	252	2,713	9.30%	680,000
Shoveler	22	448	4.91%	18,000
* Original SPA populations at citation				

5.4.8 Pintail, wigeon, teal, pochard, tufted duck, curlew, lapwing, mallard and shoveler were recorded during the M4CaN transect surveys. No records of ringed plover, grey plover, whimbrel or spotted redshank were made.

5.4.9 Overall, the assemblage for the SPA regularly consists of over 80,000 waterbirds, which includes all named and assemblage species. The conservation objectives for the Severn Estuary SPA (Appendix C2) state that the 5-year peak mean population size for the assemblage should be no less than 68,026 individuals.

5.4.10 For the purposes of this SIAA, it was considered that a potential impact (e.g. displacement/disturbance effect from construction and operation of the M4CaN Scheme) on less than 5% of the population of one of the species components of the assemblage, or less than 1% of the assemblage as a whole, would not

represent a possible adverse effect on integrity. Except for mallard (9.30%), all assemblage species were recorded at a percentage of <5% of the SPA population. The total maximum count of species components of the SPA assemblage across the M4CaN corridor (1,009 birds in total) comprised >1% of the population of the assemblage (1.48% of the original SPA citation, 1.20% of the population of 84,317 on the Natura 2000 form). As a result of these observations the assemblage is considered further below.

5.4.11 The Severn Estuary SPA encompasses a very large estuarine area, nearly 17,000 ha and includes coastal areas in both England and Wales. No part of the M4CaN Scheme encroaches into the designated site. The nearest components of the Scheme are the River Usk and River Ebbw crossings, which are approximately 300m to the north of the SPA boundary. A small number of birds of a restricted number of species relative to the SPA citation were encountered during M4CaN surveys.

5.4.12 Redshank and gadwall are the only named SPA species to be taken forward from Table 5.4 for assessment against the conservation objectives, on the basis that they are the only named components of the SPA that were recorded within the study area in numbers >1% of the latest available SPA population (maximum count during transect surveys).

5.4.13 The assemblage is also taken forward to be assessed against the conservation objectives because the maximum number of assemblage and named birds recorded was >1% of the total assemblage and named birds population at citation, and because mallard was present in numbers >5% of the SPA population.

5.4.14 Redshank were recorded mainly on the River Ebbw (see Figure 4), with lower numbers recorded on the River Usk. Birds were recorded using areas of the River Ebbw from the mouth to upstream of the proposed crossing point, though activity was generally greater towards the mouth of the river, downstream of the proposed crossing. When in flight, the vast majority of birds were recorded at heights of <20 m. At the River Usk, birds appeared to favour an area just north of the proposed crossing point. All flight activity was at the River Usk was <20 m. Redshank were recorded in low numbers in areas immediately east and west of the Rivers Ebbw and Usk, but nowhere else in the M4CaN survey area. The maximum count within the survey area was 130 birds, 5.13% of the latest available Severn Estuary SPA population.

5.4.15 Gadwall were recorded predominantly in an area known as Green Moor to the south of the Tata Llanwern Steel site (see Figure 5) and almost always in small numbers. They were recorded using waterbodies including large reens and ditches. They were not associated with the locations of either of the river crossings or recorded anywhere else within the M4CaN study area. Due to the distance between the M4CaN Scheme at this location and the Severn Estuary SPA (2.6 km between the Scheme and the Severn Estuary SPA at Goldcliff, to the south), there is some doubt as to whether the gadwall recorded in this area comprise part of the SPA population. To ensure a precautionary approach is taken, it is assumed these individuals are related to the SPA. The maximum count for this species within the M4CaN survey area was 33 birds (13.69% of the latest available SPA population).

5.4.16 Mallard was the only assemblage species recorded in numbers of >5% of the total SPA population. Mallards were recorded throughout the study area in each year of survey. In particular, records were abundant (east to west) to the west of Magor Marsh, Green Moor, west of the Solutia Nature Reserve and Tatton Farm. The peak count was 252 birds (9.29% of the SPA population). It is possible that connectivity exists between these individuals and the Severn Estuary SPA population.

5.4.17 In addition to mallard, several assemblage species were recorded during surveys in maximum numbers approaching 5% of the latest available Severn Estuary SPA population estimates. The distribution, maximum, and recording frequency of these species are detailed in the following paragraphs.

5.4.18 Pochard was recorded almost exclusively in the Pride's Bridge/Green Moor area. This is located approximately 2.5 km from the nearest boundary of the Severn Estuary SPA. The peak number of birds was 28 individuals in January 2015 (4.92% of SPA population). Pochard was only recorded on three of 17 winter surveys.

5.4.19 Shoveler was frequently recorded in low numbers throughout the three years of survey. The majority of records were made in the Pride's Bridge/Green Moor area, with a small number also made to the west of the Solutia Nature Reserve. Both of these locations are located >2 km from the Severn Estuary SPA boundary. Despite being regularly recorded, numbers were generally low, with a peak of 22 birds in January 2016 (4.91% of the SPA population).

5.4.20 Pintails were recorded infrequently, with only five surveys over three years of wintering surveys containing records. They were recorded exclusively in the Pride's Bridge/Green Moor area, approximately 2.5 km from the boundary of the Severn Estuary SPA. Numbers recorded were low, with a peak of 25 birds (4.89% of the SPA population) recorded on a single occasion in February 2015.

5.4.21 Teal, like mallard, were widespread across the study area in each of the survey years. East to west, areas of particularly high abundance were to the southwest of Magor, Pride's Bridge/Green Moor, Moor Barn and the Ebbw River. The peak count of this species was 165 birds (3.70% of the Severn Estuary SPA population).

5.4.22 Tufted duck records were located almost exclusively in the fields to the west of the Solutia Nature Reserve, which are located approximately 700 m from the nearest boundary of the Severn Estuary SPA. The peak count was 21 birds (2.65% of the SPA population).

5.4.23 Lapwings were distributed quite widely across the study area. Birds were observed at (east to west) Caldicot Moor, fields to the south of Bowleaze Reen, west of the Ebbw River and around Fox Covert/Maerdy Farm. The peak count for this species was 217 birds (2.07 % of the Severn Estuary SPA population).

5.4.24 A further two assemblage species, wigeon (peak count of 43 birds, 0.55% of the Severn Estuary SPA population) and curlew (peak count of 16 birds, 0.42% of the SPA population) were recorded. Wigeon was recorded at Pride's Bridge/Green Moor, west of Solutia Nature Reserve, and the Ebbw River. Curlew were recorded relatively frequently, but in small numbers at the River Usk and Ebbw River.

Potential Effects on the Conservation Objectives for Wintering Birds.

5.4.25 The conservation objectives for the Severn Estuary SPA qualifying species considered within this assessment are to maintain the feature's population and supporting habitats (i.e. those within the boundary of the SPA) in a favourable condition. The conservation objectives for the features of the SPA are presented in full in Appendix C2, including details of the specific attributes, measures and targets for determining favourable condition for the bird interest features of the SPA and their supporting habitats.

5.4.26 Redshank will be considered to be in a favourable condition when, subject to natural processes, the following conditions are met (see Appendix C2 for full details of these conditions for the individual interest features):

- The 5 year peak mean population size for the wintering redshank population is no less than 2,013 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);
- The extent of saltmarsh and associated strandlines is maintained;
- The extent of intertidal mudflats and sandflats is maintained;
- The extent of hard substrate habitats is maintained;
- The extent of vegetation with a sward height of <10cm throughout the saltmarsh is maintained;
- The abundance and macro-distribution of suitable invertebrates in intertidal mudflats and sandflats is maintained;
- The abundance and macro-distribution of suitable invertebrates in hard substrate habitats is maintained;
- Unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;
- Aggregations of redshank at feeding or roosting sites are not subject to significant disturbance.

5.4.27 Gadwall will be considered to be in a favourable condition when, subject to natural processes, the following conditions are met:

- The 5 year peak mean population size for the wintering gadwall population is no less than 330 (ie the 5 year peak mean between 1988/9 - 1992/3);
- The extent of intertidal mudflats and sandflats is maintained;
- Unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;
- Aggregations of gadwall at feeding or roosting sites are not subject to significant disturbance.

5.4.28 The assemblage will be considered to be in a favourable condition when, subject to natural processes, the following conditions are met:

- The 5 year peak mean population size for the waterfowl assemblage is no less than 68,026 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

- The extent of saltmarsh and their associated strandlines is maintained;
- The extent of intertidal mudflats and sandflats is maintained;
- The extent of hard substrate habitats is maintained;
- Extent of vegetation of <10cm throughout the saltmarsh is maintained;
- The abundance and macroscale distribution of suitable invertebrates in intertidal mudflats and sandflats is maintained;
- The abundance and macroscale distribution of suitable invertebrates in hard substrate habitats is maintained;
- Greater than 25% cover of suitable soft leaved herbs and grasses during the winter on saltmarsh areas is maintained;
- Unrestricted bird sightlines of >500m at feeding and roosting sites are maintained;
- Waterfowl aggregations at feeding or roosting sites are not subject to significant disturbance.

5.4.29 The following sections provide an assessment of the effects of the M4CAN Scheme on the above conservation objectives for redshank, gadwall and the assemblage, with the assessment undertaken under the headings for the LSEs listed in paragraph 5.4.1.

5.4.30 The assessments also consider mitigation to be implemented as part of the project for wintering birds (paragraph 5.4.77 *et seq*.). The potential for adverse effects on integrity of each relevant feature is then considered using the information presented within the assessments below (see paragraph 5.4.92 *et seq*.). Overall effects on the integrity of the Severn Estuary SPA (bringing together all of the conservation objectives) are considered in paragraph 5.4.118.

5.4.31 When assessing the potential impact of any habitat loss, either direct or indirect (e.g. through disturbance and displacement), the availability of alternative habitat should be considered. It has been reported that in recent years, the Severn Estuary SPA bird population has generally declined (Burton *et al*. 2010). A search of the literature found no reporting of recent habitat loss, and nothing to suggest that three of the five conservation objectives underpinning the SPA relating to habitat (the extent and distribution of the habitats of the qualifying features, the structure and function of the habitats of the qualifying features and the supporting processes on which the habitats of the qualifying features rely) are not being met. Additionally, measures have been taken within the SPA boundary to extend relevant supporting habitats at Steart Marshes (see Table 4.2). It is therefore reasonable to assume that ample habitat to support the qualifying interests of the SPA recorded in the study area exists within the SPA boundary, so alternative habitat for birds that are disturbed is available outwith the area in which impacts of the M4CaN are expected to have an influence.

Direct land take leading to habitat loss of roosting, foraging or refuge sites if located outwith the Severn Estuary SPA in the vicinity of the route

Construction

5.4.32 Chapter 10, Section 10.7 of the March 2016 ES presents an assessment of the effects of land take from the M4CaN. Since the M4CaN is not situated within the

Severn Estuary SPA, the protected site and the habitats contained within it would not be affected by direct land take.

5.4.33 The east pylon of the new crossing of the River Usk would be located within an area of salt marsh on the east bank, outside the wetted channel of the river. The wetted channel has been defined through discussion with NRW as that part of the river channel below Mean High Water level. At the location of the pylon the salt marsh is largely dominated by tall sea couch grassland (>10 cm height).

5.4.34 The land take during construction of the M4CaN would result in loss of a total area of 0.94 ha of saltmarsh vegetation at the Rivers Usk and Ebbw (see Section 2.5 above and Section 10.7 of the March 2016 ES.)This would be mitigated by the provison of 2 ha of replacement saltmarsh on the east bank of the River Usk to the south of the crossing.

5.4.35 Field observations indicate that the Severn Estuary SPA qualifying species that uses the areas around the locations of the River Usk and River Ebbw crossings most frequently is redshank. Evidence collected during fieldwork shows that this species favours areas to the north and south of both proposed crossings (see Figure 4). The sward height of the saltmarsh that would be lost temporarily and permanently at the River Usk is well in excess of 10 cm, suggesting that in its current state, this habitat is not suitable for Severn Estuary SPA species such as redshank, or members of the assemblage. At the River Ebbw, saltmarsh that will be lost on the western bank has a shorter sward height, so is more suitable for SPA species. However, this is a relatively small area (0.74 ha), so no substantial impact on redshank is anticipated. Any redshank impacted by direct land take would utilise habitat located elsewhere that is not affected.

5.4.36 The area to the south of the Tata Llanwern Steel works is used by low numbers of gadwall (Figure 5). The construction of the Scheme would result in land take in this area. This part of the Scheme is located approximately 2.6 km north of the Severn Estuary SPA boundary at Goldcliff and therefore there is some uncertainty as to whether the birds recorded in this area comprise part of the SPA population. Gadwall were recorded in small numbers using reens and ditches within the field network, with no evidence of roosting behaviour. As well as the SPA itself, a data search of the wider area revealed that gadwall have been regularly recorded north of the Tata Llanwern Steel works, and also at the Ynysfro Reservoirs. During construction, the small number of birds affected by direct land take would likely relocate to other areas not impacted.

5.4.37 Species forming part of the assemblage of the Severn Estuary SPA use various areas of the M4CaN route. Mallard and teal were recorded across much of the survey area. Areas of relative abundance of other assemblage species were Pride's Bridge/Green Moor (pochard, shoveler, pintail and wigeon), Solutia Nature Reserve (shoveler, tufted duck and wigeon), Caldicot Moor (lapwing), fields to the south of Bowleaze Reen (lapwing), fields to the west of the River Ebbw (lapwing), Fox Covert/Maerdy Farm (lapwing), and the Rivers Usk and Ebbw (curlew and wigeon). Parts of these areas would be affected by direct land take.

5.4.38 The latest available SPA advice states that the supporting habitats for assemblage species consist of intertidal mudflats and sandflats, saltmarsh and hard substrate habitats (rocky shores). The data presented in Table 2.1 shows that land take of the M4CaN on these habitats is minimal. In addition, freshwater

coastal grazing marsh, improved grassland, and open standing waters are cited as supporting the assemblage. When the land take of these additional habitats is also considered, along with the location of assemblage birds during the surveys, it is possible that effects on the assemblage could occur through direct land take.

5.4.39 During construction, assemblage birds impacted by land take would relocate to other areas. The most abundant assemblage species, mallard and teal, are adaptable and flexible with respect to habitat so will have more habitat available to them for relocation. Previous data searches have recorded these species in many locations within 5 km of the M4CaN Scheme where impacts from construction would not occur. Data searches have also revealed a similar pattern for shoveler, wigeon, tufted duck and lapwing.

Operation

5.4.40 Field observations indicate that redshank favour areas to the north and south of the proposed River Usk River Ebbw crossings. Table 2.1 confirms that land take of intertidal habitats is very small. Following construction, much of the affected area would return to saltmarsh in the medium term (i.e. some 10 years for recovery of saltmarsh) and the permanent land take would be 0.43 ha. This would be mitigated by the provison of 2 ha of replacement saltmarsh on the east bank of the River Usk to the south of the crossing.

5.4.41 Land take from the Gwent Levels during the operational phase may result in displacement of low numbers of gadwall occurring in the area of the Gwent Levels to the south of the Tata Llanwern steelworks. Gadwall in this part of the M4CaN corridor were recorded in low numbers using waterbodies, including reens and ditches within the field network, with no evidence of roosting recorded.

5.4.42 Table 2.1 in Section 2.5 presents the land take during construction and operation of the M4CaN. Habitats which may be used by gadwall in this part of the Gwent Levels include, standing and running water (i.e. reens and field ditches), swamp and marsh/marshy grassland (including reed beds) and the fields within the Gwent Levels (e.g. poor semi-improved and improved grassland and arable). Habitat replacement of these habitats would be delivered through the Reen Mitigation Strategy and SSSI Mitigation Strategy (see paragraphs 5.4.81 *et seq*.).

5.4.43 With regard to the assemblage of the Severn Estuary SPA, the latest available SPA advice states that the supporting habitats for assemblage species consist of intertidal mudflats and sandflats, saltmarsh and hard substrate habitats (rocky shores). The data presented in Table 2.1 shows that land take of the M4CaN on these habitats is minimal. In addition, freshwater coastal grazing marsh, improved grassland, and open standing waters are cited as supporting the assemblage. When the land take of these additional habitats is also considered it is possible that effects on the assemblage could occur.

5.4.44 Whilst there would be some displacement of assemblage birds during operation of the new section of motorway due to direct land take, it is expected that the effect would be restricted to a small number of birds. Furthermore, they would relocate to alternative habitats in the wider area, including unaffected areas of the Gwent Levels and habitats within the Severn Estuary SPA, and/or the SSSI mitigation areas provided as part of the Scheme (see paragraph 5.4.81 *et seq*.) The water treatment lagoons constructed as part of the M4CaN would also offer potentially suitable habitat for a range of species, in particular mallard. The

lagoon to be constructed as mitigation for common crane will provide further suitable habitat for a range of bird species.

Physical presence of M4CaN leading to potential disturbance/displacement of features; interruption of flight lines and potential collision risk depending on design of bridges

Construction

5.4.45 Chapter 10 of the March 2016 ES (Section 10.8) presents the assessment of impacts associated with construction of the M4CaN, including disturbance/displacement of Severn Estuary SPA features. As explained above, direct effects on features of the SPA and supporting habitats within the SPA boundary would not occur as the Scheme is entirely outwith the SPA.

5.4.46 Construction of the Scheme is predicted to result in a localised visual displacement/disturbance effect. This would be likely to have the greatest influence on those birds that regularly use the habitat in and directly adjacent to the proposed footprints of the River Usk and Ebbw crossings. In addition, low numbers of Severn Estuary qualifying bird species using other parts of the study area, such as land south of Bowleaze Reen, Caldicot Moor, land west of Magor Marsh, Pride's Bridge/Green Moor, Tatton Farm, Moor Barn, Solutia Nature Reserve, and Fox Covert/Maerdy Farm (see Figures 4 and 5) would be affected. As the distance from the new section of motorway increases disturbance/displacement effects would be reduced.

5.4.47 There is also the potential for the construction of the river crossings to result in a habitat fragmentation or barrier effect, preventing birds from travelling up the river channel to make use of feeding areas upstream of the crossings.

5.4.48 Based on the results of the wintering bird surveys, the named component of the Severn Estuary SPA that would be most abundant, and therefore most exposed to these effects, is redshank. This species occurs around the Rivers Ebbw and Usk, where there would be clear lines of sight to the Scheme. At the River Ebbw, redshanks were recorded between 0-500 m up and downstream of the proposed crossing. At the River Usk, birds were recorded 0-20 m upstream and 0-250 m downstream of the proposed crossing.The Waterbird Disturbance Mitigation Toolkit (TIDE, 2013) suggests that redshank are relatively tolerant to visual disturbance.

5.4.49 During the construction of the Clackmannanshire Bridge, Scotland, redshank were observed to be displaced from feeding grounds during the construction phase (Dwyer, 2010). However, the relative influence of visual and noise/vibration factors was not stated. The presence of people, and to a lesser extent machinery, is likely to be the greatest source of effect during construction through visual disturbance (TIDE, 2013).. There is ample evidence which shows that movement of redshank is not impeded by operational bridges (Avian Ecology Unit, 1994; Dwyer, 2010). There is no known evidence that bridges under construction present a greater (or lesser) barrier effect than those in operation.

5.4.50 As a species, gadwall is not included in TIDE (2013). As a result, the general advice that behavioural changes will be likely to occur in birds located <300 m from works is considered the most relevant advice. It can therefore be assumed that a proportion of gadwall present at Pride's Bridge/Green Moor may be

disturbed and/or displaced as a result of the M4CaN construction. It should be noted that construction would not always occur at the particular stretch of the new section of motorway nearest these birds, and that there would not always be a direct line of sight to the Scheme, which would potentially reduce the distance at which this effect occurs. Rather than being lost to the SPA population, disturbance/displacement of gadwall occurring around Pride's Bridge/Green Moor works would be likely to lead to birds relocating into similar habitats (i.e. ditches and reens within the field network) in the wider Gwent Levels, or other habitats for these species, either north of the Tata Llarnwern Steel works (e.g. Ynysfro Reservoirs), or further south within the Severn Estuary SPA.

5.4.51 With regard to the assemblage, it is likely that the construction of the new section of motorway would result in the disturbance and/or displacement of individuals of several species. In particular, populations at Pride's Bridge/Green Moor (mallard, pochard, shelduck, pintail, teal and wigeon), Moor Barn (teal), fields to the west of the River Ebbw (lapwing) and Fox Covert/Maerdy Farm (lapwing) may be susceptible, based on the close proximity of bird records in these areas to the Scheme. Some individuals of the widely distributed assemblage species, mallard and teal, may also be susceptible to disturbance at other locations due to construction of the Scheme. However, disturbance/displacement effects will be reduced in areas where there is no direct line of sight to the construction area, and also when workers are not present on the nearest stretches of the M4CaN to each area. In any case, these effects would be likely to result in birds moving to similar habitats further away from the Scheme rather than their loss to the population. The most abundant assemblage species, mallard and teal, are adaptable and flexible with respect to habitat so will have more habitat available to them for relocation should this be required. Previous data searches have recorded these species in many locations within 5 km of the M4CaN where impacts from construction wouldl not occur. Data searches have also revealed a similar pattern for shoveler, wigeon, tufted duck and lapwing.

Operation

5.4.52 Direct effects on habitats of named Severn Estuary features within the SPA boundary would not occur as the Scheme is to be constructed outwith the SPA. However, effects are predicted on SPA species as a result of the physical presence of the M4CaN on habitats used by qualifying features outside the SPA boundary.

5.4.53 This could include displacement of redshank from roosting or feeding habitats within the River Ebbw. The presence of the Ebbw river crossing may discourage birds from roosting and feeding nearby. There is also the potential for the operational river crossings to result in a habitat fragmentation or barrier effect, preventing birds from travelling up the river channel to make use of feeding areas upstream of the crossings.

5.4.54 Observations from elsewhere suggest that redshank would not be disturbed or displaced during operation of the new section of motorway. Whilst Dwyer (2010) recorded the localised displacement of redshank from the area in the vicinity of the Clackmannanshire Bridge during construction, birds returned once construction activities ceased and the bridge became operational.

5.4.55 At another bridge on the Firth of Forth, Scotland, no evidence was found that mudflat characteristics beneath the bridge differed significantly from those

elsewhere (Avian Ecology Unit, 1994), so habitat quality was unaffected by the presence of the bridge. In a composite site analysis across a series of locations, redshank were found to be commoner adjacent to bridges than elsewhere. This was suggested to be the result of the effects of bridge supports on water movements with consequential upturn in sediment deposits, which in turn may make prey easier to detect. Bridges also provide an element of shelter from winds which is likely to prove attractive. Avian Ecology Unit (1994) also found no evidence of barrier effects of operational bridges.

5.4.56 If barrier effects are limited, this means that there would be the potential for collision of birds with motorway infrastructure and traffic at the river crossings. Almost all redshank flights recorded during fieldwork showed birds travelling up and down the River Ebbw and River Usk at flight heights of <20 m. The River Ebbw crossing will be a minimum of 5.71 m from mean high water. The River Usk crossing will be 32 m from mean high water at the centre of the bridge. It should be noted that at high water, birds are less likely to be using the river channels, so when they are present the clearance between the water and bridge will be up to 10 m greater. Because recorded flight heights were generally at low level, it is expected that birds will fly underneath the bridges. Collision with vehicles using the crossings by SPA species, particularly redshank, is therefore considered unlikely. Avian Ecology Unit (1994) showed that even at low bridges, around 75% of wader flights still went underneath rather than over them.

5.4.57 Operation of the M4CaN in areas used by gadwall (i.e. waterbodies within the field network to the south of the Tata Llanwern Steel works) would result in displacement of the small number of gadwall in areas adjacent to the new section of motorway. Areas with no direct line of sight may be affected to a lesser extent. It is expected that any birds displaced would relocate to areas of similar habitat either further south within the wider Gwent Levels, north of the Tata Llanwern Steel works, within the SSSI mitigation areas (see section 5.4.81 *et seq.*), or to habitats within the SPA, approximately 2.6 km to the south at Goldcliff.

5.4.58 With regard to the bird assemblage of the Severn Estuary SPA, it is likely that the operation of the new section of motorway would result in the disturbance and/or displacement of individuals of several species. As with construction, populations at Pride's Bridge/Green Moor (mallard, pochard, shelduck, pintail, teal and wigeon), Moor Barn (teal), fields to the west of the River Ebbw (lapwing) and Fox Covert/Maerdy Farm (lapwing) may be the most susceptible, based on the close proximity of bird records in these areas to the Scheme. Some individuals of the widely distributed assemblage species, mallard and teal, may also be susceptible to disturbance in other areas. Disturbance/displacement effects would be reduced in areas where there is no direct line of sight to the new section of motorway. Where they do occur, these effects would be likely to result in birds locating to similar habitats further away from the M4CaN rather than their loss to the population. These habitats are likely to be either within the wider Gwent Levels, within the SSSI mitigation areas (see section 5.4.81 *et seq.*), or to habitats within the SPA, approximately 2.6 km to the south at Goldcliff. The most abundant assemblage species, mallard and teal, are adaptable and flexible with respect to habitat so will have more habitat available to them for relocation should this be required. Previous data searches have recorded these species in many locations within 5 km of the M4CaN where impacts from construction would not occur. Data searches have also revealed a similar pattern for shoveler, wigeon, tufted duck and lapwing.

5.4.59 Some level of displacement during operation would be expected for both gadwall and Severn Estuary SPA assemblage species, which would be more pronounced nearer to the new section of motorway. The provision of suitable habitats within the SSSI mitigation areas away from the M4CaN (see section 5.4.81 *et seq.*) coupled with any displacement effects from the operational carriageway would reduce the risk of collision for these species. The water treatment lagoons which would be constructed as part of the Scheme would provide suitable habitat for a range of species, in particular mallard. In addition, the lagoon to be constructed as mitigation for common crane will also provide suitable habitat for a range of species once completed.

5.4.60 In summary, the physical presence of the new section of motorway is not predicted to result in significant impacts on bird features of the Severn Esturary SPA during operation. Where birds are displaced, alternative habitats are available, including those to be provided as SSSI mitigation areas (see section 5.4.81 *et seq.*). Operation would involve large scale motorway traffic movements but this is not predicted to impact on the features of the SPA.

Noise and vibration resulting in disturbance/displacement of roosting, foraging or refuge sites within close proximity to the M4CaN

Construction

5.4.61 The effects of construction noise and vibration on wintering bird species (including those listed as features of the Severn Estuary SPA) are assessed in Section 10.7 of Chapter 10 of the March 2016 ES. The chapter concluded that Severn Estuary SPA species are sensitive to noise disturbance, although they are likely to have some tolerance to relatively high levels of background noise already present in the vicinity of Newport Docks. Construction noise from the Scheme may exceed these existing noise levels, potentially leading to some disturbance/displacement of the SPA species recorded within the M4CaN corridor.

5.4.62 Construction noise and vibration at the River Ebbw and River Usk crossings would result in a localised displacement/disturbance effect, which would have the greatest influence on those birds that regularly use the habitat directly in and adjacent to the proposed crossing footprints. Further away from the crossing locations, disturbance/displacement effects would reduce. The named component of the Severn Estuary SPA that would be most abundant, and therefore most exposed to this effect in these locations, is redshank (see Chapter 10 of the March 2016 ES, Section 10.8). At the River Ebbw, redshanks were recorded between 0-500 m up and downstream of the proposed crossing. At the River Usk, birds were recorded 0-20 m upstream and 0-250 m downstream of the proposed crossing.

5.4.63 One of the noisiest activities that wouldl take place during construction is vibropiling. According to TIDE (2013), this wousl be likely to generate an approximate constant 80 dB noise at source. TIDE (2013) also states that for redshank, a noise of up to 70 dB is acceptable at the bird but with caution above 55 dB (60 dB in a highly disturbed area). As Redshank will forage close to plant (<50 m) and >75 m to workers, this means that a noise threshold at source for disturbance would be some 100-105 dB, with caution above 87-92 dB.

5.4.64 It should be noted that the area is generally industrialised and already the subject of relatively high human activity (and therefore noise), so birds will be partially habituated to certain levels of human presence, noise and disturbance prior to the commencement of construction. With this in mind, it is considered that noise disturbance to redshank during construction would be minimal in these areas.

5.4.65 During the construction of the Clackmannanshire Bridge, Scotland, redshank were observed to be displaced from feeding grounds during the construction phase (Dwyer, 2010). However, the relative influence of visual and noise/vibration factors was not stated.

5.4.66 In the area to the south of the Tata Llanwern Steel works where limited numbers of gadwall were recorded (Figure 5), construction noise may result in a disturbance effect. There is very little information on the effects of noise disturbance on dabbling ducks such as gadwall; TIDE, 2013). In general, an 'acceptable' noise level of 70 dB at the bird has been developed. This indicates that noise may result in disturbance effects, although effects are likely to be localised, due in part to the abscence of direct line of sight to construction area in many areas. The small number of gadwall affected would be likely to redistribute to similar habitats within the Gwent Levels, or suitable habitats within the Severn Estuary SPA.

5.4.67 In general, areas that are used by Severn Estuary SPA assemblage species that are adjacent to the Scheme may be subject to disturbance/displacement effects due to noise and vibration during construction. The key areas include Pride's Bridge/Green Moor (mallard, pochard, shelduck, pintail, teal and wigeon) and Moor Barn (teal). Due to a paucity of data for all of these species with respect to reactions to noise and vibration, the standard approach to noise as advocated by TIDE (2013) is employed. This is that a noise up to 70dB at the bird is acceptable, with consideration required above 55dB. The same applies to lapwing recorded in the fields to the west of the River Ebbw and Fox Covert/Maerdy Farm. A noise of 120 dB at source would have reduced to 72 dB 170 m away, so a 200 m disturbance distance is considered precautionary.

5.4.68 It should be noted that it is highly likely that any response of Severn Estuary SPA qualifying species to construction of the Scheme would almost certainly be triggered by visual disturbance before noise, particularly as techniques such as percussive piling would not be utilised during construction of the M4CaN.

Operation

5.4.69 The effects of operation of the M4CaN, including those from noise, are assessed in Chapter 10 of the March 2016 ES, Section 10.8. The locations of the river crossings are in areas that are already subject to relatively high degrees of anthropogenic activity and disturbance. Based on noise modelling, background noise in the vicinity of the proposed river crossing at the River Usk is estimated to be 45-50 dB(A)$_{L10(18h)}$, rising to 50-55 dB(A)$_{L10(18h)}$ within 300m upstream, and falling to 40-45 dB(A)$_{L10(18h)}$ within 500-700m downstream. On the River Ebbw, the estimated background noise level at the site of the proposed crossing is 45-50 dB(A)$_{L10(18h)}$ with a similar background noise level upstream and downstream.

5.4.70 TIDE (2013) indicates that redshank are likely to show some sensitivity to noise disturbance, but only when noise levels (at the bird) exceed 70 dB. However, caution above 60 dB at the bird is recommended in disturbed areas. It is

anticipated thatnoise levels during operation are likely to be between 60-70 dB(A)$_{L10(18h)}$ around both river crossings. If the upper value is assumed, based on data in TIDE (2013) the level of noise would reduce to around 58 dB when 5 m from the source. This indicates that operational noise from the M4CaN is unlikely to result in a discernible effect on redshank at either crossing. Furthermore, as discussed above, the small number of redshank which may be affected are likely to redistribute to similar habitats along the rivers.

5.4.71 The current modelled noise level in the area of Pride's Bridge/Green Moor inhabited by gadwall ranges between approximately 45-55 dB(A)$_{L10(18h)}$. Following construction of the Scheme, the modelled operational noise in this area has been calculated to be approximately 55-70 dB(A)$_{L10(18h)}$. There is very little information on the effects of noise disturbance on dabbling ducks such as gadwall (TIDE, 2013). In general, an 'acceptable' noise level of 70 dB at the bird has been developed. This indicates that noise may result in disturbance effects in the immediate vicinity of the new section of motorway, although effects are likely to be highly localised. The small number of gadwall affected would redistribute to similar habitats within the Gwent Levels, habitats within the Severn Estuary SPA, or suitable habitats within the SSSI mitigation areas away from the new section of motorway (see section 5.4.81 *et seq.*).

5.4.72 To assess the impact of operational noise from the new section of motorway on the assemblage, it should be noted that the area of land where noise levels would exceed 70 dB is small (an area roughly 10 m either side of the road). Due to their highly localised nature, it is not anticipated that noise impacts during the operation of the new section of motorway would be siginificant on assemblage species of the Severn Estuary SPA. The small number of birds that may be affected would be likely to redistribute to similar habitats within the Gwent Levels, habitats within the Severn Estuary SPA, or suitable habitats within the SSSI mitigation areas away from the Scheme (see section 5.4.81 *et seq.*). It is likely that the most widely distributed assemblage birds (mallard and teal) would be most likely to be impacted; however, they are also the birds that are most adaptable with respect to habitat requirements.

Disturbance to night behaviour patterns by construction and highway lighting

Construction

5.4.73 Lighting 'spillage' may cause behavioural disturbance to birds, including traits such as extended feeding patterns at night rather than roosting. To ensure a precautionary approach to the assessment, it is assumed that a level of nocturnal roosting occurs by redshank in the vicinity of the River Usk and River Ebbw crossings. This approach is extended to include the reens, ditches and other adjoining habitats where both gadwall (Pride's Bridge/Green Moor) and SPA assemblage species (Pride's Bridge/Green Moor (pochard, shoveler, pintail and wigeon), Solutia Nature Reserve (shoveler, tufted duck and wigeon), Caldicott Moor (lapwing), fields to the south of Bowleaze Reen (lapwing), fields to the west of the Ebbw River (lapwing), Fox Covert/Maerdy Farm (lapwing), and the Rivers Usk and Ebbw (curlew and wigeon)) were recorded.

5.4.74 Lighting during the construction of the Scheme would be located to ensure that the working areas are precisely lit, with minimal light spill to watercourses and

areas utilised by SPA qualifying birds. It is therefore not anticipated that lighting would have more than a minimal affect on bird species of the Severn Estuary SPA during the construction phase of the M4CaN.Operation

5.4.75 When operational the new section of motorway would only be lit at junctions and their approaches (including the River Ebbw crossing), and at the River Usk crossing. The motorway across the Gwent Levels would otherwise be unlit. The lighting, where present, would be designed to minimise light spill outside the carriageways which would minimise any impact on named Severn Estuary SPA species, including redshank at the crossings of the Rivers Usk and Ebbw.

5.4.76 Disturbance to night behaviour patterns may also occur along unlit sections of the M4CaN, where traffic headlights shine into unlit habitats adjacent to the main carriageway. Such effects could potentially lead to the displacement of gadwall from the area to the south of the Tata Llanwern Steel works into neighbouring areas. These may include areas of similar habitat (i.e. reens and ditches within the field network), either north of the Tata Llanwern Steel works, the Ynysfro Reservoirs, further south within the wider Gwent Levels, enhanced areas within the SSSI Mitigation Areas (see section 5.4.81 *et seq.*), or to suitable habitats within the Severn Estuary SPA, approximately 2.6 km to the south at Goldcliff at its closest point.

5.4.77 Habitats used by the Severn Estuary SPA assemblage could also be affected by light from traffic headlights. This would include Pride's Bridge/Green Moor, Solutia Nature Reserve, Caldicott Moor (lapwing), fields to the south of Bowleaze Reen (lapwing), fields to the west of the Ebbw River (lapwing), Fox Covert/Maerdy Farm (lapwing), and the Rivers Usk and Ebbw (curlew and wigeon)). Other areas where mallard and teal were recorded could also be impacted. As with gadwall, these impacts may cause displacement of birds into areas of similar habitat either further south within the wider Gwent Levels, within the SSSI Mitigation areas (see section 5.4.81 *et seq.*), or to suitable habitats within the SPA.

Mitigation Measures

5.4.78 The following mitigation measures would be implemented as part of the Scheme to ensure that the project does not adversely affect the conservation objectives of the qualifying bird features of the Severn Estuary SPA. These measures are either embedded, i.e. designed into the Scheme, or additional, i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Chapter 10, Section 10.5 for further detail of embedded and additional measures). These measures (both embedded and additional) are considered, in conjunction with the supporting information in the preceding paragraphs, in the context of the conservation objectives for the Severn Estuary SPA in paragraph 5.4.92 *et seq.*

5.4.79 In addition to the mitigation measures outlined below, in order to ensure proper and compliant ecological management of the construction process throughout, construction of the new section of motorway would be overseen by an Environmental Liaison Group comprising key stakeholders including NRW. Reporting to them would be an Environmental Co-ordinator who would be responsible for ensuring effective liaison between environmental specialists and engineers, and for obtaining relevant licenses and consents. In additon to the Environmental Co-ordinatior, the construction budget provides for two

Environmental Clerks of Works (ECoW) each assisted by two Assistant Environmental Clerks of Works (AECoW). At least one ECoW and at least two AECoWs would be ecologists by training. It is not anticipated that these resources would be required full-time over the entire construction period, but they would be available full-time during the most environmentally sensitive periods, which are during the first eighteen months of the construction period. At other times during the construction period appropriate environmental resources would be available as required.

Land take leading to habitat loss (though only from land linked to the SPA, not from the SPA itself):

5.4.80 0.20 ha of saltmarsh would be permanently lost for the River Usk crossing and 0.74 ha permanently lost at the River Ebbw. Approximately 2 ha of saltmarsh would be developed to mitigate these losses.

5.4.81 The revised Environmental Masterplan (September 2016 ES Supplement Figure R2.6) sets out the habitat creation and landscape planting that would be provided along the M4CaN corridor. The Masterplan would result in 9.9 ha of new reedbeds, 38.1 ha of new species rich grassland, 4.1 km of new hedgerows and hedgerows with trees, 20.8 ha of new linear belts of trees and shrubs and 83.6 ha of new woodland.

5.4.82 In addition to the Environmental Masterplan, the implementation of the SSSI Mitigation Strategy and Reen Mitigation Strategy (March 2016 ES Appendices 10.35 and 2.3 respecitvely) are the two other measures to mitigate habitat loss. The purpose of the SSSI Mitigation Strategy is to mitigate the loss of coastal grazing marsh habitat and to ecologically enhance land within the Gwent Levels SSSIs. The purpose of the Reen Mitigation Strategy is to mitigate the 2,755 m of reen and 9,373 m of reens and ditches that would be infilled or culverted during construction of the new section of motorway. A Supplementary File note on the Reen Mitigation Strategy was Appendix S2.1 to the September 2016 ES Supplement, and a revised SSSI Mitigation Strategy was submiitted to the Public Inquiry as PID 049.

5.4.83 The 78 ha of coastal and floodplain grazing marsh permanently lost within the Gwent Levels (86 ha including temporary impacts), would be mitigated by the implementation of the SSSI Mitigation Strategy works at Maerdy Farm, Tatton Farm and Caldicot Moor. The implementation of the Reen Mitigation Strategy would replace reens at an overall ratio of 1:1 (2,826 m and 10,594 m respectively). Proposals for SSSI mitigation also include re-cutting of 5,865 m of former ditches at Maerdy Farm and Caldicot Moor.

5.4.84 In addition to this, the water treatment lagoons which would be constructed as part of the Scheme would provide suitable habitat for a range of species, in particular mallard. As well as these, the lagoon to be constructed as mitigation for common crane will also provide suitable habitat for a range of species once completed.

5.4.85 As wetland habitats generally establish relatively quickly, wintering and migratory wildfowl such as gadwall, teal and pintail would benefit from the new reens, ditches and pools early in the Scheme's operational phase.

Physical presence leading to disturbance or displacement, interruption of flight lines and/or potential collision risk:

5.4.86 The SSSI Mitigation Strategy and Reen Mitigation Strategy would provide alternative habitat for Severn Estuary SPA species displaced from the vicinity of the new section of motorway during operation.

5.4.87 The cable stayed bridge design of the River Usk crossing would retain an open flyway and would therefore minimise habitat fragmentation. The River Ebbw crossing would be a minimum of 5.71 m from mean high water and the River Usk crossing 32 m from mean high water at the centre of the bridge. Taking account of the fact that clearance increases by some 10 m with the fall of the tide, this leaves significant clearance for birds to fly under both bridges based on observations during fieldwork for the M4CaN and at other bridge locations (e.g. Avian Ecology Unit, 1994).

Noise and vibration:

5.4.88 As explained in the Pre-CEMP, standard best practice construction working methods (for example, the use of silenced plant, turning off plant when not in use, and selecting quieter plant where available), would be adopted during the construction phase.

Visual disturbance and lighting:

5.4.89 The limiting of construction activities to daylight hours where possible would provide a temporal break in construction activity. Generally, night working would be avoided and this would reduce impacts on any nocturnal bird roosts.

5.4.90 Other than the main construction compounds, any construction lighting would be limited to the local working area and times of working only. Lighting would be limited as required during periods of normal working hours in autumn and winter. As far as possible, task lighting would be positioned at low level on posts and directed at the work area to reduce light spillage and impacts on areas surrounding the works.

5.4.91 Design of lighting of the River Usk and River Ebbw crossings would aim to reduce light spill onto the river channels and banks to avoid causing behavioural changes to birds using these areas.

Effects of M4CaN on Conservation Objectives

5.4.92 Potential effects on the conservation objectives for the relevant wintering birds of the Severn Estuary SPA (redshank, gadwall and the assemblage, as presented in paragraph 5.4.25 *et seq*) are discussed below, including consideration of whether the Scheme has the potential to interrupt progress or cause delays towards achieving these conservation objectives, disrupt the factors which help maintain favourable condition and interfere with the favourable condition of the Severn Estuary SPA.

Redshank

The 5 year peak mean population size for the wintering redshank population is no less than 2,013 individuals (i.e. the 5 year peak mean between 1988/9 - 1992/3, the SPA baselines stated in Appendix C2).

5.4.93 The maximum transect survey count within the study area for redshank during the 2014, 2014/15 and 2015/16 winter seasons was 130 birds, but was generally lower than this (mean count 38 birds, standard deviation 50; see Figure 4). If disturbed and displaced during construction, these birds would not be lost to the Severn Estuary SPA population, but would relocate to other habitats, likely within the SPA boundary. During the operational phase, it is not expected that any significant effects would occur. Therefore, impacts are not predicted to affect redshank at the population level and this objective would be maintained.

The extent of supporting habitats (i.e. saltmarsh, intertidal mudflats and sandflats and hard substrate habitats) is maintained.

5.4.94 There will be no impact on intertidal mudflats, sandflats and hard substrate habitats. The only permanent habitat loss would be a small area of saltmarsh (0.94 ha) at the River Usk and River Ebbw crossings. This is not within the boundary of the Severn Estuary SPA, nor is it of particular importance to redshank based on survey data. In parts of this habitat, particularly on the east banks of the River Usk and River Ebbw, the sward is in excess of 10 cm length, rendering it suboptimal for this species. Saltmarsh is only a very limited part of the mosaic of habitats that redshank utilise. Furthermore, replacement saltmarsh is to be created downstream of the proposed River Usk crossing to offset this loss. This objective would be maintained.

The extent and distribution of suitable vegetation or macro-invertebrate communities is maintained.

5.4.95 The area of habitat that would be lost due to construction of the Scheme is entirely outwith the Severn Estuary SPA boundary, and there would be no loss of suitable habitat, or the constituent macro-invertebrates that form the prey of the redshanks, within the designated site. Redshank feed in the mud areas within the river channels at low tide, and these invertebrate communities would not be impacted by the scheme. Field data suggests that the areas which would be directly underneath the bridges are not of particular importance to redshank and this habitat would still be available in any event. This objective would therefore be maintained.

Unrestricted bird sightlines of >200m at feeding and roosting or refuge sites are maintained.

5.4.96 The construction and operation of the River Usk and River Ebbw crossings is unlikely to impact on the sightlines of the commonly used feeding areas, unless birds are feeding in the immediate vicinity (i.e. underneath) the crossings. In this case, the bridge actually provides cover against predation, which is the subject of this objective. Because of the bridge design avoids land take within the wetted channel of the rivers, and maintain flyways, there will be no restriction in sightlines at ground level. This objective would therefore be maintained.

Aggregations of redshank at feeding or roosting sites are not subject to significant disturbance.

5.4.97 Redshank are relatively tolerant to visual disturbance and habituate to works rapidly (Section 10.8 of the March 2016 ES), though it is likely that disturbance (e.g. visual and noise disturbance) would occur at distances within 300 m of works. In a composite site analysis across a series of locations, redshanks were found to be commoner adjacent to bridges than elsewhere (Section 10.9 of the

March 2016 ES). Literature has shown a temporary disturbance effect during construction, with birds returning during the operational phase. As such, a temporary displacement effect is predicted. However, the temporary nature of this effect would not compromise the favourable conservation status of this species in the Severn Estuary SPA, due to the abundance of alternative feeding habitat available, and the relatively small number of birds affected. Whilst Burton *et al.* (2006) reported a reduction in body condition and survival of redshanks displaced by the construction of the Cardiff Bay barrage, a key difference here is the fact that direct habitat loss by land take is virtually zero, and even if use of small amounts of habitat is reduced due to disturbance, the scale of loss is far smaller and temporary. Therefore the same effects are not anticipated here, and in the long term this objective would be maintained.

Gadwall

The 5 year peak mean population size for each interest feature is no less than the baseline stated for this species of 330 individuals (i.e. the 5 year peak mean between 1988/9 - 1992/3, the SPA baselines stated in Appendix C2)..

5.4.98 The maximum study area transect count during the three seasons of survey was (on one date) 33 birds, although generally much lower numbers were encountered (mean count 10 birds, standard deviation 12). These 33 birds, recorded in autumn, in a worst case scenario would be displaced into either the Severn Estuary SPA, the area north of the Tata Llanwern Steel works, the Ynysfro Reservoirs or unaffected areas of the Gwent Levels to the south of the Tata Llanwern Steel works (see Figure 5), rather than be lost to the SPA population. Consequently, the 5 year peak mean population size would not be affected by the M4CaN and this objective would be maintained.

The extent of supporting habitats is maintained.

5.4.99 Although the Scheme does not pass through the Severn Estuary SPA, and as such there would be no direct loss of habitat from within the designated site, there would be some loss of suitable habitat for this species, since the surveys have shown that small numbers of gadwall use the reens and ditches within the Gwent Levels (in particular those to the south the Tata Llanwern Steel works (see Figure 5). However, this would be mitigated by the creation of new reens and field ditches as part of the Scheme, such that the extent of supporting habitats (and therefore the objective) would be maintained.

The extent and distribution of suitable vegetation or macro-invertebrate communities is maintained.

5.4.100 As described above, there would be some loss of suitable habitat for gadwall outside the SPA boundary by direct habitat loss, and indirect effects resulting in displacement. However this would be mitigated by the creation of new reens and field ditches as part of the Scheme. In the vicinity of the area of habitat which would be affected by the Scheme there is other suitable habitat for gadwall (the area north of the Tata Llanwern Steel works and the Ynysfro Reservoirs) that would not be affected by construction or operation of the new section of motorway. Thus the extent and distribution of suitable vegetation and macro-invertebrate communities would be maintained.

Unrestricted bird sightlines at feeding, roosting or refuge sites are maintained.

5.4.101 Gadwall was generally recorded to the south of the Tata Llanwern Steel works in small numbers, with no roost sites identified. These birds were occupying narrow reens with bankside vegetation, so unrestricted sightlines are not considered an issue for this species in this habitat. This objective would therefore not be compromised by the Scheme.

Aggregations of interest features at feeding, roosting or refuge sites are not subject to significant disturbance.

5.4.102 No aggregations of gadwall occurred in the study area bar a single record of 33 birds in autumn 2015 along Transect 3 (see Figure 5). The lack of subsequent records from this area suggests that this is not a key location for this species. It is not therefore considered that key aggregations of gadwall would be disturbed by the Scheme and this objective would therefore be maintained.

Internationally important assemblage of waterfowl

The 5 year peak mean population size for the waterfowl assemblage is no less than 68,026 individuals (ie the 5 year peak mean between 1988/9 - 1992/3).

5.4.103 The maximum count in the study area in a single transect during the three seasons of survey was 578 birds, although generally much lower numbers were encountered. Of these, 200 birds were mallards, a species that is tolerant of anthropogenic activity and relatively adaptable. The construction and operation of the new section of motorway would result in the displacement and redistribution of birds rather than their loss to the Severn Estuary SPA population. Consequently, the 5 year peak mean population size would not be affected by the M4CaN and this objective would be maintained.

The extent of supporting habitats (i.e. saltmarsh, intertidal mudflats and sandflats and hard substrate habitats) is maintained.

5.4.104 There would be impact on intertidal mudflats, sandflats and hard substrate habitats. The only permanent loss of supporting habitat would be small areas of saltmarsh (0.94 ha) at the River Usk and River Ebbw crossings. This is not within the boundary of the Severn Estuary SPA, nor is it of particular importance to assemblage species based on survey data and the fact that in parts of this habitat, the sward is in excess of 10 cm length, rendering it suboptimal for these species. Saltmarsh is only a very limited part of the mosaic of habitats that the assemblage species utilise. Furthermore, replacement saltmarsh is to be created downstream of the proposed River Usk crossing to offset this loss. This objective would be maintained.

The abundance and macroscale distribution of suitable invertebrates in intertidal mudflats and sandflats is maintained.

5.4.105 Because no impacts on intertidal mudflats and sandflats are predicted as a result of the construction and operation of the new section of motorway, this objective would be maintained.

The abundance and macroscale distribution of suitable invertebrates in hard substrate habitats is maintained.

5.4.106 Because no impacts on hard substrate habitats are predicted as a result of the construction and operation of the M4CaN, this objective will be maintained.

Greater than 25% cover of suitable soft leaved herbs and grasses during the winter on saltmarsh areas is maintained.

5.4.107 This objective would be maintained since the saltmarsh habitat associated with the Severn Estuary SPA that already possesses this characteristic would be unaffected by the construction and operation of the new section of motorway. The exception is the saltmarsh lost around the River Usk and River Ebbw crossings which would be replaced by new saltmarsh at the River Usk.

Unrestricted bird sightlines of >500 m at feeding and roosting sites are maintained.

5.4.108 The construction and operation of the M4CaN is unlikely to impact the sightlines of areas that would be used for feeding and roosting following the commencement of construction. No particular area in close proximity to the Scheme was identified as being especially important to assemblage species during surveys. Many of the sites which supported relatively small numbers of assemblage species were narrow reens with bankside vegetation, so unrestricted sightlines are not considered an issue. This objective woiuld thus be maintained.

Waterfowl aggregations at feeding or roosting sites are not subject to significant disturbance.

5.4.109 There was no evidence of large aggregations of assemblage species occurring in the study area during surveys in 2014, 2015 or 2016. Assemblage species were recorded in relatively low numbers, and distributed across the study area. Data suggest that the study area is not a key location for assemblage species. It is not therefore considered that key aggregations of assemblage species would be disturbed by the M4CaN, and this objective would therefore be maintained.

In-Combination Effects

5.4.110 The plans and projects considered in this in-combination assessment are presented within Section 4.2. As explained in Section 4.2, the outline nature of the plans and the strategic nature of the plan-level assessments (due to insufficient detail of projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN. It should be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments of the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessments.

5.4.111 Paragraphs 4.2.5 *et seq* and Table 4.3 present a number of projects which were considered as part of the Cumulative Effects Assessment (Chapter 17 of the March 2016 ES), and included a number of projects (including solar farm and wind turbine developments) in proximity to the M4CaN which had the potential to affect features of the Severn Estuary SPA. No in-combination LSEs were identified for these projects with the M4CaN, due to a lack of information on these projects (i.e. due to their being at an early stage in development), the small scale

of the effects on the qualifying features, and/or the fact that these related to qualifying features for which the M4CaN was not predicted to affect.

5.4.112 LSEs would, however, be expected on features of the Severn Estuary SPA as a result of the Cardiff and Newport Tidal Lagoon projects. As discussed in paragraph 4.2.5, effects from these projects are expected to comprise loss of estuarine habitats (e.g. mudflats and sandflats), with consequent effects on SPA bird populations which depend on these. Due to the early nature of these developments, however, it has not been possible to complete an in-combination assessment with the M4CaN, although it should be noted that the very different nature of the impacts of the Scheme (there would be no significant loss of estuarine habitats) and their small scale (only the displacement of a small number of birds outside the SPA) indicates that in-combination effects are unlikely.

5.4.113 The Shoreline Management Plan (SMP2) for the Severn Estuary identified potential adverse effects on the integrity of the Severn Estuary SPA due to loss of intertidal habitat and subsequent potential impacts on ornithological features. In order to compensate for this adverse effect on integrity, one of the actions of the SMP2 (as explained in Section 4.2 above) has been to create compensatory habitat to replace the relevant habitats (which are listed as features of European sites) in order to maintain the integrity of the site and help achieve the relevant conservation objectives of the site/features (Severn Estuary Coastal Group, 2010b).

5.4.114 Projects associated with SMP2 were discussed in paragraph 4.2.10, i.e. the Portland Grounds flood defence and Tabb's Gout flood defence. Although these were initially considered to have the potential to disturb overwintering bird features of the Severn Estuary SPA and Ramsar Site, significant effects were subsequently not predicted to occur as a result of these projects, due to the avoidance of construction operations during the overwintering period. Therefore, there is no potential for LSEs in-combination with the M4CaN.

5.4.115 Research by Burton *et al*. (2010) into key environmental issues affecting the Severn Estuary identified some trends (e.g. the effects of climate change, and changes over time to sewage treatment regimes) which are the main driving forces behind bird population changes within the SPA.

5.4.116 Climate change was one of the key issues discussed by Burton *et al.* (2010), and research on the changing status of water birds in Great Britain has revealed that nine wader species are now wintering in decreasing proportions in south west Britain. Given that current climate change scenarios predict further increases in temperatures for Great Britain, it might thus be predicted that the proportions and overall numbers of waders wintering on the Severn Estuary, and in southwest Britain as a whole, would continue to decrease. However, it should be noted that species and populations of water bird that currently winter further south or west, in France, Spain, Portugal or Ireland, could move north to winter in the Severn Estuary.

5.4.117 Water quality also affects waterfowl numbers both positively and negatively. Over the last two decades there have been major improvements in treatment and discharge of sewage in the UK as a result of the implementation of EC policy and legislation. Despite sewage being a historical source of contamination, within the Severn Estuary it has also historically provided a very important source of

nutrients to a system that is relatively nutrient-poor, with the result that outfalls have been a key resource for wading birds (owing to the increase in prey biomass). The cleaning up of the Severn Estuary under EU bathing water legislation has thus also contributed significantly to waterfowl population changes in the Severn Estuary.

Effect on Site Integrity

5.4.118 Based on the information presented above, no adverse effects on the integrity of the Severn Estuary SPA are predicted as a result of the M4CaN, alone or in-combination with other plans or projects.

5.5 Severn Estuary Ramsar Site

5.5.1 The Screening Assessment concluded there was the potential for LSEs on the qualifying bird (i.e. Bewick's swan, European white-fronted goose, dunlin, redshank, shelduck, gadwall and an internationally important assemblage of waterfowl) and migratory fish interest features (i.e. sea lamprey, river lamprey, twaite shad, allis shad, Atlantic salmon, sea trout and European eel) of the Severn Estuary Ramsar site.

5.5.2 In addition to these species, herring gull and lesser black-backed gull are included on the Information Sheet on Ramsar Wetlands as a noteworthy species and species for future inclusion respectively. The citation states that approximately 4,167 apparently occupied lesser black-backed gull nests are present, as well as 1,540 apparently occupied herring gull nests. Although both species were reported in the study area, no nests or breeding behaviour were reported. These species are known to range over large areas (50 km – 60 km from breeding colonies) and therefore exploit wide areas.

5.5.3 As set out for the Severn Estuary SAC and SPA in Sections 5.3 and 5.4 above, the M4CaN project would not directly affect land within the boundary of the Severn Estuary Ramsar Site, and therefore any LSEs would only occur on land in the vicinity rather than within the Ramsar Site itself. Effects on qualifying bird interest features of the Severn Estuary Ramsar Site are identical to those of the Severn Estuary SPA (see paragraph 5.4.1). Effects on qualifying migratory fish interest features of the Severn Estuary Ramsar Site are identical to those of the River Usk SAC (see paragraph 5.3.1), with the exception of the LSEs identified for European eel and sea trout.

5.5.4 Five additional species are considered as part of the Ramsar Site designation, in addition to those in the SPA citation. These are migratory species with peak counts in spring/autumn - little egret, ruff, whimbrel, Eurasian curlew (breeding) and greenshank. These species are further discussed in paragraph 5.5.85 *et seq*.

5.5.5 European eel and sea trout are both listed as features of the Severn Estuary Ramsar Site, and migrate through the Severn Estuary to the River Ebbw and River Usk, with European eel also occurring throughout the watercourses of the Gwent Levels. The Screening Assessment therefore identified the following LSEs on migratory fish species:

- Land take leading to habitat loss/fragmentation of European eel habitat within the Gwent Levels, outside of the Ramsar Site (construction and operation).

- Physical presence of the M4CaN may represent a barrier to the movement of European eels across the Gwent Levels (operation).
- Release of pollutants into water courses leading to water quality changes and potential physiological/behavioural/barrier effects during migration through the River Ebbw and River Usk and across the Gwent Levels (construction and operation).
- Noise and vibration leading to disturbance/barrier effects during migration through the River Ebbw and River Usk and across the Gwent Levels (construction); and
- Lighting for the M4CaN causing behavioural/barrier effect on fish migration through the River Ebbw and River Usk and across the Gwent Levels (construction and operation).

Migratory Fish

Baseline

5.5.6 The baseline characterisation of migratory fish occurring within the River Usk and the wider Severn Estuaryis described in paragraphs 5.2.3 to 5.2.11. Two additional species are features of the Severn Estuary Ramsar Site (European eel and ea trout. A summary of migration periods for the migratory fish interest features is provided in Table 5.1. Chapter 10 of the March 2016 ES provides a baseline description of the migratory fish species occurring within the River Usk and wider Severn Estuary (Section 10.4 and Appendix 10.18: Aquatic Ecology Desk Top Study of the March 2016 ES). No site-specific surveys were undertaken for migratory fish, and therefore the baseline is based on desk study information. This was considered to be appropriate due to the availability of information and data on fish migration (particularly timing of migrations) from a range of sources around the Severn Estuary and River Usk, including long term monitoring at the Hinkley Power Station (e.g. Claridge *et al*., 1986; EDF, 2011) and the information presented within the Severn Tidal Power reports (DECC, 2008), and also on the basis that this SIAA assumes that all of the qualifying migratory fish features of the River Usk SAC are present and would be passing through the Usk Estuary to reach spawning grounds.

5.5.7 Baseline information on European eel and sea trout (both listed as features of the Severn Estuary Ramsar Site, but not of the River Usk SAC and Severn Estuary SAC) is provided below.

European eel

5.5.8 The European eel is listed as critically endangered on the International Union for Conservation of Nature (IUCN) Red List and the global population of the species is declining (IUCN, 2014). The European eel is a priority species in the OSPAR list of threatened and declining species. It is also a UKBAP priority species and it is a species of principal importance for the purpose of conserving of biodiversity listed under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006. Section 42 of the NERC Act has been replaced by Section 7 of the Environment (Wales) Act 2016. The Section 7 list is interim and is exactly the same as the previous list under Section 42 of the NERC Act

5.5.9 European eel is also listed as a nationally important marine species (NIMS; Avant, 2007).

5.5.10 European eels begin their life as eel larvae, and it is thought that they drift from their birthplace in the Sargasso Sea for three years across the Atlantic on ocean currents to the Severn Estuary. Here they metamorphose into 'glass eels' and subsequently develop into more pigmented 'elvers'.

5.5.11 Most upstream migration of elvers (juveniles) occurs between April and September (inclusive) and is followed by a freshwater phase (lasting several years). This is a feeding and growing stage, before they migrate out of the estuary. The peak downstream migration of adult eels takes place between September and November (EDF, 2011). Spawning takes place in late winter and spring, again assumed to be in the Sargasso Sea area.

5.5.12 Low numbers of European eel have been recorded in fyke net surveys undertaken by NRW between 2008 and 2015 off Goldcliff, to the east of the mouth of the River Usk (NRW, 2015); European eel were typically recorded during spring netting surveys. There is a lack of data relating to fish ecology associated with the reen systems of the Gwent Levels, although the reens are known to support a large population of European eel, which dominate the fish stocks in these waterbodies (NRW pers. comm., 2015). The results of two fyke net surveys, undertaken by CCW in the summers of 2008 and 2009 in the Rhosog Fawr Reen (Rumney and Peterstone SSSI) support these broad conclusions with European eel recorded in both years (NRW, 2015). In addition, data provided by NRW (2015) from timed fyke net surveys in the River Ebbw between 1996 and 2007 (all sites north of the existing M4) recorded European eel within the River Ebbw.

Sea trout

5.5.13 Sea trout generally enter the rivers of South Wales between June and September, with smaller numbers entering at other times of the year. The timing of the downstream migration of sea trout smolts is similar to that of Atlantic salmon (April to June). They differ from salmon in that they have a greater propensity to survive to undertake repeated spawnings and their marine phase is usually more coastal than salmon, which undertakes more extensive marine migrations. This species is likely to occur within the River Usk and River Ebbw, but is not likely to occur within the reens of the Caldicot and Wentlooge Levels. The majority of the discussion in the following paragraphs therefore relates to the European eel only.

5.5.14 Data provided by NRW (2015) from timed fyke net surveys in the River Ebbw between 1996 and 2007 (all sites north of the existing M4) show brown /sea trout to be frequently recorded (up to 1.4 fish caught per minute).

Potential Effects on the Conservation Objectives for the migratory fish interest of the Seven Estuary Ramsar Site

5.5.15 The conservation objectives for the migratory fish interest features of the Severn Estuary Ramsar Site are identical to those for the Severn Estuary SAC and are provided in Appendix C2. As with the conservation objectives for the interest features of the Severn Estuary SAC, the conservation objectives for these interest features are to maintain the features in a favourable condition. Appendix C2 provides details of the specific attributes, measures and targets for determining favourable condition for the Seven Estuary Ramsar Site and for the purpose of relevant Ramsar Site interest features, with summaries provided in

paragraph 5.3.3 for migratory fish interest features (i.e. these are identical to those of the Severn Estuary SAC).

5.5.16 The following sections provide an assessment of the effects of the Scheme on the conservation objectives above, with the assessment undertaken under headings for the LSEs listed in paragraph 5.5.5. The assessments also consider mitigation to be implemented as part of the project for migratory fish (paragraph 5.5.65 *et seq*.). The potential effects on sea trout would be the same as for the other migratory species of the River Usk SAC and the Severn Estuary SAC since, in the vicinity of the Scheme, they would be confined to the River Usk and the River Ebbw. The effects on conservation objectives for the European eel feature of the Severn Estuary Ramsar Site are considered below for each conservation objective using the information presented within the assessments below (see paragraph 5.5.68 *et seq*.). Effects on the integrity of the Severn Estuary Ramsar Site as a whole are then considered in paragraph 5.5.92, with consideration of effects on the conservation objectives for both migratory fish and wintering birds.

Land take leading to habitat loss/fragmentation of European eel habitat across the Gwent Levels, outside the Ramsar Site

5.5.17 Chapter 10 of the March 2016 ES assesses the impacts of habitat loss/fragmentation of habitats (including those used by European eel) across the Gwent Levels. The effects on the freshwater fish assemblage (including European eel) are assessed in Section 10.8 of the March 2016 ES for construction and Section 10.9 for operation.

Construction

5.5.18 Due to the duration of the construction phase of the Scheme (approximately 42 months; see March 2016 ES Chapter 3: Scheme Construction), temporary severance and fragmentation of habitats has the potential to result in significant impacts upon the integrity and connectivity of aquatic habitats, including those used by European eel. Temporary severance and/or fragmentation of aquatic habitats would occur during construction through the creation of access routes (which would involve the construction of temporary pipe culverts), construction compounds and other land take, and the construction of the motorway corridor itself, including the construction of culverts to route reens and ditches beneath the motorway corridor. The areas of temporary land take for construction and storage compounds have been chosen to minimise disruption to the existing reen network.

5.5.19 The primary cause of watercourse fragmentation would be the creation of culverts to route reens and field ditches beneath the motorway corridor. Design of construction would seek to ensure that the severance of watercourses during culvert construction would be as brief as possible. It is anticipated that the construction of culverts would be staggered throughout the duration of the Scheme construction, with each culvert reconnected to the network rapidly following its completion. While the culvert itself would take time to establish as a habitat in terms of substrate depth and composition, functional connectivity for eels would be maintained. Full details of the reens and ditches to be lost and culverted have been presented in March 2016 ES Chapter 2: Scheme Description and within the EMP (Figure R2.6 of the September 2016 ES Supplement). The sequence of crossing reens and ditches in a typical section of

the Gwent Levels is shown in Annex 7 of the revised Buildability Report (Appendix SR3.1 of the December ES Supplement).

5.5.20 Longitudinal connectivity (along watercourses) is of fundamental importance to all aquatic organisms (Environment Agency, 2010), and this is particularly important for highly mobile fauna such as fish. Connectivity is particularly important for migratory fish such as the European eel, which return from the sea to freshwater habitats as elvers where they mature before returning to the sea to breed. Eel have the advantage of being able to cross damp land to locate new waterbodies.

5.5.21 Mitigation in the M4CaN design proposals referred to above would minimise the fragmentation of the existing reen network, but some reens and ditches would be infilled or truncated during construction (as further discussed in paragraph 5.5.23 *et seq* below).

5.5.22 In order to mitigate any negative effects on European eel, and other ecological features of the reen and ditch network of the Gwent Levels, a Reen Mitigation Strategy has been developed through consultation with NRW. This strategy includes details of how reen connectivity is to be maintained (e.g. through installation of culverts and replacement of reens and ditches where these are lost) and other measures to minimise negative impacts on reen habitats and species utilising them and the wider Gwent Levels. Further details of this mitigation strategy are summarised in paragraph 5.4.82, with the draft Reen Mitigation Strategy presented in Appendix 2.3 of the March 2016 ES and a Supplementary File note on the Reen Mitigation Strategy at Appendix 2.1 of the September 2016 ES Supplement.

Operation

5.5.23 During construction of the M4CaN, 2,755 m of reens (consisting of approximately 20 separate reen sections) and 9,373 m of field ditches (approximately 51 sections) would be infilled or culverted. As described in paragraph 5.5.20, longitudinal connectivity across the reen network is of fundamental importance for freshwater fish, including European eel (Environment Agency, 2010) and therefore there is the potential for fragmentation and/or severance of the reen network. Details of reens to be affected and associated new culverts are provided in March 2016 ES Chapter 2: Scheme Description and the EMP (Figure R2.6 of the September 2016 ES Supplement).

5.5.24 Culverting of reens and ditches would maintain the connectivity of these watercourses. European eels are considered able to tolerate these short macrophyte-free sections, especially given their preference for relatively silted watercourses and low light conditions, together with their high mobility.

5.5.25 Mitigation has been incorporated in the design proposals to maintain the connectivity of reens and ditches within the network as far as practicable (see paragraph 5.4.82). New reens constructed as part of the M4CaN Scheme would reconnect reens that have been crossed. Where field ditches are infilled or cut off by the works, new ditches would be created; these would connect to the nearest reens and compensate for loss of habitat connectivity. It is proposed that the total length of replacement reens and ditches would be essentially the same as the reens and ditches to be infilled.

5.5.26 As explained in the Reen Mitigation Strategy (March 2016 ES Appendix 2.3) continuing advice would be sought from NRW on the specification for reen

design. Each section of reen would be designed in detail, and the need to provide a range of ecological conditions, by varying depths and alignments (within the constraints of land availability and the need to ensure satisfactory drainage characteristics), would be an important part of the design of each section. Welsh Government would identify areas where there is scope for widening of reens to provide shallow margins, and would also provide an illustrative design. The design of reens as set out on the Reen Mitigation Strategy (as revised) is based on the standard indicative dimensions put forward by NRW which includes a width of 5.7m. The River Corridor Survey (March 2016 ES, Appendix 10.32) sets out, amongst other things, the dimensions of the reens to be lost to the scheme. The width of the reens being is lost is generally about 4m. There is therefore scope to incorporate shallow areas, particularly on the non-motorway side of the reen which would be open to grazing by cattle (and therefore poaching) alongside the reen. There is thus sufficient flexibility to ensure that the reens have sufficient capacity whilst enabling shallow margins to be provided.

5.5.27 Taking into account the proposed mitigation described above, the effects of habitat fragmentation upon freshwater fish in the reen network would be minimal (see March 2016 ES Section 10.9). Whilst the development of the mature habitats within the newly created reen and ditch network may take some time, the presence of these features would ensure that effects of habitat loss/fragmentation of European eel habitats would be minimal.

5.5.28 The effects of land take of the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary Ramsar Site are considered in paragraph 5.5.68 et seq.

Physical presence of the M4CaN may pose a barrier to the movement of European eels across the Gwent Levels (operation)

5.5.29 As explained in the assessment above, there is the potential for the operational M4CaN to represent a barrier to migration of European eel across the Gwent Levels and to/from other watercourses in the area (e.g. River Ebbw, River Usk and Severn Estuary). Any potential barrier effects on European eel would be minimised through the implementation of the measures summarised above and set out in the Reen Mitigation Strategy (Appendix 2.3 of the March 2016 ES) and the Supplementary File note on the Reen Mitigation Strategy (September 2016 ES Supplement Appendix S2.1). These include maintaining connectivity of the reen network north and south of the operational M4CaN by culverting reens crossed by the M4CaN (see March 2016 ES Chapter 2: Scheme Description for details of reens to be crossed by the M4CaN). Creation of new reens and ditches (which would be connected to the wider network in the Gwent Levels) would compensate for those reens and ditches infilled during construction and maintain connectivity to the wider network.

5.5.30 The effects of the physical presence of the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary Ramsar Site are considered in paragraph 5.5.68 et seq.

Release of pollutants into water courses leading to water quality changes and potential physiological/behavioural/barrier effects during migration through the River Ebbw and River Usk and across the Gwent Levels

5.5.31 The assessment of the effects of release of pollutants from the M4CaN (specifically the Usk crossing) on migratory fish features of the River Usk SAC during construction and operation of the M4CaN on migratory fish features of the River Usk SAC (which includes the species listed as features of the Severn Estuary Ramsar Site with the exception of European eel and sea trout) is presented in paragraph 5.2.14 *et seq*. Paragraphs 5.3.5 *et seq*. presents additional information on the effect of release of contaminants on estuarine prey species of the qualifying features of the Severn Estuary SAC and Ramsar Site.

5.5.32 Chapter 10 of the March 2016 ES presents the assessment of the potential effects of release of pollutants on the freshwater fish assemblage (including European eel), with the effects during construction presented in Section 10.8 and effects during operation presented Section 10.9.

Construction

5.5.33 The effects of potential pollution from inappropriate storage of chemicals or spillages have been assessed in Chapter 10 of the March 2016 ES. Pollution with chemicals (e.g. hydrocarbons, cement additives, detergents) can have significant detrimental effects upon fish populations in rivers for many kilometres downstream of the pollution input, with five of the most commonly occurring toxic chemicals in freshwater environments being ammonia, copper, cyanide, phenol and zinc (Mason, 1991). The species characteristic of the reen network (e.g. roach, tench and European eel) display similar sensitivities to such pollutants, and are expected to be generally more tolerant than species characteristic of faster flowing rivers. The relative tolerance of these species to pollution events is dependent upon the level and duration of pollutant input and the reduced water flows within the reen network may therefore result in a greater and more prolonged effect should such a pollution event occur.

5.5.34 European eel is notable as a potentially useful indicator species for pollution events; this species may remain relatively sedentary during their development period of up to 20 years in freshwater, and can spend a large proportion of their time in close contact with the sediment, from which they can absorb contaminants (Mason, 1991). This can result in bioaccumulation of pollutants within the eel rather than acute toxicity and resulting mortality; however, significant pollution inputs can result in mass mortality of all fish species.

5.5.35 Measures would be employed throughout the construction phase to ensure appropriate storage of chemicals and fuels in accordance with best practice set out in NRW PPGs. This includes best practice to be implemented in the event of a leak or spillage in order to contain the pollution and prevent harm to the environment. It is anticipated that these mitigation measures (see also paragraph 5.2.68 et seq) would be sufficient to reduce the risk of pollution from chemicals or spillages on the aquatic environment and the magnitude of spills should these occur.

5.5.36 The potential effects of particulate pollution due to run-off from the construction areas on the freshwater fish assemblage (including European eel) are assessed and presented in March 2016 ES Section 10.8.

5.5.37 Construction of the Scheme would inevitably result in significant areas of bare earth, with the potential for large quantities of silt, other sediment and associated pollutants to run-off into the reen network. Therefore, in the absence of mitigation, there is the potential for large additional quantities of silt to disrupt the ecological balance of the reen network.

5.5.38 Coarse fish species present within the reen network, including European eel, are adapted to the conditions maintained by the on-going management of the system (see March 2016 ES Section 10.8). The preference of these fish species for still or slow-flowing water means that they are tolerant of relatively high levels of siltation and a soft substrate of fine sediment. Due to their slow-flowing nature, the reens and field ditches have a propensity for the accumulation of silt, current levels of which are controlled by on-going management.

5.5.39 While the freshwater fish community is adapted to survive in the slow-flowing conditions characteristic of the reen network, a significant additional input of fine sediment above and beyond what is currently managed through the on-going maintenance cycle may lead to the following impacts and effects on European eel: choking and shading of aquatic vegetation resulting in plant decay and increased eutrophication; reduced oxygen levels due to reduced macrophyte growth and eutrophication; increased turbidity of heavily silted sections creating impassable barriers to fish movement; and direct mortality of fish in blind-ending reens and ditches due to siltation and associated pollution inputs.

5.5.40 In order to mitigate for any potentially negative effects of construction related water pollution, the SWMP would consider all drainage required during the construction phase, referencing all industry and regulatory pollution prevention guidelines (see March 2016 ES Chapter 16: Drainage and the Water Environment and paragraph 5.2.68 et al).

Operation

5.5.41 The effects of the release of pollutants into water courses on the freshwater fish assemblage of the reen and ditch network of the Gwent Levels was assessed in Chapter 10 of the March 2016 ES, under the following headings:

- Effects of highway drainage (paragraphs 10.9.82 to 10.9.90);
- Salt accumulation from de-icing operations may affect the ecology of the receiving watercourses (paragraphs 10.9.94 to 10.9.99); and
- Potential for pollution events resulting from collision/other traffic incidents on the new road (paragraphs 10.9.91 to 10.9.93).

5.5.42 As explained in Section 2.7, all drainage (with the exception of the discharges to the River Usk and River Ebbw) would be treated through water treatment areas prior to discharge to the main reen network (full details of these, including receiving water courses, are provided in Chapter 16 of the March 2016 ES). . Runoff from the new section of motorway through the Gwent Levels would be intercepted into grassed channels in the road verge. These channels would transfer the runoff to the water treatment and attenuation areas. The grassed channels would be lined with a geosynthetic clay liner (and topsoil) to contain

pollutants. The use of grassed channels would reduce the flow rate and would allow for some sediment to be deposited and oily residues and organic matter to be retained and broken down. Where the use of grassed channels is not possible, concrete channels would be utilised. The water treatment areas would include a small lagoon for capture of hydrocarbons and grit prior to runoff entering the main attenuation pond. The water would then pass through a reedbed for final treatment before discharging to a reen.

5.5.43 All infrastructure capturing drainage from the new section of motorway would be designed to capture runoff from the carriageway for all events up to a1 in 100 year rainfall event, with a 30% allowance for climate change. During operation of the Scheme (as explained in March 2016 ES Chapter 16: Road Draiange and the Water Environment), routine drainage has been assessed utilising an approved risk assessment tool for the evaluation of pollution of watercourses. Given the high sensitivity of the Gwent Levels, the Scheme design has incorporated the use of roadside grass lined channels capturing and transferring runoff to water treatment areas. Both the grass lined channels and the water treatment areas are capable of removing the potential pollutants emanating from the carriageway to allow water to return to the reen network to both prevent flooding (to a 1 in 100 year plus climate change standard) and to preserve long term water quality conditions of the Gwent Levels.

5.5.44 This water treatment infrastructure is considered sufficient to prevent any consequent negative effects on the freshwater fish assemblage (including European eel).

5.5.45 The effects of release of pollutants from the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary Ramsar Site are considered in paragraph 5.5.69 *et seq*.

Noise and vibration leading to disturbance/barrier effects during migration through the River Ebbw and River Usk and across the Gwent Levels (construction)

Construction of River Usk crossing

5.5.46 The assessment of the effects of noise and vibration during construction of the M4CaN (specifically the Usk crossing) on the migratory fish features of the River Usk SAC (which includes five of the species listed as features of the Severn Estuary Ramsar Site, European eel and sea trout being the other species) is presented in paragraph 5.2.27 *et seq*. Paragraph 5.3.10 *et seq* presents additional information on the effect of underwater noise on estuarine prey species of the qualifying features of the Severn Estuary SAC and Ramsar Site.

5.5.47 Chapter 10 of the March 2016 ES presents further information on the sensitivity of European eel and sea trout to underwater noise (see March 2016 ES Section 10.8), both of which are not considered to be particularly sensitive to the underwater noise levels associated with vibropiling operations. During vibropiling at Red Funnel's Southampton Terminal in Southampton Water, monitoring of caged trout revealed no evidence that trout reacted to the vibropiling, even at a range of less than 50 m (Nedwell *et al*., 2003). The upper audible frequency limit in European eel has been reported as being approximately 300 Hz (Jerkø *et al*., 1989). The hearing range of European eel is likely to be below the range of

frequencies that are likely to be generated by the vibropiling but does overlap with the dominant frequencies of ship noise.

5.5.48 The potential for effects of piling associated with the River Usk crossing on sea trout and European eel were considered to be limited, on the basis that the hearing frequencies for European eel are unlikely to overlap with those generated by the proposed piling activities and that studies have demonstrated no evidence that sea trout react to vibropiling.

Construction operations in the Gwent Levels

5.5.49 The impact assessment of construction noise on fish assemblage (including European eel) within the reen network is presented in March 2016 ES, Section 10.8.

5.5.50 Normal working hours would be 07.00 to 19.00 hours Monday to Friday, and 07.00 hrs to 17.00 hours on Saturdays; however, some out of hours and 24 hour working will be required.

5.5.51 The installation of pre-cast driven piles would be required along the route of the new motorway where a higher embankment is needed to take the proposed carriageway over existing side roads and the main railway line. Driven piles may also be required to support new culverts. All piling for culverts would be undertaken in dry channels, with flows of water diverted (e.g. using temporary sheet piles) and sediments excavated to create a reduced level platform to undertake piling. Such construction activities would be likely to generate significant noise above background levels (although noise would only enter the aquatic environment via transmission through the ground) and given the close proximity of the works to watercourses in the reen network, disturbance to freshwater fish species (including European eel) is possible. Piling events would represent intermittent occurrences throughout the construction phase. Most studies of anthropogenic noise have concentrated on high intensity noises from sources such as pile driving or seismic air guns (Popper and Hastings, 2009). European eel is sensitive to low frequency continuous noise sources, including shipping noise and may therefore be sensitive to some other aspects of construction noise in proximity to the reen and ditch network.

5.5.52 Throughout the construction phase it is proposed to maintain the connectivity of reens and ditches within the network through the creation of culverts (see paragraph 5.5.17 *et seq.*). Therefore it would be possible for fish to utilise the longitudinal connectivity and reen/ditch network to avoid areas exposed to construction noise and seek refuge in areas where no construction activities are occurring at that time. Whilst the construction works are planned over approximately 42 months (see March 2016 ES Chapter 2: Scheme Construction), only a small proportion of the reen network would be disturbed by construction activities at any one time. Furthermore, the majority of construction activities would be scheduled during daylight hours and therefore would avoid the periods of darkness when adult European eels are most active, including periods of migration (further discussed in paragraph 5.5.56 et seq below).

5.5.53 The effects of construction noise from the M4CaN on the conservation objectives of the migratory fish features of the Severn Estuary Ramsar Site are considered in paragraph 5.5.71.

Lighting for the M4CaN may cause behavioural/barrier effect on fish migration through the River Ebbw and River Usk and across the Gwent Levels

5.5.54 The assessment of the effects of lighting of the M4CaN River Usk crossing during construction and operation on migratory fish features of the River Usk SAC (which includes five of the species listed as features of the Severn Estuary Ramsar Site) is presented in paragraph 5.2.57 *et seq*. As described in these sections, the careful design and siting of construction lighting, and avoidance of directly illuminating the channel and banks of the River Usk and the River Ebbw, would reduce the potential for adverse behavioural effects on migratory fish species (including sea trout and European eel) during the construction phase and operation of the M4CaN River Usk crossing.

5.5.55 The potential effects of light on the fish assemblage (including European eel) within the reen network is presented in Chapter 10 of the March ES, paragraphs 10.8.186 to 10.8.192 (construction) and 10.9.100 to 10.9.102 (operation).

Construction

5.5.56 Normal working hours would be 07.00 to 19.00 hours Monday to Friday, and 07.00 hrs to 17.00 hours on Saturdays; however, some out of hours and 24 hour working would be required. Working areas would need to be lit during periods of night working and some lighting would also be required for access roads and walkways and therefore there is potential for light disturbance of European eel within the reen network.

5.5.57 Eels are strongly photophobic (Bruijs and Durif, 2009) and studies have documented strong avoidance reactions to light. Both the movement of glass eel and elver into freshwaters and of pubescent silver eel to sea typically occur at night (Bruijs and Durif, 2009) and light falling onto their migratory pathway may have a marked obstructive effect on their movement (Sörensen, 1951; Hadderingh *et al*., 1992; though this study used high intensity light to deter eels from power station intakes). Mature eels are also more active at night and are therefore susceptible to disturbance from artificial light.

5.5.58 The area in the vicinity of the River Usk crossing currently includes industrial docklands and Newport city centre, and both the Transporter Bridge and the Southern Distributor Road Bridge are lit. Therefore there is a degree of existing light spill into the River Usk and to a lesser extent the River Ebbw..

5.5.59 Throughout the construction phase it is proposed to maintain the connectivity of reens and ditches within the network in the Gwent Levels (see paragraph 5.5.17 *et seq.*). Therefore during construction it would be possible for fish to utilise the longitudinal connectivity and reen/ditch network to avoid light disturbance and seek refuge in areas unaffected by light disturbance. Whilst the construction works are planned over approximately 42 months (see Chapter 2: Scheme Construction), only a small proportion of the reen network would be disturbed at any one time.

5.5.60 In addition, lighting required during the construction of the Scheme would be located to ensure that the required areas are precisely lit with minimal light spill to watercourses i.e. reens and ditches as well as the River Ebbw and River Usk (see paragraph 5.2.74 et seq).

Operation

5.5.61 As explained in in Section 2.8 and in the March 2016 ES Chapter 2: Scheme Description, the Scheme would be unlit with the exception of junctions (including approach and link roads) and the River Usk Crossing. The use of LED luminaires is proposed as part of the Scheme design, allowing directional lighting onto the carriageway with minimal light spill. The minimum clearance between mean high water and the centre of the River Usk crossing is 32 m, with lighting columns a further 12 m above the deck level. As such the potential for disturbance to European eel from light effects in the River Usk and Ebbw during operation would be minimal.

5.5.62 Effects of lighting during operation of the M4CaN would be minimised through implementation of an effective lighting strategy including directional lighting to minimise spillage onto watercourses, i.e. the reen and ditch network, the River Usk and River Ebbw (see paragraph 5.2.74).

5.5.63 As described in paragraph 5.5.54, artificial lighting can result in disturbance of European eel, which would be expected to avoid areas affected by artificial lighting. Following recolonisation of newly created reens and field ditches after the construction phase, it is anticipated that there would be sufficient macrophyte cover to provide shelter for fish species from the low levels of light spillage that may occur in the vicinity of the junctions with the new motorway (should such spillage occur at all).

5.5.64 The effects of lighting of the M4CaN during construction and operation on the conservation objectives of the migratory fish features of the Severn Estuary Ramsar are considered in paragraph 5.5.72

Mitigation Measures

5.5.65 Mitigation measures would be implemented as part of the M4CaN project to ensure the project does not have the potential to adversely affect the conservation objectives effects of the migratory fish features of the Severn Estuary Ramsar Site. These measures are either embedded, i.e. designed into the M4CaN Scheme, or additional, i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Section 10.5 for further detail on embedded and additional measures). These measures (both embedded and additional) are considered, with the supporting information in the preceding paragraphs, in the context of the conservation objectives for the Severn Estuary Ramsar Site in paragraph 5.5.15 *et seq.* and are identical to those for the Severn Estuary SAC.

5.5.66 As most of the LSEs on migratory fish are the same or similar as those described for the River Usk SAC then the same mitigation measures are proposed, that is:

- Water quality, see paragraph 5.2.68 *et seq*;
- Noise and vibration, see paragraph 5.2.72 *et seq*; and
- Lighting see paragraph 5.2.74 *et seq*.

5.5.67 However, due to the presence of European eel using the Gwent Levels, additional mitigation measures would be implemented through the Reen Mitigation Strategy (Appendix 2.3 of the March 2016 ES and the Supplementary File note on the Reen Mitigation Strategy (September 2016 ES Supplement Appendix S2.1) which has been developed through consultation with NRW. Specific measures to minimise impacts on European eel would include:

- Retention of reen connectivity with the installation of culverts.
- Provision of eel passes on all new sluices
- Replacement of the length of reens at a ratio of approximately 1:1.
- Reinstatement of field ditches, at a ratio of approximately 1:1.
- Provision of access for NRW to maintain existing and new reens.
- Location and layout of temporary construction sites to avoid the infilling of reens and ditches.
- For watercourses which would be infilled, once isolated and subject to NRW agreement, translocation of fish to suitable watercourses prior to infilling..

Effects of the M4CaN on the Conservation Objectives for Migratory Fish

5.5.68 Potential effects on the relevant conservation objectives for migratory fish species of the Severn Estuary Ramsar Site (as presented in paragraph 5.5.5) are discussed in turn below.

The migratory passage of both adult and juvenile stages of the interest feature is not obstructed or impeded by physical barriers, changes in flows or poor water quality.

5.5.69 The passage of both adult and juvenile stages of European eel would not be obstructed or impeded during construction or operation of the M4CaN. Potential adverse effects would be avoided through the implementation of appropriate measures set out in the Reen Mitigation Strategy and the Supplementary File Note on the Reen Mitigation Strategy (see paragraph 5.5.67) which ensure that connectivity of the reen and ditch network in the Gwent Levels is maintained throughout construction and operation.

5.5.70 The passage of both adult and juvenile stages of migratory fish would not be obstructed or impeded by discharges from the M4CaN (i.e. poor water quality), due to:

- The implementation of a Pollution Prevention Plan, including best practice measures set out in NRW PPGs during the construction phase (see paragraph 5.2.68 *et seq*);
- The production and implementation of a SWMP to consider all drainage during the construction phase and prevent release of pollutants into water courses (see paragraph 5.2.68 for further detail);
- The provision of oil separators (and in the case of the River Usk a pollution control lagoon) to control levels of potential contaminants and suspended sediments to be discharged into the River Usk and River Ebbw and the high dilution from the point of discharge; and
- The water treatment infrastructure comprising grass lined channels and water treatment areas designed as part of the M4CaN scheme to avoid adverse effects on water quality in the reen network during operation.

5.5.71 The migratory passage of both adult and juvenile stages of migratory fish would not be obstructed or impeded by construction-related underwater noise, due to the avoidance of piling works for the east pylon of the River Usk crossing at the

key migration period of April-June and the relatively short term, intermittent and localised piling elsewhere. Behavioural effects on the relevant species (due to low noise levels predicted) would be limited should these occur at all.

5.5.72 The migratory passage of both adult and juvenile stages of migratory fish would not be obstructed or impeded by light shining onto the River Usk, River Ebbw or the reen and ditch network of the Gwent Levels, due to implementation of appropriate measures during construction and operation to minimise light spillage onto these watercourses.

The size of the interest feature's population within the Severn Estuary and rivers draining into it is at least maintained and is at a level which is sustainable in the long term.

5.5.73 The size of the European eel population within the Severn Estuary, the River Usk, River Ebbw and the reen and ditch network of the Gwent Levels connected to the Severn Estuary, would not be negatively affected by habitat loss/fragmentation of habitat on the Gwent Levels or physical presence of the M4CaN. This is due to access to the reen and ditch network being maintained during throughout the construction phase and creation of new reen and ditch habitats which would compensate for those lost during construction of the M4CaN.

5.5.74 The size of the migratory fish populations within the Severn Estuary, the River Usk, River Ebbw and the reen and ditch network of the Gwent Levels connected to the Severn Estuary, would not be negatively affected by potential release of pollutants due to the pollution control measures which form part of the Scheme.

5.5.75 The size of the populations of migratory fish within the Severn Estuary, the River Usk, River Ebbw and the reen and ditch network of the Gwent Levels connected to the Severn Estuary, would not be affected by underwater noise during construction of the M4CaN as significant effects on migration (upstream or downstream or within the Gwent Levels) are not predicted to occur.

5.5.76 The size of the populations of migratory fish within the Severn Estuary, the River Usk, River Ebbw and the reen and ditch network of the Gwent Levels connected to the Severn Estuary, would not be affected by lighting during construction or operation of the M4CaN.

5.5.77 Thus, the ability of the populations of migratory fish to be at least maintained and be sustainable in the long term would not be affected.

The abundances of prey species forming the interest feature's food resource within the estuary are maintained.

5.5.78 The abundances of prey species forming the food resource for European eel within the Gwent Levels would not be affected due to the measures included in the Scheme to maintain water quality and the connectivity and extent of the reen and ditch system.

5.5.79 The abundances of prey species forming the food resource for migratory fish within the Severn Estuary, River Usk and River Ebbw would not be affected due to the measures included in the Scheme to maintain water quality and avoidance of light spillage at the River Usk and River Ebbw crossings.

Toxic contaminants in the water column and sediment are below levels which would pose a risk to the ecological objectives described above.

5.5.80 Toxic contaminants in the water column and sediment would be maintained below levels which would pose a risk to the ecological objectives described above by the measures included in the Scheme to maintain water quality during construction and operation of the Scheme.

In-combination Assessment

5.5.81 The plans and projects considered within this in-combination assessment are presented in Section 4.2 (see also in-combination assessment in paragraphs 5.2.86 *et seq*. for the River Usk SAC and paragraph 5.3.30 *et seq*. for Severn Estuary SAC). As explained in Section 4.2, the outline nature of the plans and the strategic nature of the plan-level assessments (due to insufficient detail of projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN.

5.5.82 The plan-level HRAs concluded that the plans will not have an adverse effect on conservation objectives of the migratory fish features of the Severn Estuary Ramsar Site, particularly when the appropriate avoidance and mitigation measures identified in the plan level HRAs are implemented. It should also be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments on the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment.

5.5.83 The Shoreline Management Plan (SMP2) for the Severn Estuary identified potential adverse effects on integrity on the Severn Estuary Ramsar Site due to loss of intertidal habitat (with the creation of compensatory habitat to replace this; see paragraph 5.2.180). The M4CaN project would not have any effects on habitat features of the Severn Estuary Ramsar Site (see AIES Stage 1: Screening Report; Welsh Government, 2015) and therefore there is no in-combination effect (see paragraphs 5.3.30 *et seq*. for further discussion of in-combination effects on the Severn Estuary SAC).

Birds

5.5.84 The potential LSEs on qualifying bird species, outwith the Ramsar Site, are the same as those described previously for the Severn Estuary SPA (see section 5.4).

Baseline

5.5.85 The baseline characterisation for ornithological features of the Severn Estuary SPA and Ramsar Site is described in paragraph 5.4.2 *et seq*., with a summary of the site specific survey data provided in Tables 5.3 to 5.5. As explained in paragraph 5.5.4, five additional species are included in the Ramsar Site designation. These are migratory species with peak counts in spring/autumn - little egret, ruff, whimbrel, Eurasian curlew (breeding) and greenshank. Little egret, Eurasian curlew greenshank and ruff were recorded during transect and vantage point surveys for the M4CaN, although consistently in low numbers as follows:

- Little egret: maximum count of 5 individuals during transect surveys;

- Curlew: maximum count of 12 individuals during transect surveys;
- Greenshank: maximum count of 1 individual during transect surveys;
- Ruff: 1 individual recorded during all surveys (vantage point survey).

5.5.86 These species were considered in Chapter 10 of the March 2016 ES, but were not taken forward for assessment n this SIAA given the low number of individuals recorded and the sporadic nature of the records where made. As discussed in paragraph 5.5.2, herring gull and lesser-black backed gull (features of the Severn Estuary Ramsar Site) were reported in the study area, although no breeding behaviour was recorded within and in the immediate vicinity of the study area. The Ramsar Site citation states that approximately 4,167 apparently occupied lesser black-backed gull nests are present within the SPA, as well as 1,540 apparently occupied herring gull nests. These species are known to range over large areas (50km – 60km from breeding colonies).

Potential Effects on the Conservation Objectives

5.5.87 The conservation objectives for the bird species and the internationally important assemblage of waterfowl of the Severn Estuary Ramsar Site are to maintain them in favourable condition, as defined by the conservation objectives for the Severn Estuary SPA (see paragraph 5.4.25 *et seq*).

5.5.88 The potential effects of the M4CaN Scheme on the bird features of the Severn Estuary Ramsar Site are the same as those considered for the Severn Estuary SPA (see paragraph 5.4.25 *et seq*).

Mitigation Measures

5.5.89 As the effects on ornithological features of the Severn Estuary Ramsar Site are the same as those described for the Severn Estuary SPA, the same mitigation measures are proposed for the qualifying birds of the Severn Estuary Ramsar Site (see paragraph 5.4.78 *et seq*).

In-Combination Effects

5.5.90 The plans and projects considered in this in-combination assessment are presented in Section 4.2 (see also in-combination assessment for Severn Estuary SPA in Section 5.4.110 *et seq*.). As explained in Section 4.2, the outline nature of the plans and the strategic nature level of the plan-level assessments (due to insufficient detail of projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN. It should also be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments on the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment.

5.5.91 The Shoreline Management Plan (SMP2) for the Severn Estuary identified potential adverse effects on integrity on the Severn Estuary Ramsar due to loss of intertidal habitat and subsequent potential impacts on ornithological features. In order to compensate for this adverse effect on integrity, one of the actions of the SMP2 is to create compensatory habitat to replace the relevant habitats (which are listed as features of European sites), to maintain the integrity, structure and function of EU site and the species they support (i.e. including

ornithological features) and help achieve the relevant conservation objectives of the site/features (Severn Estuary Coastal Group, 2010b; see also paragraphs 5.4.113 *et seq*. for further discussion of in-combination effects on the Severn Estuary SPA).

Effect on Site Integrity

5.5.92 Based on the information presented above, no adverse effects on the integrity of the Severn Estuary Ramsar Site are predicted as a result of the M4CaN, alone or in-combination with other plans or projects (taking into account the compensatory measures discussed above for the SMP2).

5.6 Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC

5.6.1 Potential LSEs were identified on qualifying bat species (i.e. lesser and greater horseshoe bats) of the SAC. These include:

- Direct land take leading to habitat loss/fragmentation of roosts/foraging routes and severance of flight lines (construction);
- Physical presence leading to disturbance to species/restriction in movement/ severance of flight lines (construction and operation);
- Physical Presence - vehicle collision and increased predation risk (construction and operation);
- Noise and vibration leading to disturbance to species (construction and operation);
- Lighting has the potential to disturb species and sever flight lines (construction and operation); and
- Release of pollutants leading to water quality changes/physiological effects which in turn could affect insect prey populations (construction and operation).

Baseline

5.6.2 The Wye Valley and Forest of Dean Bat Sites/Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC is designated for lesser horseshoe and greater horseshoe bats.

5.6.3 The SAC comprises a complex of sites on the border between England and Wales containing the greatest concentration of lesser horseshoe bats in the UK, equivalent to approximately 26% of the national population. The complex also represents the northern part of the range for greater horseshoe bats and supports approximately 6% of the UK population. The sites contain maternity bat roosts as well as hibernation roosts in disused mines.

5.6.4 The SAC includes four SSSIs, two of which are located within the study area for the M4CaN: the Mwyngloddfa Mynydd-Bach SSSI and the Wye Valley Lesser Horseshoe Bat SSSI.

5.6.5 The Mwyngloddfa Mynydd-Bach SSSI provides habitat for the lesser horseshoe bat, including disused mines suitable for hibernation, and the Wye Valley Lesser Horseshoe Bat SSSI includes summer nursery roosts for lesser horseshoe bat.

2014 Bat Surveys

5.6.6 In 2014, a series of bat activity surveys were undertaken by Arup (Appendix 10.7 of the ES). Wildlife Acoustic Song Meter 2 Ultrasonic Bat Detectors (SM2+ BAT) were used to record bat activity for five consecutive nights at 20 locations along the route each month from April to October. During these surveys, activity of a limited number of/individual lesser horseshoe bats was recorded at eight of the 20 static detector locations as shown on Figure 3. These locations were all to the east of the River Usk, between Pye Corner and the eastern end of the study area, and spread over 9 km, i.e:

- bat detector location 11, Figure 3c, close to Pye Corner, where, during five night survey periods in April and October, between 5 and 7 lesser horseshoe bat passes were recorded;
- bat detector locations 13-15, Figure 3d, within or adjacent to the Tata Steel site, where during five-night survey periods in September and April, between 1 and 3 lesser horseshoe bat passes were recorded;
- bat detector location 16, Figure 3e, to the south of Llandevenny and the A4810, where, during five-night survey periods between April and October, between 1 and 18 lesser horseshoe bat passes were recorded;
- bat detector locations 17-19, Figure 3e, to the north and west of Magor where, during five-night survey periods between April and October, the number of lesser horseshoe bat passes recorded were between 1 and 5 for locations 17 and 18, and between 1 and 55 for location 19; and
- bat detector location 20, Figure 3e, along a green underpass beneath the existing M4 to the north of Undy, where during five-night survey periods between May and September, between 1 and 9 lesser horseshoe bat passes were recorded).

5.6.7 It was concluded that lesser horseshoe bat roosts may be present in the area.

5.6.8 The recording of 55 lesser horseshoe passes at detector location 19 during one five-night survey period in April and 22 passes recorded at this location in September indicates the potential value of the underpass associated with a watercourse as a crossing route for lesser horseshoe bats beneath the existing M4.

5.6.9 A single greater horseshoe bat was recorded on a one occasion in October 2014 approximately 8.5 km from Ruperra Castle SSSI, which is the nearest known roost (2014 survey location 7, Figure 3b). There is the potential that this bat was from this roost and either foraging in the area or was moving between summer and winter roosts.

2015 Bat Surveys

5.6.10 Two types of bat activity surveys were undertaken in 2015; a static detector survey of fifty linear features that would be crossed by the new road (primarily hedgerows and tree belts along watercourses); and manned dusk and dawn surveys at seven underpasses and bridges crossing the existing M4 motorway (Appendix 10.23 of the March 2016 ES).

5.6.11 Results of the 2015 surveys reported the presence of limited numbers of lesser horseshoe bats in areas around Magor and to the south of Llandevenny (Figure

3) where activity levels were generally comparable with those observed in 2014, i.e.:

- bat detector locations 3-10, Figure 3e, to the east and south of Llandevenny and south of the main railway line, where between 1 and 14 lesser horseshoe bat passes were recorded during five-night survey periods between June and September; and
- bat detector locations 1-2, 32-33 and 35-37, Figure 3e, where the numbers of lesser horseshoe bat passes recorded during a five-night survey period between June and September, were between 1 and 16 for locations 1-2 and 32-33, and between 1 and 5 for locations 35-37).

5.6.12 No recordings of greater horseshoe bats were reported, although their absence from the site could not be discounted. If present, numbers are likely to be low.

2016 Bat Surveys

5.6.13 The report of the bat hibernation survey report carried out in 2016 is at Appendix S10.7 of the September 2016 ES Supplement. The survey covered two trees and a lime kiln previously assessed as having the potential to provide roosts for hibernating bats. No evidence of use of the trees and the lime kiln by hibernating bats was found.

5.6.14 The report of the bat tree roost survey carried out in 2016 is at Appendix SS10.2 of the December 2016 ES Supplement. The survey covered 17 trees and a lime kiln. Three trees and the lime kiln were confirmed to be bat roosts and a further three trees were considered to be probable bat roosts. No evidence of use of the trees or lime kiln by either greater or lesser horseshoe bats was found.

5.6.15 The report of the 2016 survey of buildings and structures with the potential to support bat roosts is at Appendix SS10.3 of the December 2016 ES Supplement. Twelve buildings within or close to the footprint of the Scheme were surveyed as were three bridges over the existing M4 motorway. Seven of the buildings were confirmed to be bat roosts. No evidence of use of the buildings or bridges by greater or lesser horseshoe bats was identified.

2017 Bat Surveys

5.6.16 An internal survey of Woodland House, Magor, the adjoining coach house and garage, was undertaken in February 2017, two bat emergence surveys were undertaken in May and June 2017 and a Wildlife Acoustics SM4 bat detector was left in the coach house to record bat activity between the emergence surveys. The results of the survey are reported as M4CaN Public Inquiry Document (PID) 081. Approximately 200 mixed age lesser horseshoe bat droppings were found on the first floor of the coach house in February 2017; a single lesser horseshoe bat was present in the coach house during the May 2017 bat emergence survey; but no bats were observed on 13 June 2017. This was considered likely to indicate an occasional day and/or night roost used by a small number of bats.

5.6.17 An internal survey of buildings at Berryhill Farm was undertaken in May 2017, two bat emergence surveys were undertaken in June and July 2017, and a Wildlife Acoustics SM4 bat detector was left in the garage to record bat activity between the emergence surveys. Approximately 10 fresh greater horseshoe bat droppings were found in the garage in May 2017. This was considered likely to indicate an occasional day and/or night roost used by a small number of bats.

5.6.18 A bat activity survey of an existing underpass under the M4 at Blacksmith's Way at Castleton was undertaken on the 3rd April 2017 to determine if bats use it to cross the existing M4. The report of the survey is within PID-057. A single greater horseshoe bat was seen to fly through the underpass from north to south. No lesser horseshoe bats were recorded.

5.6.19 A re-entry survey of the old lime kiln north of the existing M4 to the east of Knollbury on 7 June 2017 identified two lesser horseshoe bats using the structure as a night feeding perch. Lesser horseshoe bat were previously recorded

Effects on the Conservation Objectives

5.6.20 The following conservation objectives have been set for the horseshoe bat features of the Wye Valley and Forest of Dean Bat Sites/Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC:

- The site will support a sustainable population of horseshoe bats in the Wye Valley area;
- The populations will be viable in the long term, acknowledging the population fluctuations of the species;
- Buildings, structures and habitats on the site will be in optimal condition to support the populations;
- Sufficient foraging habitat is available, in which factors such as disturbance, interruption to flight lines, mortality from vehicle collision or predation, and changes in habitat management that would reduce the available food source are not at levels which could cause any decline in population sizes or ranges;
- Management of the surrounding habitat is of the appropriate type and sufficiently secure to ensure there is likely to be no reduction in population size or range, or any decline in the extent or quality of breeding, foraging or hibernating habitat;
- There will be no loss or decline in the quality of linear features (such as hedgerows and tree lines) which the bats use as flight lines;
- There will be no loss of foraging habitat used by the bats or decline in its quality, such as due to over-intensive woodland management; and
- All factors affecting the achievement of the foregoing conditions are under control.

5.6.21 The following sections provide an assessment of the effects of the Scheme on the conservation objectives above, with the assessment undertaken under headings for the LSEs listed in paragraph 5.6.1. The assessments also consider mitigation to be implemented as part of the project for greater and lesser horseshoe bat (paragraph 5.6.89 *et seq*.). The effects on conservation objectives for the relevant features of the Wye Valley and Forest of Dean Bat Sites SAC (and thereby potential for adverse effects on integrity of the feature) are then considered for each conservation objective using the information presented within the assessments below (see paragraph 5.6.113 *et seq*.). Effects on the integrity of the Wye Valley and Forest of Dean Bat Sites SAC are considered in paragraph 5.6.113.

Land take - loss of roosts, foraging and commuting habitat (construction)

Foraging and commuting habitat

5.6.22 There would be no land take in the SAC as a result of the Scheme. However, taking into account the potential for bats from the SAC to utilise the M4CaN corridor and immediately surrounding area, land take due to the Scheme could have an impact on SAC bat populations.

5.6.23 Lesser horseshoe bats are known to forage in woodland, around broadleaved trees (including young, semi-mature and mature trees), in wetland, and in pastures with woodland edge or unmanaged hedgerows (Bontadina *et al*. 2002; Knight 2006). In particular, broadleaved trees and woodland edge appear to be of key importance (Knight 2006).

5.6.24 The most important foraging habitat for greater horseshoe bats appears to be permanent cattle-grazed pasture, hay meadows, wetland habitats such as streams, and deciduous and/or wet woodland (Natural England 2010).

5.6.25 The area of habitat within the Gwent Levels of potential value to horseshoe bats that would be lost to construction would include 2,755 m of reens, 9,373 m of field ditches, 6.59 hectares of reed beds, 49.0 hectares of woodland, 35.8 km of hedgerows, 6.99 hectares of unimproved grassland, 6.45 hectares of marshy grassland, and 123.8 hectares of semi-improved grassland.

5.6.26 Post-construction habitat replacement would include woodland, watercourses with associated grass margins, reed beds, and unimproved or species-rich and marshy grassland all of which would be managed to encourage biodiversity. The extent of these habitats is shown on the EMP (Figure R2.6 of the September 2016 ES Supplement, and described in Section 10.5 of March 2016 ES and the SSSI Mitigation Strategy (Inquiry Document 49).

Bat roosts

5.6.27 No lesser or greater horseshoe bat roosts were identified during bat roost surveys undertaken in 2015 (Appendix 10.24 of the March 2016 ES) or 2016 (Appendix S10.7 of the September 2016 ES Supplement and Appendices SS10.2 and SS10.3 of the December 2016 ES Supplement. An occasional day and possible night roost used by a small number of lesser horseshoe bats has been identified in the coach house at Woodland House, Magor. This building would be demolished to enable construction of the Scheme and the roost would be lost.

5.6.28 A night time feeding perch used by two lesser horseshoe bats has been identified in an old lime kiln north of the existing M4 east of Knollbury. This structure would be demolished to enable constrction of the Scheme and the roost would be lost.

5.6.29 A Bat House would be constructed at the eastern end of the M4CaN route, closest to the Wye Valley and Forest of Dean Bat Sites SAC, and to the north of the existing M4 (as shown on Figure 3f), so as to prevent the need for bats from the SAC to cross the existing M4 or new road. The building would be designed with regard to best practice guidelines for horseshoe roosts (including the Lesser Horseshoe Conservation Handbook (Schofield 2008), Bat Mitigation Guidelines (Mitchell-Jones 2004) and the Bat Conservation Trust's Bat Roost Replacement and Enhancement Resource (available at http://roost.bats.org.uk).

5.6.30 The final design of the Bat House would be agreed with NRW. However, it would be likely to include areas sun warmed throughout the day of benefit to breeding individuals, as well as cool areas for autumn to spring roosting. The single-storey building would be likely to have a slate or tile roof (lined with type 1f bituminous felt) over an open uncluttered loft (i.e. not using trussed rafters), 2.5-3m high to the ridge with a traditional ridge board and sheltered access points, suitable for horseshoe bats

5.6.31 The Welsh Government would be responsible for ensuring the long term maintenance of the Bat House.

Physical Presence - disturbance to species/restriction in movement/ severance of flight lines

5.6.32 Major roads can present a barrier to the movement of some bat species. Berthinussen and Altringham (2012) recorded a significant reduction in bat activity up to 1.6 km from an 80 km section of the M6 in Cumbria, England. This reduction in activity was considered in part to be due to the barrier effect of major roads.

5.6.33 Studies of flight behaviour by Knight (2006) showed that lesser horseshoe bats do not tend to cross open fields and instead appear to favour commuting alongside habitat corridors such as hedgerows. Greater horseshoe bats, appear to favour commuting close to corridors of vegetation such as woodland edge, hedgerows, trees and vegetated watercourses (Natural England 2010). Where these corridors are relatively low-level (e.g. hedgerows less than 3 m in height), Knight (2006) reported that lesser horseshoe bats tend to fly at low level (i.e. between approximately 0.3 m above ground-level and up to the height of the vegetation) and close to the vegetation (i.e. at a distance of no more than approximately 1.5 m from the feature).

5.6.34 However, Knight (2006) also recorded some lesser horseshoe bats crossing over roads.

5.6.35 Horseshoe bats are known to utilise underpasses beneath roads. Lesser horseshoe bats have been recorded flying through underpasses apparently in preference to crossing roads at high level (Boonman 2011) and surveys of lesser horseshoe bat activity along the A465 Heads of the Valley Road in South Wales reported that horseshoe bats appeared to favour the use of culverts and subways beneath the road to flying over the road (Welsh Government 2013). A study in 2009 and 2010 at three underpasses below a four lane motorway in Ennis, West Ireland, reported the majority of lesser horseshoe bats recorded crossing the road did so using an underpass (a total of 58 bat passes over 16 nights) and only a small proportion were recorded flying over the road (1 bat pass in 16 nights) (Abbott *et al*. 2012).

5.6.36 However, the type of underpass appears to have an impact on the potential for use by horseshoe bats. Abbott *et al*. (2012) reported lesser horseshoe bats flying through narrow drainage pipes (43 m or 91 m long by 1 x 1.4 m cross section) in order to cross a road, although the bats appeared to favour larger underpasses (6 x 17 m cross section and 26 m long), and only a small proportion were recorded crossing over the road. A study of bat activity through underpasses completed in 2002 and 2003, reported greater horseshoe bats flying through

elliptical tunnels of 1.8 m and 2.2 m in diameter (Wray *et al*. 2005) and Billington (2003) reported greater horseshoe bats using tunnels beneath the A38.

5.6.37 The Highways Agency (2001b) recommends the use of culverts 1 m high by 2 m wide to facilitate the movement of lesser horseshoe bats across a road. In addition, the association of water with the culvert is suggested to improve chances of use due to the foraging potential of waterbodies. More recent research (Møller *et al*. 2016) suggests that to be effective for both lesser and greater horseshoe bats, culverts should be greater than 2m wide and greater than 2m high.

5.6.38 Potential bat crossing points along the M4CaN route would comprise underpasses, box culverts along reens and dry mammal crossings.

5.6.39 The locations of these structures would be along or close to commuting or foraging routes of horseshoe bats, as recorded in 2014 and 2015 (as shown on Figure 3 and at Appendices 10.7 and 10.23 of the March 2016 ES).

5.6.40 Temporary pipes would be installed within the existing reens early in the construction programme to maintain connectivity of the watercourses and these would be replaced by permanent culverts once the haul road has been constructed. The methodology for construction of the temporary and permanent culverts is set out in December 2016 ES Supplement Appendix SR3.1 Buildability, Annex 7. The locations of culverts and underpasses are shown in Figure 3 of the Bat Mitigation Strategy Update (May 2017) [ID-56]. Figure 6 of the Bat Mitigation Strategy Update (May 2017) [ID-56] shows the locations of structures likely to be effective for different species groups of bats. Horseshoe bats are included in Group A.

5.6.41 In order to improve the probability of bats finding and using crossing points, strategic planting of trees and shrubs would be undertaken in order to provide habitat corridors to guide bats into entrances to culverts and dry underpasses. Planting would be set back from the hard-shoulder of the new road so as to help deter bats away from the road.

5.6.42 Planting would be carried out as soon as practicable and as soon as it can be confirmed that ongoing construction would not result in damage to new plants, e.g., by machinery driving over planted areas.

5.6.43 Whilst planting becomes established, artificial “bat corridors” (e.g. lines of hazel hurdle fencing or 2m high debris netting fixed to Heras fencing panels) would be installed alongside new planting at culverts and underpasses of potential value to sensitive species, at least between March and October (the main period of bat activity) in order to help guide bats towards crossing points.

5.6.44 Mammal exclusion fencing would be installed along the boundaries of the operational boundaries of the new road. Where fencing joins an underpass, it would be installed up to the entrance of the underpass in order to help direct species including low flying horseshoe bats into these crossing points and, therefore, away from the construction site or new road.

5.6.45 Taking the above measures into account, there would be suitably sized structures along the Scheme to allow both horseshoe species to safely cross the road. Other than the existing Mill Reen Culvert, which is to be retained and extended, no important horseshoe bat flight lines have been identified. There are only two

records of greater horseshoe bat, found at the western end of the scheme, and low levels of lesser horseshoe bat activity were recorded around Magor and Pye Corner. Whilst the new road could present a physical obstruction to bats, it is expected that they would find and use the proposed crossing structures in preference to flying over the road (refer to section below – 'Physical Presence - vehicle collision and increased predation risk (construction and operation)' paragraph 5.6.47 *et seq*). However, as Section 10.10 of the March 2016 ES states, the exact significance of impact is not possible to estimate as evidence relating to the effectiveness of mitigation described above and in Chapter 10 of the ES is limited (Berthinussen and Altringham 2012). Therefore, monitoring to assess the effectiveness of mitigation and potential need for additional mitigation measures would be undertaken as described under Section 6 below.

Physical Presence - vehicle collision and increased predation risk

5.6.46 Major roads have been shown to result in a vehicle collision risk for some species of bats, which will fly over roads (Berthinussen and Altringham 2012). There is little evidence to show that bats that fly over roads will time their flights in order to avoid vehicles (although light-averse species such as horseshoes would be expected to avoid areas heavily-lit by vehicle lights), and therefore roads can present a risk of injury and fatality due to vehicle collision (Halcrow Group Ltd., 2011). Berthinussen and Altringham (2012) attributed a threefold reduction in bat activity recorded during a study of bat activity within 1.6 km of the M6 in Cumbria, England, in part, to vehicle collision fatalities, although there no evidence of mortality was collected and there were no horseshoe bats in their study area..

5.6.47 Slow and/or low flying bat species including horseshoe bats tend to cross roads at low level, putting them at greater risk of mortality due to vehicle collisions (Russell *et al*. 2009; Lesinski *et al*. 2010). Studies of flight behaviour by Knight (2006) recorded lesser horseshoe bats crossing roads at heights of between 0.15 m and 2-3 m above ground-level, with greater heights being associated with more open conditions. However, where tree lines were associated with road verges, bats tended to cross the roads at tree canopy height. Greater horseshoe bats also tend to fly at low level, i.e. less than 2m above ground level (Natural England 2010).

5.6.48 The retention of severed sections of habitat corridors used by foraging and commuting bats too close to a new road may increase the potential for bats to fly over the road in order to continue to use these historic habitat corridors and, therefore, increase the risk of vehicle collision (Halcrow Group Ltd.2011).

5.6.49 The risk of predation also affects bats. Bats must balance the need to forage when insect prey are still active with the need to avoid predatory birds (Rydell, Entwistle and Racey 1996; Duverge et.al. 2000).

5.6.50 Flying across open spaces, such as roads, could make bats more detectable to predators and, therefore, increase the risk of predation (Berthinussen and Altringham 2012).

5.6.51 The provision of shelter, such as tree canopies, can provide effective protection against potential predation (Verboom and Spoelstra 1999; Duverge et.al. 2000; Russo *et al*. 2007).

5.6.52 Taking into account the potential for horseshoe bats to cross over roads, to favour flying at low level, and the potential risks resulting from crossing roads of

vehicle collision and increased predation, safe crossing points (underpasses, including culverts along retained reens) would be constructed along the M4CaN route in order to reduce the risk to horseshoe bats.

5.6.53 As described above (under Physical Presence - disturbance to species/restriction in movement/severance of flight lines; paragraph 5.6.33 *et seq.*), safe crossing points would comprise culverts and dry mammal crossings that would be constructed as soon as practicable during construction, as near as practicable to locations where commuting and foraging horseshoe bats were recorded in 2014 and 2015 (Appendices 10.7 and 10.23 of the March 2016 ES) as shown in Figure 3. In addition, tree and shrub planting and mammal exclusion fencing along the operational boundaries of the M4CaN route would be used to guide bats towards these crossing points. Planting would be set back from the hard shoulder so as to help deter bats from foraging along the road edge.

5.6.54 As described above, artificial bat corridors would be installed as necessary until new planting becomes sufficiently developed to act as an effective habitat corridor to guide bats to safe crossing points.

5.6.55 Taking into account the limited number of horseshoe bats recorded in the M4CaN surveys, it is considered that the above mitigation measures would be sufficient to reduce the potential impact of vehicle collision and predation on horseshoe bats from the SAC so that there would be no significant effect on the integrity of the SAC.

5.6.56 Monitoring would be undertaken (as described in Section 6 of this report) in order to assess the effectiveness of measures and the potential need for additional measures.

Noise and vibration - disturbance to species

5.6.57 Due to the distance between the M4CaN site and the SAC, no direct impact from construction or operational noise would affect horseshoe bat populations within the SAC.

5.6.58 However, noise and vibration generated during construction and operation have the potential to cause disturbance to horseshoe bats that could be roosting on or close to the Scheme. Bats, including horseshoe bats, can be relatively tolerant of some noise whilst roosting, particularly if the noise is relatively regular or not unexpected and bats can become accustomed to it.

5.6.59 An occasional day and possible night roost used by a small number of lesser horseshoe bats has been identified in the coach house at Woodland House, Magor. This building would be demolished to enable construction of the Scheme and the roost would be lost. A new Bat House would be constructed more than 230 m from the new road cuttings (as shown on Figure 3e), and situated between the new road and the Bat House would be a Water Treatment Area with associated woodland planting, in order to further minimise the potential for disturbance to any roosting bats.

5.6.60 An occasional day or night roost used by a small number of greater horseshoe bats (likely only one) has been identified in the garage at Berryhill Farm, between Duffryn and Castleton. This building would be retained, along with a vegetated corridor to the east, connecting to the existing M4 underpass at Blacksmiths Way, where a greater horseshoe bat was recorded in April 2017. Should greater

horseshoe bats continue to use this roost following vegetation clearance in the area, if used as a night roost, there would be no (or limited) night-time construction work or disturbance. If used as a day roost, it is expected that bats would tolerate construction noise.

5.6.61 With regard to foraging and commuting bats, limited studies have been undertaken on the potential impacts of noise. However, studies have reported that for some bat species, noise can be a deterrent (Schaub *et al*. 2008) and for others, including Daubenton's bat, unfavourable noise can trigger avoidance measures (Luo *et al*. 2015), potentially affecting the ability of a species to forage or commute to roosting sites.

5.6.62 The degree and type of impact can vary according to the source and level of noise. Results of a study of greater mouse-eared bats (Schaub *et al*. 2008) showed traffic noise (recorded 7.5 m from a highway, where passing vehicles averaged 30.7 ± 2.5 per minute) to be less of a repellent than noise recorded from moving vegetation, despite the amplitude of the noise from vegetation being 12dB below that of traffic noise. It is likely that noise from traffic may have a greater effect on passive hearing species, rather than those species which use echolocation to capture prey, such as horseshoe bats.

5.6.63 With regard to horseshoe bats, although ambient noise may have a negative impact on foraging efficiency (Hage *et al*. 2014), it is considered that traffic noise would not have the same impact due to the fact it is broadband and up to 50 kHz and horseshoe bats tend to echolocate prey at around 80 kHz (greater horseshoe bats) and 110 kHz (lesser horseshoe bats).

5.6.64 In addition, results of surveys of lesser and greater horseshoe bats along Section 2 of the A465 Heads of the Valley Road in South Wales confirmed that horseshoe bats were utilising underpasses to cross beneath the road, and were roosting in sites alongside the road, confirming that noise from a major road does not necessarily present a complete deterrent to horseshoe bats (Welsh Government 2013).

5.6.65 Taking the above into account and the potential for noise to have an impact on some bat species, precautionary measures would be implemented in order to reduce the level of noise on site during construction and operation (as described in Chapter 13 of the March 2016 ES). Measures would include:

- The inclusion of measures to control noise and vibration during construction in the CEMP;
- Limiting construction work to daytime hours wherever practicable;
- Use of silenced or quieter plant where available and turning off plant when not in use;
- The provision of a thin road surface system which is relatively low noise;
- The installation of a solid safety barrier of 0.9 m height along the central reservation of the new motorway alignment; and
- The construction of 2 m high noise barriers at four locations along the carriageway. The final locations are subject to evaluation and confirmation; however, provisionally they would include barriers to the north and west of Magor, which would be of potential value to any SAC bats commuting onto the Gwent Levels from the SAC.

Lighting - disturbance to species/severance of flight lines

5.6.66 Due to the distance between the M4CaN site and the SAC, there would be no direct impact from the Scheme's lighting on the horseshoe bat populations within the SAC.

5.6.67 Greater and lesser horseshoe bats will typically avoid lighting (Bat Conservation Trust and the Institution of Lighting Engineers 2008; Natural England 2010) and this response could affect roosting, foraging, commuting, dispersal and population interactions (Stone *et al*. 2009; Wray *et al*. 2005), which in turn could have an adverse impact upon an individual's survival potential as well as a population's viability should it affect their ability to access favourable foraging grounds or roost sites.

5.6.68 Research suggests the impact of lighting on maternity and hibernation roosts, and emergence, foraging, commuting and swarming sites could be highly negative (Stone, 2013).

5.6.69 In addition, lighting could also make bats more visible to predatory raptors, resulting in an increased risk of predation.

5.6.70 However, artificial lighting in certain settings may not be a complete deterrent to some bats. Surveys of bat activity along subways beneath the A465 Heads of the Valley Road in South Wales reported lesser horseshoe bats flying through lit subways (Welsh Government 2013). This lack of deterrent may, in part, be due to limited level of lighting as well as the fact that lighting was associated with an enclosed space and in a low risk area with regard to predation from birds.

5.6.71 Although bats will seek out alternative commuting routes as necessary, e.g. if unfavourable lighting prevents the use of a traditional commuting route, this could result in additional energy expenditure, which could in turn impact upon the viability of a bat colony and if suitable alternative routes are not available, may result in fragmentation of a population from key foraging areas and/or roost sites (Natural England 2010).

5.6.72 Currently research evidence is insufficient to confirm the level of lighting required to ensure an insignificant or no impact on bats, but for horseshoe bats this level of lighting may be minimal, e.g. Stone *et al*. (2012) recorded a disturbance impact on commuting lesser horseshoe bats from light levels as low as 3.6 lux and an average natural light level along preferred commuting routes of 0.04 lux (Stone 2011).

5.6.73 Therefore, where the reduction of lighting to such minimal levels is impracticable, alternative strategies would be required, such as the use of measures to screen light spill, e.g. planting or the use of walls or fencing.

5.6.74 Research regarding the impact of lighting on bats has resulted in the following general recommendations for light fixtures (Stone 2013):

- Blue-white short wavelength lights should be avoided as these have a significant negative impact on insect prey. Alternatives could include warm-white (long wavelength) lights, which have a reduced impact on insects.
- Lights with high ultra violet (UV) content should be avoided, e.g. metal halide or mercury light sources, or the UV content should be reduced or removed

(e.g. using filters or glass housings), so as to reduce the negative impact on insects.

5.6.75 In addition, recommendations include measures to prevent light spill into:

- Nearby potential roosts (should any be located prior to construction) and associated entrances, emergence and swarming areas;
- Habitat of value to foraging and commuting horseshoe bats, including watercourses, culverted reens and underpasses; and
- Above a 90º angle.

5.6.76 During the M4CaN construction period, lighting would be provided as necessary during normal working hours in the autumn and winter and for night time working. Night working could be undertaken along the M4CaN route.

5.6.77 Operational lighting would be installed at the following locations (as described in Chapter 2 of the March 2016 ES):

- The approaches to and throughout the Castleton Interchange;
- The approaches to the Docks Way Junction and over the full extent of the River Usk Crossing;
- The Glan Llyn Junction and the new link road connecting the new section of motorway with the A4810; and
- The approaches to and throughout the Magor Interchange.

5.6.78 Lighting columns are anticipated to be aluminium and to generally have the following characteristics:

- 15 metres high along the mainline of the new section of motorway;
- 12 metres high along slip roads; and
- 12 metres high on the River Usk Crossing.

5.6.79 In order to minimise the impact of light on bats, the following measures would be set in place.

5.6.80 Construction lighting for specific tasks would be set at low level and directed towards working areas. Twenty-four hour security lighting at construction compounds would also be inward facing.

5.6.81 Construction and operational lighting would be directed towards the M4CaN corridor and away from the Bat House and any horseshoe bat roosts that might be located through pre-construction surveys; watercourses including the River Usk and Ebbw and culverted reens; dry underpasses; and surrounding areas of woodland, trees, scrub and hedgerows.

5.6.82 Luminaires during construction and operation would be designed to exclude light above the horizontal level. Light Emitting Diode (LED) luminaires are proposed, as these can be used to provide directional lighting or directional accessories would be installed to reduce light spill. Warm white LEDs would be favoured where practicable as these have a low negative impact on bat insect prey (Stone 2013).

5.6.83 In order to confirm the effectiveness of these measures, monitoring would be undertaken as described in Section 6 of this report.

Release of pollutants leading to water quality changes/physiological effects which in turn could affect insect prey populations

5.6.84 Due to the distance between the M4CaN site and the SAC, no impact from pollutants would be expected within the SAC. However, construction would result in the production of dust and run-off (Chapters 3, 7, 11 and 12 of the March 2016 ES), which could impact upon habitats of potential value to bats and their insect prey within or immediately adjacent to the M4CaN site.

5.6.85 Dust created during construction could have an adverse impact on bat invertebrate prey through direct mechanical damage, pollution, and impacts on vegetation. However, results of the limited studies undertaken to date provide insufficient information in order to conclude any definite guidelines regarding levels of dust deposition that could have an adverse impact on invertebrates (Latimer *et al*. 2003).

5.6.86 Construction would be undertaken in accordance with the Pollution Control and Prevention, Ground Water and Surface Water, Materials Management and Site Waste Management Plans; the CEMP; legislative requirements; and NRW best practice guidelines. Only materials with no significant potential for leaching of contaminants would be used in the construction process. Operational surface water run-off from the new motorway would be managed via grassed verge channels and Water Treatment Areas (including reed beds) in order to remove particulate and chemical pollutants before discharging to main reens (Chapter 16 of the March 2016 ES).

5.6.87 With the above pollutant management measures in place, as concluded in Sections 10.8 and 10.9 of the March 2016 ES, no adverse effect on water quality across the Gwent Levels would be expected.

Mitigation Measures

5.6.88 The following mitigation measures would be implemented as part of the M4CaN project to ensure the project does not have the potential to adversely affect the conservation objectives of the qualifying bat features of the Wye Valley and Forest of Dean Bat Sites SAC. These measures are either embedded, i.e. designed into the M4CaN Scheme, or additional, i.e. where these have been required to ensure avoidance of adverse effects (see March 2016 ES Section 10.5 for further detail on embedded and additional measures). These measures (both embedded and additional) are considered, with the supporting information in the preceding paragraphs, in the context of the conservation objectives for the Wye Valley and Forest of Dean Bat Sites SAC in paragraph 5.6.113 *et seq.*

Land take-habitat loss/fragmentation (roosts):

5.6.89 An occasional day or night roost used by a small number of lesser horseshoe bats has been identified in the coach house at Woodland House, Magor. A night time feeding perch used by two lesser horseshoe bats has been identified in an old lime kiln north of the existing M4 east of Knollbury. Both of these structures would be demolished to enable constrction of the Scheme and the roosts would

be lost. Demolition of these buildings would require a European Protected Species Licence issued by NRW.

5.6.90 Further pre-construction surveys of buildings to be demolished would be undertaken in order to determine whether or not they support lesser or greater horseshoe bat roosts. Surveys would be carried out in accordance with best practice guidelines published by the Bat Conservation Trust (Collins (ed.) 2016) or any potential future updates.

5.6.91 Should additional roosts be located, works that would result in an offence under the Habitats Regulations 2010 would be carried out in accordance with an NRW licence.

5.6.92 A Bat House would be constructed to the north of the new road and north of the existing M4 (as shown on Figure 3e and Figure R2.6 of the September 2016 ES Supplement). The design would be developed with regard to guidelines published in the Lesser Horseshoe Conservation Handbook (Schofield 2008), Bat Mitigation Guidelines (Mitchell-Jones 2004) and the Bat Conservation Trust Bat Roost Replacement and Enhancement Resource (http://roost.bats.org.uk). The final design would be agreed with NRW. Following the five year aftercare period, the Bat House would be under Welsh Government's ownership and management.

Land take-habitat loss/fragmentation (foraging and commuting habitat):

5.6.93 Replacement planting would benefit foraging and commuting bats (as shown on the EMP, Figure R2.6 of the September 2016 ES Supplement and described in Section 10.5 of the March 2016 ES). The replacement of habitat of potential high value to bats would include:

- Reens - 2,755 m lost: 2,826 m replacement.
- Field ditches - 9,373 m lost: 10,594 m replacement.
- Reed beds – 6.59 hectares lost: 9.9 hectares replacement.
- Woodland – 49 hectares (excluding coniferous plantation - 0.24 ha) lost: 83.59 hectares replacement and 20.78 ha of linear belts of trees and shrubs.

5.6.94 Although a significantly greater area of semi-improved and improved grassland would be lost when compared to replacement habitat creation, the following replacement ratios of value to bats would be included in the Scheme:

- Unimproved grassland – 6.99 hectares lost: 38.1 hectares of species-rich grassland replacement.
- Marshy grassland - 6.45 hectares lost: 13.4 hectares of wet grassland replacement.

Physical Presence - disturbance to species/restriction in movement/severance of flight lines

5.6.95 Installation of four box culverts along retained reens that are likely to be effective for horseshoe bats to cross the road safely, plus another three that are approaching the size likely to be effective, a further three that are likely to be used by horseshoe bats, and four underpasses likely to be effective as safe crossings under the road..

5.6.96 Planting of trees and scrub in order to guide foraging and commuting bats towards crossing points.

5.6.97 Installation of artificial "bat corridors" to connect hedges and other linear habitats with culverts and underpasses, until planting develops sufficiently to provide suitable habitat corridors for bats to follow.

5.6.98 Installation of mammal exclusion fencing around the operational site boundaries leading into entrances of culverts and dry mammal crossings/underpasses.

Physical Presence - vehicle collision and increased predation risk

5.6.99 See measures above (Physical Presence - disturbance to species/restriction in movement/severance of flight lines (construction and operation).

5.6.100 See measures below (Visual disturbance and lighting impacts - barrier effects (construction and operation).

Noise - disturbance to species

5.6.101 Measures to control noise and vibration during construction in the Pre-CEMP (Appendix SR3.2 of the December 2016 ES Supplement)) including:

- limiting construction work to day time hours wherever practicable;
- use of silenced or quieter plant where available;
- turning off plant when not in use; and
- for works located in close proximity to buildings that would create noise levels exceeding those acceptable even with standard good practice measures in place, additional, effective mitigation would be provided as appropriate to meet appropriate noise levels, e.g. temporary hoardings or noise barriers (see Chapter 13 of the March 2016 ES).

5.6.102 Installation of a solid safety barrier of 0.9 m height along the central reservation of the new motorway alignment.

5.6.103 Construction of 2 m high noise barriers at four locations along the carriageway. Final locations are to be evaluated and confirmed; however, provisionally they would include barriers to the north and west of Magor (as shown on Figure 13.10 of the March 2016 ES).

Visual disturbance and lighting impacts - barrier effects

5.6.104 Avoidance of light spill to the Bat House and any other horseshoe bat roost.

5.6.105 Avoidance of light spill into habitats of value to bats including watercourses including the Rivers Usk and Ebbw, culverts and dry underpasses, woodland, hedgerows and unimproved grassland or hay meadows.

5.6.106 Installation of luminaires designed to not emit light above the horizontal level. LED luminaires are proposed, and warm white LEDs would be favoured where practicable so as to minimise the impact on insect prey.

Release of pollutants leading to water quality changes/physiological effects which in turn could affect prey populations):

5.6.107 Outline Pollution Control and Prevention Plan (see paragraph 5.2.68 *et seq* for further detail).

5.6.108 Ground and Surface Water, Materials and Site Waste Outline Management Plans (see paragraph 5.2.68 *et seq* for further detail).

5.6.109 The inclusion of pollution control measures in the Pre-CEMP, including legislative requirements and NRW best practice guidelines (Appendix SR3.2 of the December 2016 ES Supplement); see paragraph 5.2.68 *et seq* for further detail).

5.6.110 Materials with no significant potential for leaching of contaminants would be used in the construction process.

5.6.111 Operational surface water run-off would be managed via grassed verge channels and Water Treatment Areas (including reedbeds) in order to remove particulate and chemical pollutants before discharging to main reens.

Effects of the M4CaN on the Conservation Objectives for Lesser and Greater Horseshoe Bats

5.6.112 Potential effects on the relevant conservation objectives (as presented in paragraph 5.6.21) are discussed in turn below.

The site will support a sustainable population of lesser and greater horseshoe bats in the Wye Valley area.

The populations of lesser and greater horseshoe bats will be viable in the long term, acknowledging the population fluctuations of the species.

5.6.113 An occasional day or night roost used by a small number of lesser horseshoe bats has been identified in the coach house at Woodland House, Magor. A night time feeding perch used by two lesser horseshoe bats has been identified in an old lime kiln north of the existing M4 east of Knollbury. These structures would be demolished to enable construction of the Scheme and the roosts would be lost. The construction and long term appropriate management of the Bat House (Figure 3e) would provide an alternative roost location and would also offer roosting opportunities for bats from the SAC without having to cross the existing or new M4.

5.6.114 The long term management of replacement and new habitat of potential value to foraging and commuting bats, and measures to ensure sufficient access (as described below) would help ensure the long term viability of the lesser and greater horseshoe bat populations of the SAC, particularly given the limited number of lesser and greater horseshoe bats in the vicinity of the Scheme.

Sufficient foraging habitat is available, in which factors such as disturbance, interruption to flight lines, mortality from vehicle collision or predation, and changes in habitat management that would reduce the available food source are not at levels which could cause any decline in lesser or greater horseshoe population sizes or ranges.

5.6.115 The location of the M4CaN route, as far north and as close to Newport and surrounding built-up areas as practicable, would help to minimise the impact on the available habitat across the Gwent Levels that is of potential value to lesser and greater horseshoe bats.

5.6.116 The provision of bat crossings along the M4CaN Scheme, along with the use of temporary artificial bat corridors, new planting and fencing to divert bats towards crossings, would help to ensure bats could continue to move across the landscape and the new road and reduce the risk of vehicle collisions.

5.6.117 Mitigation measures would help limit the potential for light spill to adversely affect:

- bats utilising the Bat House as a roost;
- bats foraging around the M4CaN Scheme (including along watercourses, in woodland, scrub and hedgerows); and
- bats utilising underpasses to cross beneath the new road.

5.6.118 Measures to control pollutants would ensure no loss or decline in the quality of watercourses, or grassland, of value to foraging bats.

Management of the surrounding habitat is of the appropriate type and sufficiently secure to ensure there is likely to be no reduction in lesser or greater horseshoe population sizes or ranges, or any decline in the extent or quality of breeding, foraging or hibernating habitat.

5.6.119 The Welsh Government would be responsible for ensuring the successful establishment of all areas of new planting and habitat creation following the five year aftercare period.

5.6.120 The Welsh Government would be responsible for ensuring appropriate long term management of new habitat, new planting, replacement and culverted watercourses and the Bat House included in the Scheme. Provisions would also be made so as to ensure NRW would be able to continue to manage the reen system as appropriate. Therefore, management of habitats within the boundaries of the Scheme and the SSSI Mitigation Areas, and management of the reen network would be of the appropriate type and sufficiently secure to ensure no effects on the extent or quality of habitats which would be likely to affect lesser and greater horseshoe bat population ranges or result in declines in populations.

5.6.121 Construction sites such as those at Duffryn, Tata Steel and Magor, would be returned to land owners on completion of construction.

There will be no significant loss or decline in the quality of linear features (such as hedgerows and tree lines) which lesser or greater horseshoe bats use as flight lines.

5.6.122 No significant long term decline in the quantity or quality of linear features of the Gwent Levels is expected due to the following:

5.6.123 Hedgerow replacement would be undertaken on a less than 1:1 basis due to the conflicting landscape requirements of the Gwent Levels, which include the restoration of an open landscape with fields bordered by watercourses only. However, extensive linear and woodland planting of trees and scrub would be undertaken in selected areas particularly at the west and east of the Scheme, as shown on Figure R2.6 of the September 2016 ES Supplement. This new planting

would increase the amount of woodland and linear tree and scrub habitat in the vicinity of the Scheme and help to mitigate hedgerow loss (see paragraph 5.6.94).

5.6.124 Watercourses with their associated rough grass banks and margins provide valuable foraging and commuting resources for bats. Reen connections would be retained through box culverts beneath the new road and length of reen culverted or infilled would be replaced, along with ditches, at a ratio of approximately greater than 1:1 (see paragraph 5.6.90). The replacement of watercourses would be undertaken as described in Chapters 3 and 10 of the March 2016 ES.

5.6.125 As explained in the SSSI Mitigation Strategy (Inquiry Document 49), the management plans for the SSSI Mitigation Areas would include the restoration of lost watercourses and management of watercourse banks and margins for the benefit of insects and, therefore, foraging bats.

There will be no significant loss of foraging habitat used by lesser or greater horseshoe bats or decline in its quality.

5.6.126 Habitat retention (i.e. culverting of retained reens beneath the new road) and replacement would ensure no net loss of high value habitats for lesser and greater horseshoe bats (i.e. woodland, scrub and watercourses).

5.6.127 Ecologically sensitive management of the SSSI Mitigation Areas for the primary benefit of biodiversity, as described in the SSSI Mitigation Strategy (Inquiry Document 49) would provide additional and enhanced habitats of value to horseshoe bats.

All factors affecting the achievement of the foregoing conditions are under control.

5.6.128 Mitigation measures set out in the March 2016 ES and associated reports, including the SSSI Mitigation Strategy (Inquiry Document 49); the EMP (Figure R2.6 of the September 2016 ES Supplement); and the Pre-CEMP (Appendix SR3.2 of the December 2016 ES Supplement) would be secured through Commitments. The relevant Commitments are 101 (previously 68) and 127 (previously 143) (SSSI Mitigation Strategy), 119 (previously 135) (EMP) and 91 (previously 59) (pre-CEMP).

5.6.129 Taking the above into account and considering the limited numbers of lesser and greater horseshoe bats recorded in the survey area during 2014 and 2015 (Appendices 10.7 and 10.23 of the March 2016 ES) which may be from the Wye Valley and Forest of Dean Bat Sites SAC (given the distance of the nearest roosts within the SAC from the Scheme), and taking into account the loss of the roost used by a small number of lesser horseshoe bats at the coach house at Woodland House, the loss of the night time perch used by two lesser horseshoe bats in the old lime kiln at Knollbury, and the roost used by a small number of greater horseshoe bats at the garage at Berryhill Farm, there would be no adverse effect on the viability of the SAC bat populations or integrity of the SAC with regard to bats.

In-Combination Assessment

5.6.130 The plans and projects considered within this in-combination assessment are presented in Section 4.2. As explained in Section 4.2, the outline nature of the

plans and the strategic nature of the plan-level assessments (due to insufficient detail on projects) mean that it is difficult to undertake an in-combination assessment with these plans and the M4CaN.

5.6.131 The plan-level HRAs concluded that the plans will not have an adverse effect on the conservation objectives of the horseshoe bat features of the Wye Valley and Forest of Dean Bat Sites SAC, particularly when the appropriate avoidance and mitigation measures identified in the plan-level HRAs are implemented. It should be noted that when the specific projects under these plans come forward, these will need to undertake specific, detailed assessments on the potential effects on European sites and include the M4CaN project (if relevant) as part of their in-combination assessment.

Effect on Site Integrity

5.6.132 Based on the information presented above, no adverse effects on the integrity of the Wye Valley and Forest of Dean Bat Sites SAC are predicted as a result of the M4CaN, alone or in-combination with other plans or projects.

6 Proposals for Monitoring and Reporting

6.1.1 The following sections set out the proposals for monitoring and reporting for the qualifying features of the European/International designated sites.

6.2 Pre-construction Monitoring

Migratory Fish Species

Underwater Noise

6.2.1 Background underwater noise levels in the vicinity of the Usk Crossing (e.g. from vessel traffic associated with Newport Docks) would be measured. Data collected would provide context for the underwater noise levels associated with vibropiling, validating the predictions made within this assessment (and the impact assessment presented in Chapter 10 of the March 2016 ES).

Water Quality Monitoring

6.2.2 Pre-construction water quality monitoring would be undertaken at key locations along the M4CaN corridor to be agreed with NRW. The detail of water quality monitoring would be developed through detailed design and agreed with NRW via the Surface Water Management Plan (SWMP).in line with the Surface Water Monitoring Protocol agreed with NRW (PID-054). Monitoring will be undertaken for a broad range of potential contaminants of concern including metals, petroleum hydrocarbons and supended sediments.

European Otter

6.2.3 Pre-construction surveys of habitat of potential value to breeding and/or resting otters located within 100 m of the works area would be undertaken in accordance with best practice survey guidelines in order to locate any potential otter holts or resting places. The results of these surveys, in combination with the detailed work being carried out in 2017, would inform the potential need for an NRW otter licence.

Overwintering bird assemblages

6.2.4 No pre-construction surveys for wintering birds are proposed, beyond those already carried out for the ES in early 2014, 2014/15 and 2015/16.

Lesser and Greater Horseshoe Bats

6.2.5 The method statement to be submitted to NRW in support of a licence application would be updated in response to results of pre-construction surveys that will be completed in 2017 including surveys at the coach house at Woodland House, Magor which is used by a small number of lesser horseshoe bats, and the garage at Berryhill Farm, which is used by a small number of greater horseshoe bats.

6.2.6 Pre-construction monitoring would also be undertaken of a sample of potential road crossing points to be agreed with NRW. These should include a sample of large underpasses, new underbridges, an overbridge, and reen culverts with over 1 m freeboard. Suggested locations are as follows:

- Castleton Interchange Underbridge - ch. 3,750 (carrying eastbound carriageway of new section of motorway over the A48).
- Athensway Culvert - ch. 4,300
- Church Lane Overbridge - ch. 4,625
- Morfa Gronw Reen Culvert - ch. 6,900
- Old Dairy Reen Culvert - ch. 7,750
- Pont-y-Cwcw Culvert - ch. 7,980
- Steelworks Dedicated Reen Bridge - ch. 16,375
- Bareland Street Underbridge - ch. 19,800
- Mill Reen Underpass - ch. 21,375

6.2.7 Monitoring would follow the best practice survey protocol in Appendix G of DEFRA Science and Research Project W1060 (Berthinussen, & Altringham, 2015), which recommends that surveys should be repeated at each site at the same time each year before and during construction, and for a minimum of three years' post-construction.

6.2.8 Baseline survey data will be gathered in 2017 (before construction). If after two preliminary surveys the crossing points are considered to be important, i.e., more than 10 bats are recorded using a flight path (1-5 for rare species, depending upon rarity), a total of six surveys would be undertaken. Should the crossing points not be considered important, no further survey would be undertaken at those locations.

6.3 During Construction Monitoring

Migratory Fish Species

Underwater Noise

6.3.1 Monitoring for underwater noise at the River Usk crossing would be undertaken during the early stages of construction, during piling of the coffer dam for the east pylon.

Water Quality Monitoring

6.3.2 Monitoring of water quality during the construction phase would comprise the monitoring of water treatment areas to ensure contaminants within water to be discharged into the reen network) comply with the discharge consents to be regulated by NRW.

6.3.3 The water quality monitoring programme would be developed and agreed with NRW via the SWMP and would comprise monitoring for a broad range of potential contaminants of concern, including metals, petroleum hydrocarbons and suspended sediments.

European Otter

6.3.4 The ECoW would be responsible for ensuring regular monitoring of potential protective measures required within the boundaries of the construction site, such as the installation of 'ladders' in deep (>0.5 m) excavations. Monitoring would be carried out to ensure measures are in place as required to ensure the protection of otters.

6.3.5 The ECoW would also be responsible for regular monitoring of construction lighting throughout the construction period, to ensure measures to limit/prevent light spill are implemented, as required, to minimise the potential for disturbance or displacement of otters.

6.3.6 The ECOW would be responsible for ensuring that, so far as practicable, means for otters to cross the working area are available.

6.3.7 Detailed monitoring requirements for otter during the construction period would be agreed with NRW as part of the Otter Mitigation Strategy.

6.3.8 Site inductions and toolbox talks will include the need for construction personnel to report any sightings of otters on site, or the presence of potential holts or resting sites, to the ECoW, either directly or via the Site Manager. This would enable the ECoW to advise and, if necessary, ensure that any additional mitigation measures are implemented as soon as practicable to prevent any adverse impacts on otters.

Overwintering bird assemblages

6.3.9 During construction surveys would focus on the use of habitats by redshank, gadwall and the assemblage. This would include monitoring of redshank roosting behaviour at the Rivers Ebbw and Usk crossings (e.g. monitoring whether this species continues to roost close to the crossing location, or is displaced to alternative roosts upstream or downstream of the crossing) and monitoring of gadwall, within fields, reens and ditches south of the Tata Llanwern Steel works, noting any evidence of construction related disturbance effects.

6.3.10 Key locations frequented by birds of the assemblage would also be the subject of monitoring to assess whether impacts are occurring. These include Pride's Bridge/Green Moor (pochard, shoveler, pintail and wigeon), Solutia Nature Reserve (shoveler, tufted duck and wigeon), Caldicot Moor (lapwing), fields to the south of Bowleaze Reen (lapwing), fields to the west of the River Ebbw (lapwing), Fox Covert/Maerdy Farm (lapwing), and the Rivers Usk and Ebbw (curlew and wigeon).

6.3.11 Monitoring requirements would be confirmed with NRW.

Lesser and Greater Horseshoe Bats

6.3.12 The ECoW would be responsible for ensuring regular monitoring of construction lighting throughout the construction phase so as to ensure measures to limit/prevent light spill are implemented as required to minimise the potential for disturbance or displacement of bats.

6.3.13 The ECoW would be responsible for ensuring regular monitoring of artificial bat corridors throughout the construction phase so as to ensure measures are implemented as required.

6.3.14 Monitoring would be undertaken by a NRW bat licensed ecologist, who would internally inspect the Bat House on four occasions each year during construction, one each in spring (March/April), summer (May-August), autumn (September-November) and winter (December-February) following its construction.

6.3.15 The greater horseshoe bat roost in the garage at Berryhill Farm would be surveyed annually during construction by internal inspection inj the summer. Baseline surveys will be undertaken in 2017 and 2018 as part of pre-construction monitoring. Monitoring would be reviewed each year in discussion with NRW.

6.3.16 Construction phase monitoring of road crossing points would begin once culverts are constructed and temporary guidance measures are in place. The need for further construction monitoring or implementation of remedial action would be reviewed each year in discussion with NRW.

6.3.17 An annual report of monitoring results would be provided to the Welsh Government, NRW and, if requested, the Local Planning Authorities.

6.3.18 Records would also be provided to the local biological records centre as part of the requirements of the survey licence held by the ecologist.

6.4 Post-construction Monitoring

Migratory Fish Species

Water Quality Monitoring

6.4.1 Post-construction water quality monitoring would be undertaken in accordance with the Surface Water Monitoring Protocol as agreed with NRW.

European Otter

6.4.2 Mammal exclusion fencing installed along the boundaries of the operational Scheme would be monitored regularly to confirm its effectiveness. It would also be assessed after any damage is reported (e.g. as a result of an accident on the road), in order to ensure any repairs are undertaken as soon as practicable and are effective.

6.4.3 The movement of otters through culverts, dry mammal crossings and along the River Usk channel would be monitored to confirm whether or not otter movement and home ranges are being impacted upon by the Scheme. The duration of this post-constructon monitoring would be agreed with NRW, but it is unlikely that this would need to continue beyond the 5-year aftercare period, as this should be sufficient time to demonstrate the effectiveness, or otherwise, of the mitigation. The results of monitoring surveys would inform the need for any amendments to the mitigation, or additional mitigation measures, such as additional measures to direct otters towards underpasses.

Overwintering Bird Assemblage

6.4.4 Post construction monitoring surveys would focus on the use of habitats by gadwall, redshank and assemblage species to test the predictions made in this SIAA with respect to continued use of surrounding habitats. This would include monitoring of redshank roosting behaviour at the Ebbw and Usk river crossings (e.g. monitoring whether this species continues to roost close to the crossing location, or is displaced to alternative roosts upstream or downstream of the crossing) and monitoring of gadwall within fields, reens and ditches around the Tata Llanwern Steel works, noting any evidence of construction related disturbance effects. Monitoring would also focus on the use of the ecological mitigation areas (i.e. those committed to within the Reen Mitigation Strategy and the SSSI Mitigation Strategy) by SPA bird species, particularly gadwall (i.e. in reen and ditch habitats) and redshank at the replacement saltmarsh to be created in the lower Usk).

6.4.5 Key locations frequented by birds of the assemblage would also be the subject of monitoring to assess whether impacts were occurring. These include Pride's Bridge/Green Moor (pochard, shoveler, pintail and wigeon), Solutia Nature Reserve (shoveler, tufted duck and wigeon), Caldicot Moor (lapwing), fields to the south of Bowleaze Reen (lapwing), fields to the west of the River Ebbw (lapwing), Fox Covert/Maerdy Farm (lapwing), and the Rivers Usk and Ebbw (curlew and wigeon).

6.4.6 Monitoring requirements would be confirmed with NRW.

Lesser and Greater Horseshoe Bats

6.4.7 New planting would be monitored during the establishment period (5 years post planting) so as to ensure failed plants are replaced in order to ensure failures do not result in significant gaps in planting.

6.4.8 The Bat House and the greater horseshoe bat roost in the garage at Berryhill Farm would be monitored for a period to be agreed with NRW.

6.4.9 Operational phase monitoring of these roosts would begin at road opening and be reviewed after year 1. Further monitoring may be undertaken, for example in year 5 and year 10 after opening.

6.4.10 During each roost monitoring visit signs of bat presence would be recorded. A condition assessment of the bat roosts would also be made during each monitoring visit so that should there be any damage or deterioration of roost conditions maintenance work can be instructed.

6.4.11 Monitoring would also be undertaken of a sample of potential road crossing points to be agreed with NRW as set out under Pre-construction Monitoring above. Operational phase monitoring would begin in the first survey period (June-August) following road opening and be continued for three years. Following the three-year post-monitoring period, the need for any further monitoring would be reviewed and agreed with NRW.

6.4.12 An annual report of monitoring results would be provided to the Welsh Government, NRW and, if requested, the Local Planning Authorities.

6.4.13 Records would also be provided to the local biological records centre as part of the requirements of the survey licence held by the ecologist.

6.5 Criteria for Success

Migratory Fish Species

Underwater Noise

Water Quality

6.5.1 Criteria for success of water treatment measures adopted as part of the M4CaN project during construction and operation would be measured through compliance with discharge consents which would be regulated by NRW. These consents would relate to discharge of suspended sediments and other contaminants of concern associated with operation of the M4CaN.

6.5.2 For example, should monitoring of suspended sediments in water treatment areas during construction show that settlement has not been sufficient to meet standards for discharge (as regulated by NRW), then alternative methods may be considered, including flocculation and potentially off site disposal, if appropriate.

European Otter

6.5.3 The mitigation measures for otter would be considered a success if:

- Otter activity is recorded along new culverts and dry underpasses, confirming these provide effective safe crossing points and prevent a reduction in individuals' home ranges and dispersal potential;
- Otter activity continues to be recorded in all areas where activity was reported in 2014 and 2015 (March 2016 ES Appendices 10.8 and 10.25 and any prec-construction surveys), confirming no significant impact on otter ranges; and
- No otter casualties are recorded on the new carriageway.

Overwintering Bird Assemblage

6.5.4 The mitigation measures for overwintering bird species would be considered a success if wintering birds were monitored and seen to return in subsequent seasons to the wider area.

6.5.5 This would likely include continued redshank roosting within the Ebbw estuary, either close to the Ebbw crossing or at the roosts upstream and downstream of the crossing, as noted during baseline surveys.

6.5.6 Success for gadwall would be represented by continued use of the reen and ditch network surrounding the M4CaN and particularly those waterbodies to be replaced as part of the Reen Mitigation Strategy.

6.5.7 While the focus of monitoring would be redshank and gadwall (as these were the species for which LSEs were predicted to occur), other SPA species would be noted. Their continued presence in the habitats surrounding the M4CaN (e.g. reen and ditches within the field network of the Gwent Levels) and the ecological mitigation areas (to be developed through the SSSI Mitigation Strategy and the

Reen Mitigation Strategy) would also be evidence of success of the mitigation measures.

Lesser and Greater Horseshoe Bats

6.5.8 The mitigation measures would be considered successful if the monitoring programme demonstrates the following:

- Lesser and greater horseshoe bats cross beneath the new road utilising culverts and other underpasses. Success would be measured by the proportion of bats using the underpasses compared to those crossing the M4CaN, with the majority of bats predicted to use underpasses. The proportion of bats using underpasses which would indicate success would be at least 90% (Berthinussen and Altringham 2105).
- The Bat House has been inhabited by roosting horseshoe bats.

7 Consultation

7.1 Consultation during preparation of the draft plan level Strategic Habitat Regulation Assessment A

7.1.1 A considerable amount of consultation with the regulatory authorities took place for the draft plan level Strategic Habitat Regulation Assessment for the M4CaN (see Welsh Government, 2014a). This included consideration of a range of options (e.g. alternative routes) and subsequently led to selection of the Black Route as the preferred option. Comments provided by NRW ensured that all LSEs were captured in the final SHRA, with NRW ultimately agreeing, in principle, with the conclusions of the SHRA.

7.2 Consultation during preparation of the Project Level AIES

7.2.1 To ensure a consistent approach, all of the previous consultation for the SHRA in terms of LSEs and survey requirements has also been captured within the project level AIES Stage 1: Screening Report (Welsh Government, 2015) and SIAA for the M4CaN. Representations on the draft AIES Stage 1: Screening Report were invited from NRW, as the appropriate Nature Conservation Body under the Habitat Regulations on 6th October 2015. Following receipt of these comments the Screening Assessment has been revised and the updated version is set out in Section 4 of this report. The NRW response to the AIES Stage 1: Screening Report is presented in Appendix A1, with Welsh Government responses to the NRW comments presented in Appendix A2.

7.2.2 Natural England were also invited to make representations on the draft AIES Stage 1: Screening Report (Welsh Government, 2015) in October 2015, but did not provide a response. During consultation on the SHRA, Natural England replied that based on the information provided that they would not expect the proposed works to affect any national or European protected sites within England, and therefore did not have comments on the proposals. They indicated that should NRW identify potential effects on such sites, they would comment further.

7.2.3 Since commencement of detailed development of the route for the purposes of EIA/SIAA and environmental surveys in 2015, monthly liaison meetings have been held with NRW, with other meetings to discuss particular aspects of the Scheme as required.

7.2.4 A draft of this SIAA report was submitted to NRW and Local Planning Authorities for consultation as part of the overall public consultation on the Draft Orders.

7.2.5 NRW responded to the draft Orders consultation in a letter dated 4 May 2016. Annex 2 of the letter provided detailed comments on the draft SIAA.

7.2.6 NRW confirmed that they considered that likely significant effects could not be ruled out for:

- the River Usk SAC;
- the Severn Estuary SAC;

- SPA and Ramsar site; and
- the Wye Valley and Forest of Dean Bat Sites SAC.

7.2.7 This was in accordance with the advice they gave Welsh Government in relation to the Plan stage of the M4 CaN.

7.2.8 NRW thus confirmed that the Welsh Government, as the competent authority, would need to carry out a test of likely significant effects under regulation 61 of the Conservation of Habitats and Species Regulations 2010 (as amended).

7.2.9 NRW agreed that, provided the measures summarised in the draft SIAA are fully implanted, adverse effects on migratory fish features of the River Usk/Afon Wysg SAC, Severn Estuary/ Môr Hafren SAC and Severn Estuary Ramsar site can be avoided. They would require this matter to be addressed through Commitments.

7.2.10 NRW required further information before they could give their view in relation to European otter as a feature of the River Usk/Afon Wysg SAC

7.2.11 They required the results of the 2015/16 overwintering bird survey to have been evaluated and considered, before they could give a view in respect of the likelihood of adverse effects on the qualifying bird species/ assemblages of the Severn Estuary SPA and Ramsar site

7.2.12 They required the results of the bat surveys then in progress to have been evaluated and their significance considered in relation to assessment of adverse effects on site integrity of the Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC.

7.2.13 This further information has subsequently been provided to NRW and is incorporated into this SIAA.

8 Conclusions

8.1.1 This SIAA report demonstrates that the M4CaN would not have an adverse effect on the integrity of the River Usk SAC, Severn Estuary SAC, SPA and Ramsar Site and the Wye Valley and Forest of Dean Bat Sites SAC, either alone or in-combination with other projects or plans. This has been concluded based on the information provided which shows that progress towards achieving the relevant conservation objectives of the qualifying features would not be interrupted or delayed. The M4CaN would also not disrupt the factors which help maintain favourable condition and interfere with the balance, distribution and density of key indicator species of favourable condition of these European sites.

8.1.2 Adverse effects on migratory fish (listed as features of the River Usk SAC and Severn Estuary SAC and Ramsar Site) are not predicted to occur due a range of measures embedded into the scheme, most notably the avoidance of construction of any structures within the wetted channel of the River Usk and maintaining connectivity of the Gwent Levels reen and ditch network (particularly important for European eel). Other measures would include avoidance of piling for the east pylon of the River Usk crossing during the most sensitive period for fish migration (Aperil to June), measures to ensure water quality of the River Usk and Gwent Levels is maintained in a favourable condition and appropriate design of lighting during construction and operation to minimise effects on migratory fish. These measures, in combination with the short term, intermittent (for construction) and localised effects of the M4CaN (during construction and operation) would ensure that adverse effects on the conservation objectives of migratory fish features of European sites do not occur.

8.1.3 Adverse effects on European otter (listed as a feature of the River Usk SAC) are not predicted to occur as a result of the M4CaN construction or operation. The natural range of otters within the River Usk and the surrounding habitats (including the Gwent Levels) would be maintained through the avoidance of construction within the wetted channel of the River Usk (and provision for otters to move past the east pylon construction site), and the provision of culverts and underpasses beneath the new section of motorway across the Gwent Levels. Other measures which would be implemented as part of the Scheme include the use of mammal exclusion fencing to minimise collision risk and encourage use of dedicated mammal underpasses; limiting construction and operational lighting; replacement of habitats of value to otters (e.g. reen and ditch habitats within the Gwent Levels); and protection or replacement of any otter holts identified before or during construction. These measures would ensure that there would be no adverse effects on the ability of the otter population in the River Usk SAC to be ‘stable or increasing’ in the long term, and would also ensure that otters can move safely around the River Usk and other habitats in the surrounding area, including the Gwent Levels.

8.1.4 Effects of the M4CaN on qualifying bird species of the Severn Estuary SPA and Ramsar Site are not expected to lead to adverse effects on the conservation objectives for these features. The M4CaN is located outwith the boundary of the Severn Estuary SPA and Ramsar Site (located 300 m south of the River Ebbw crossing) and therefore any effects are only expected on habitats used by qualifying features. Qualifying bird species were present along the M4CaN corridor in relatively low numbers and in many cases at significant distances from the M4CaN (e.g. birds recorded in parts of the Gwent Levels were in excess of 2

km from the SPA boundary). Redshank and gadwall were the only two SPA qualifying species considered to be present in numbers considered to be high enough to give rise to apotential likely significant effect, along with the SPA assemblage. Redshank were predominantly recorded at the location of the River Ebbw crossing and tidal mudflats to the north and south of it, while gadwall were recorded in low numbers in reens and ditches within the Gwent Levels to the south of the Tata Llanwern Steel works at Green Moor). Assemblage species were often restricted to particular sections of the M4CaN corridor, whilst some species such as mallard and teal were distributed throughout its length.

8.1.5 While disturbance and displacement effects are predicted to occur, particularly during construction, there is a wide availability of alternative suitable habitat in the surrounding landscape. These include: redshank roosting sites upstream and downstream of the Ebbw crossing, and gadwall relocating to either the wider reen and ditch network of the Gwent levels, north of the Tata Llanwern Steel works and Ynysfro Reservoirs. There are a range of habitats available to assemblage species. For all species, the supporting habitats both within the Severn Estuary SPA and Ramsar Site, and habitats within mitigation areas for the M4CaN Scheme (to be developed through the SSSI Mitigation Strategy and the Reen Mitigation Strategy) which would include replacement reens and ditches (and replacement saltmarsh to be created alongside the River Usk.

8.1.6 Adverse effects on the greater and lesser horseshoe bat features of the Wye Valley and Forest of Dean Bat Sites SAC are not predicted to occur as a result of construction or operation of the M4CaN. The Scheme is located over 6 km from the closest SSSI component of this SAC, although greater and lesser horseshoe bats (assumed for the purpose of this SIAA to be associated with this SAC) were recorded along the M4CaN scheme in small numbers.There is a roost used by a small number of lesser horseshoe bats at the coach house at Woodland House, Magor (to be demolished) and a roost used by a small number of greater horseshoe bats at the garage at Berryhill Farm, between Duffryn and Castleton (to be retained). The provision of habitat replacement and enhancement measures, including a Bat House (which would provide an alternative lesser horseshoe bat roost), as part of the Scheme would ensure effects on roosting, foraging and commuting bats would be minimised. To ensure access to foraging habitat provided around the M4CaN (including parts of the Gwent Levels) is maintained and to reduce the potential for collision or predation due to the presence of the M4CaN, the Scheme would provide crossinmg structures to accommodate these species and measures including artificial bat corridors, new planting and fencing to divert bats towards these structures. These, and other measures to be implemented as part of the M4CaN Scheme, would ensure that any adverse effects on the integrity of the Wye Valley and Forest of Dean Bat Sites SAC are avoided.

8.1.7 DMRB HD44/09 guidance (Highways Agency, 2009) recommends that, for the purposes of Regulation 61 of the Conservation of Habitats and Species Regulations 2010, answers to the following four questions (a to d) should be provided (based on the information presented) when concluding a SIAA. These are addressed in turn here.

(a) Is the proposal directly connected with or necessary to site management for nature conservation?

8.1.8 The M4CaN project is neither connected with nor necessary to site management for any of the relevant European sites.

(b) Is the proposal likely to have a significant effect on the features of the site of European Importance, alone or in combination with other plans and projects?

8.1.9 The M4CaN AIES Stage 1: Screening concluded that LSEs could not be ruled out on qualifying features of the following European sites (summarised in Section 4 of this SIAA):

- River Usk SAC;
- Severn Estuary SAC;
- Severn Estuary SPA;
- Severn Estuary Ramsar Site; and
- Wye Valley and Forest of Dean Bat Sites SAC.

8.1.10 It is therefore necessary for an Appropriate Assessment to be carried out for the M4CaN project on the qualifying features of these five sites. In accordance with DMRB HD44/09 guidance, it is therefore necessary to provide answers to questions (c) and (d) below.

(c) What are the implications of the effects of the proposal on the sites' conservation objectives and will it delay or interrupt progress towards achievement of any of the objectives?

8.1.11 It has been concluded that, assuming the implementation of the mitigation measures outlined in Sections 5.2 to 5.6 of this SIAA, the proposals would not adversely affect the conservation objectives nor delay or interrupt progress towards achieving these.

(d) Can it be ascertained that the proposal will not adversely affect the integrity of the site beyond reasonable scientific doubt?

8.1.12 As explained above, the implementation of the mitigation measures described in this SIAA would ensure that the proposals would not adversely affect the integrity of the sites beyond reasonable scientific doubt.

8.1.13 Therefore, for the purposes of Regulation 61 of the Conservation of Habitats and Species Regulations 2010, it is considered that there would be no adverse effect on the integrity of the relevant European sites either alone or in-combination with other plans and projects.

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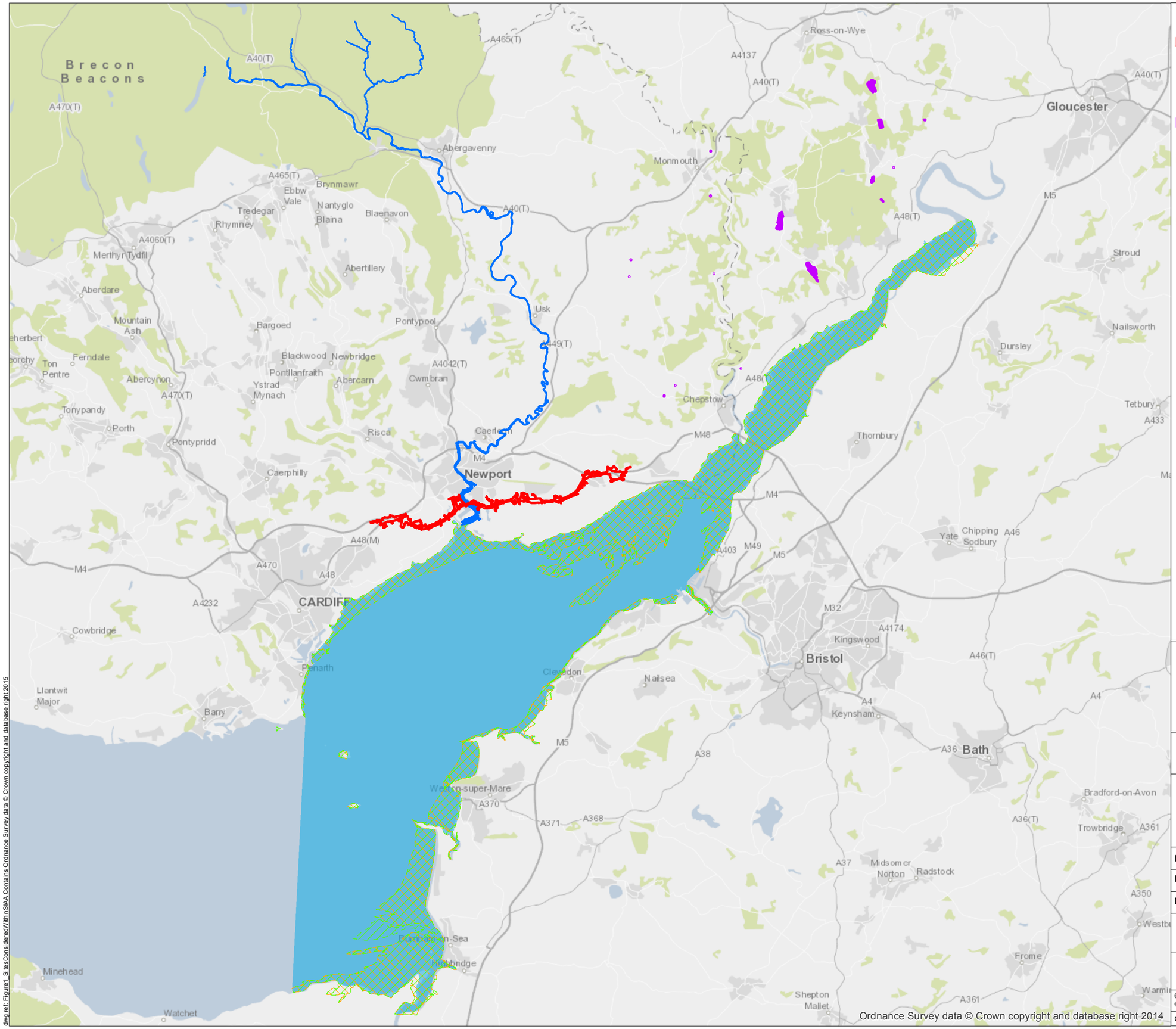
Figures



Legend

- Limit of Permanent and Temporary Works for New Section of Motorway
- River Usk Special Area of Conservation (SAC)
- Wye Valley and Forest of Dean Bat Sites Special Area of Conservation (SAC)
- Severn Estuary RAMSAR Site
- Severn Estuary Special Area of Conservation (SAC)
- Severn Estuary Special Protection Area (SPA)

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

International/European Sites Considered within SIAA

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: KL

Scale: A3 @ 1:300,000

0 5 10 km

N

dwg ref: Figure1_SitesConsideredWithinSIAA

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Operational lighting
- Indicative location of mammal crossing: 900 mm diameter pipes
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Watercourses with signs of otter presence

Llywodraeth Cymru
Welsh Government

M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2a	Revision: -
Date: July 2017	Status: DRAFT
Drawn: CR	Checked: JW

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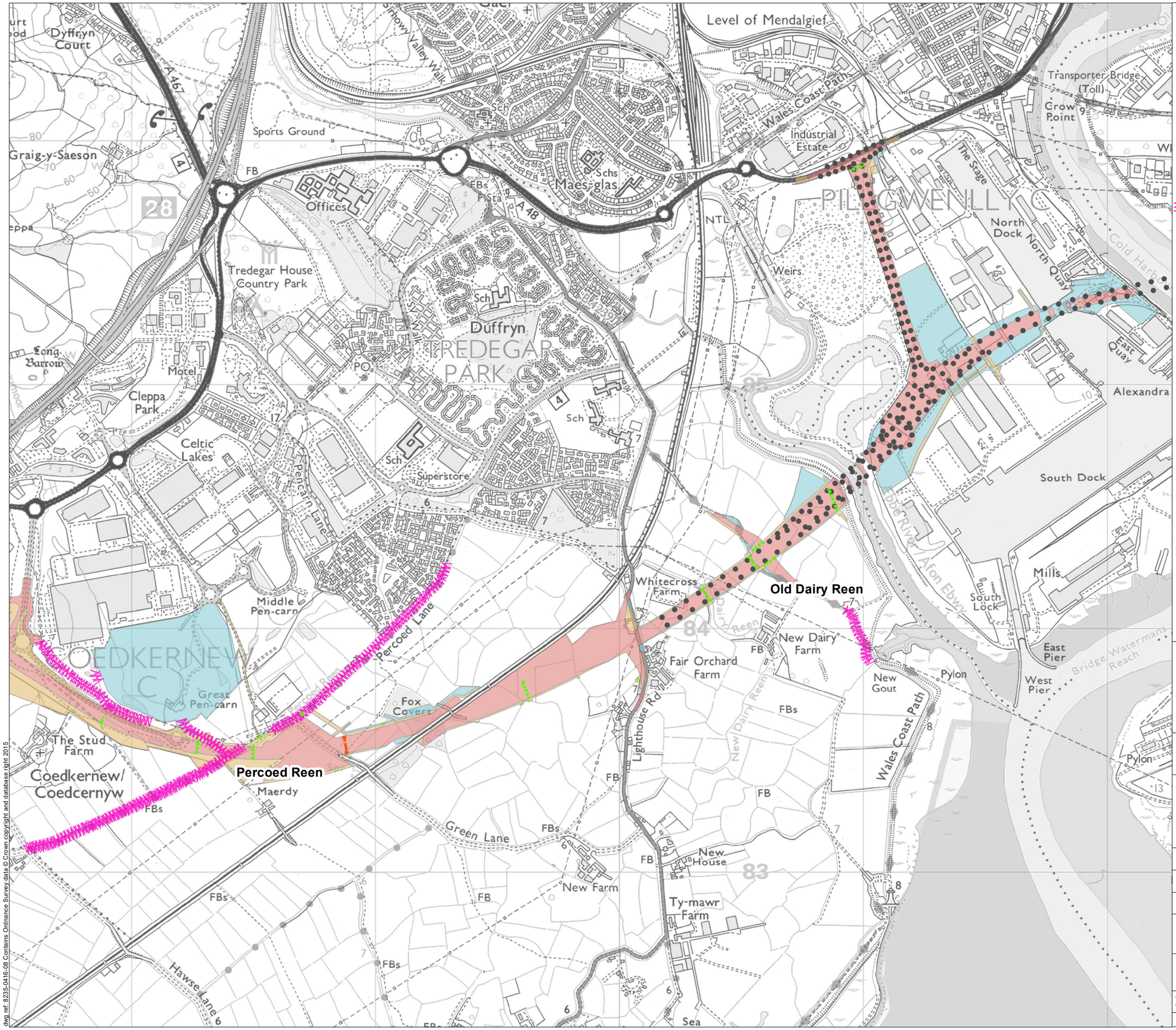
dwg ref: 8235-0416-08



Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Operational lighting
- Indicative location of mammal crossing: 900 mm diameter pipes
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Watercourses with signs of otter presence

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M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2b	Revision: -
Date: July 2017	Status: DRAFT
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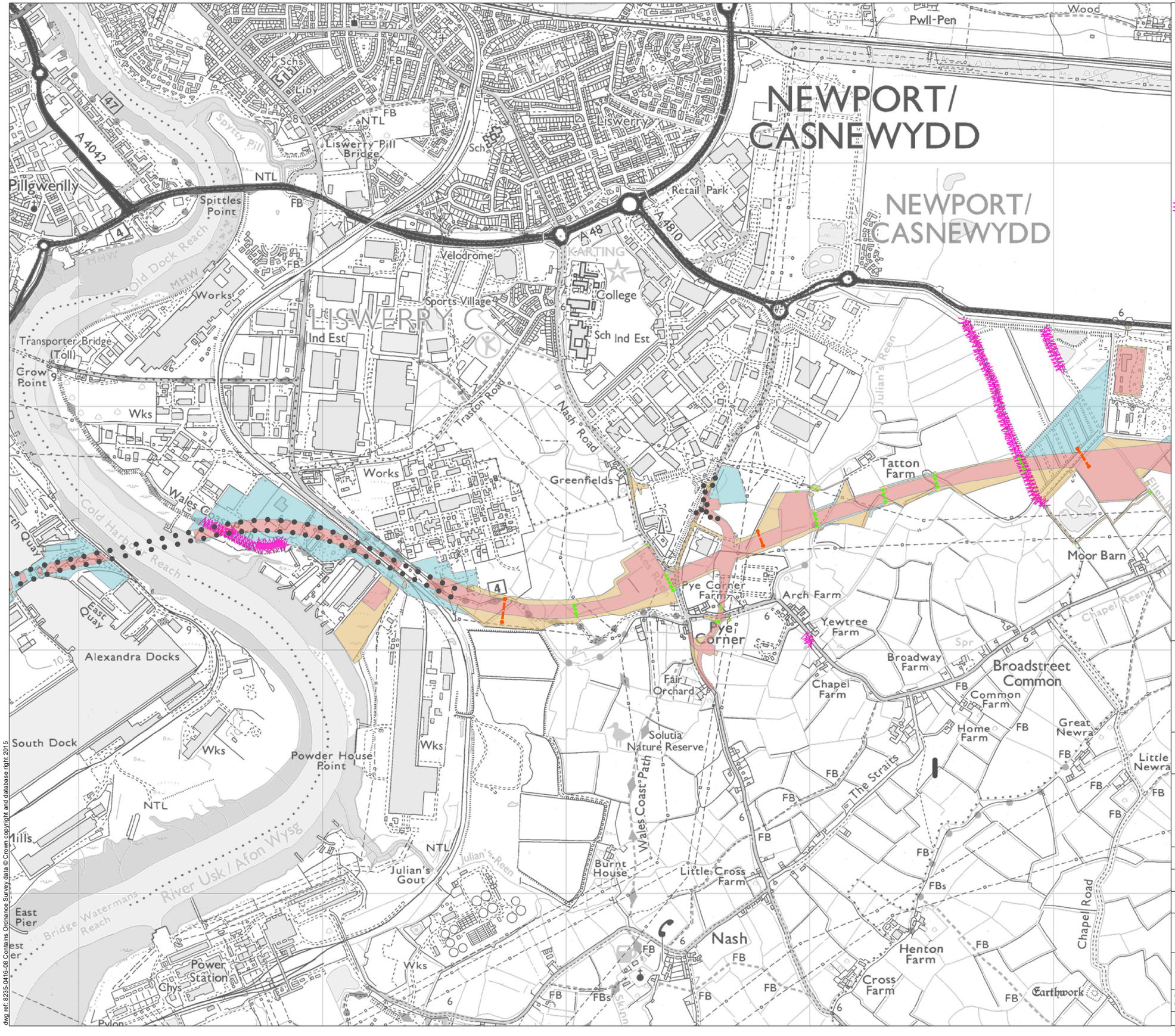

Legend

- Permanent highway land within fenceline, including water treatment areas
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- Temporary construction land
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M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2c	Revision: -
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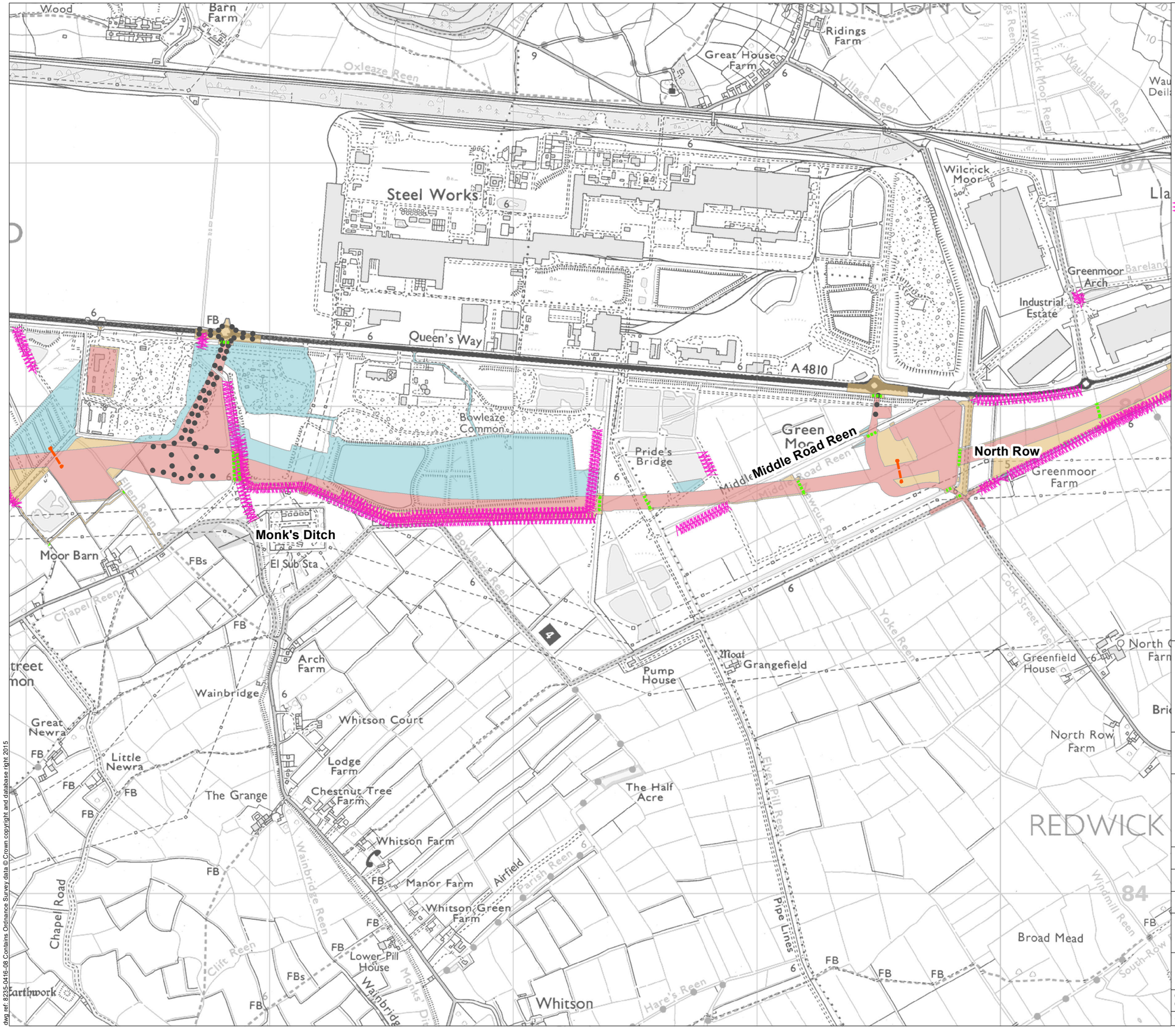

Legend

- Permanent highway land within fenceline, including water treatment areas
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- Indicative location of mammal crossing: 900 mm diameter pipes
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Watercourses with signs of otter presence

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M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2d	Revision: -
Date: July 2017	Status: DRAFT
Drawn: CR	Checked: JW

Scale: A3 @ 1:15,000

0 245 490m

N

dwg ref: 8235-0416-08

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Operational lighting
- Indicative location of mammal crossing: 900 mm diameter pipes
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Watercourses with signs of otter presence

Llywodraeth Cymru
Welsh Government

M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2e	Revision: -
Date: July 2017	Status: DRAFT
Drawn: CR	Checked: JW

Scale: A3 @ 1:15,000

0 245 490m

N

dwg ref: 8235-0416-08

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Operational lighting
- Indicative location of mammal crossing: 900 mm diameter pipes
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Watercourses with signs of otter presence

Llywodraeth Cymru
Welsh Government

M4CaN SIAA – June 2017

Otter Survey Results (2014, 2015 and 2017) and Crossing Points

Figure: 2f	Revision: -
Date: July 2017	Status: DRAFT
Drawn: CR	Checked: JW

Scale: A3 @ 1:15,000
0 245 490m

N

dwg ref: 8235-0416-08

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number (x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

- 2016/2017 Horseshoe bat records

GH (A) - Greater Horseshoe bat flying through Blacksmiths Way underpass

GH (B) - Greater Horseshoe bat night roost at Berryhill Farm

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3a	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number
(x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

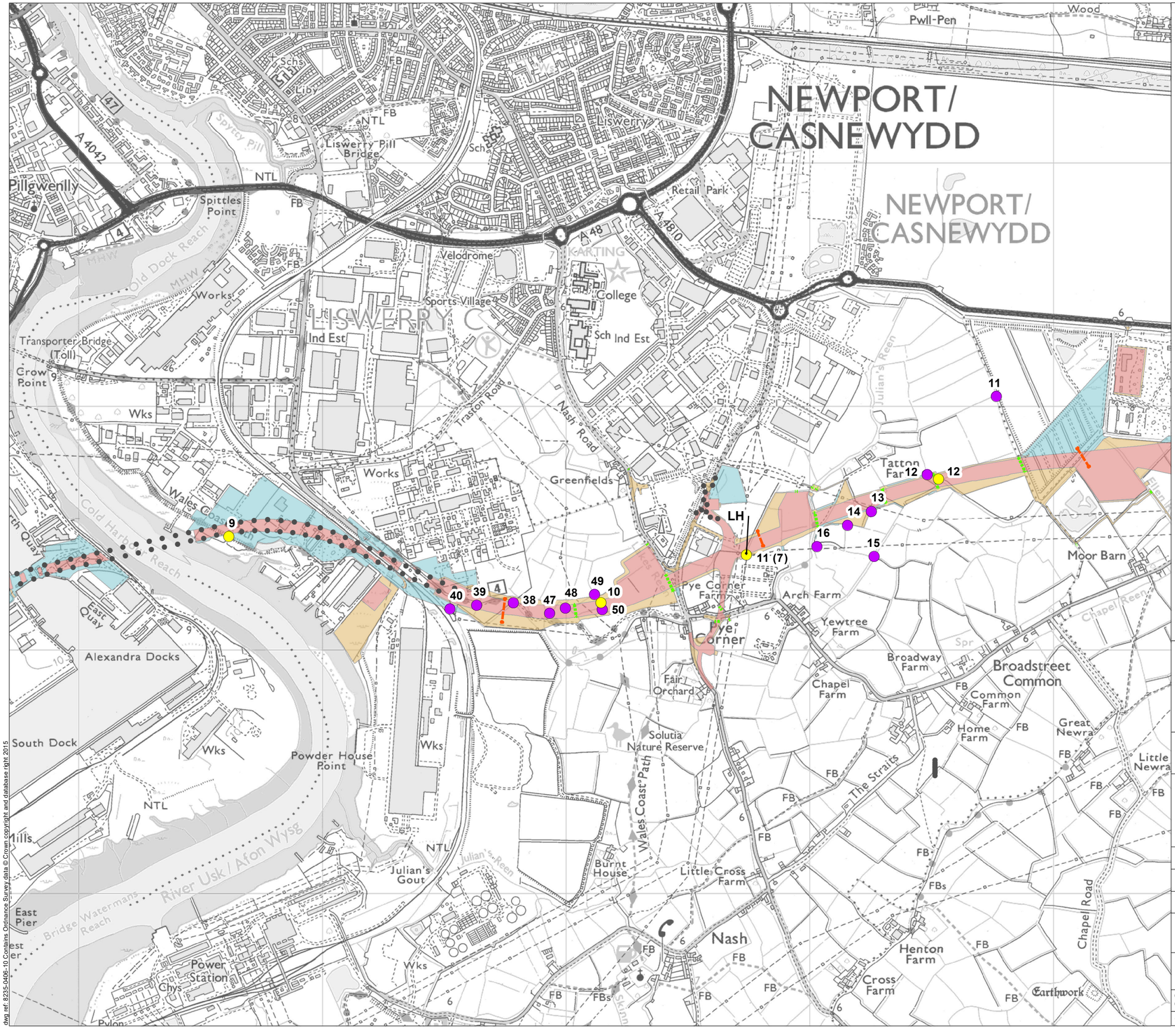
Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3b	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10



Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number (x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3c	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number (x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3d	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number (x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

- 2016/2017 Horseshoe bat records

LH (A) - Lesser Horseshoe bat day/night roost in Woodland House Coach House

LH (B) - Lesser Horseshoe bat night roost in Lime Kiln

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3e	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10

Legend

- Permanent highway land within fenceline, including water treatment areas
- Other permanent land take e.g. mitigation planting.
- Temporary construction land
- Mammal crossing (900 mm diameter pipes) associated with culvert
- Indicative location of Bat House
- Indicative location of mammal crossing: 900 mm diameter pipes
- Operational lighting
- 2014 static bat detector locations
- 2015 static bat detector locations

6 - Static bat detector reference number (x)- greatest number of bat passes recorded during a single 5 night survey period

LH- Lesser Horseshoe
GH- Greater Horseshoe

- 2016/2017 Horseshoe bat records

LH (A) - Lesser Horseshoe bat day/night roost in Woodland House Coach House

LH (B) - Lesser Horseshoe bat night roost in Lime Kiln

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Locations of bat detectors utilised during the 2014 - 2017 activity surveys

Figure: 3f	Revision: -
Date: July 2017	Status: AT ISSUE
Drawn: CR	Checked: KJ

Scale: A3 @ 1:15,000
0 250 500 m

N

dwg ref: 8235-0406-10

Legend

- Limit of Permanent and Temporary Works for New Section of Motorway

Wintering Bird Survey 2013/14

- 6 Redshank

Wintering Bird Survey 2014/15

- 6 Redshank
- Flight line
- Vantage point survey location

6 = Abundance (if if recorded)

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Welsh Government

M4CaN - SIAA

Redshank presence in Wintering Bird Survey

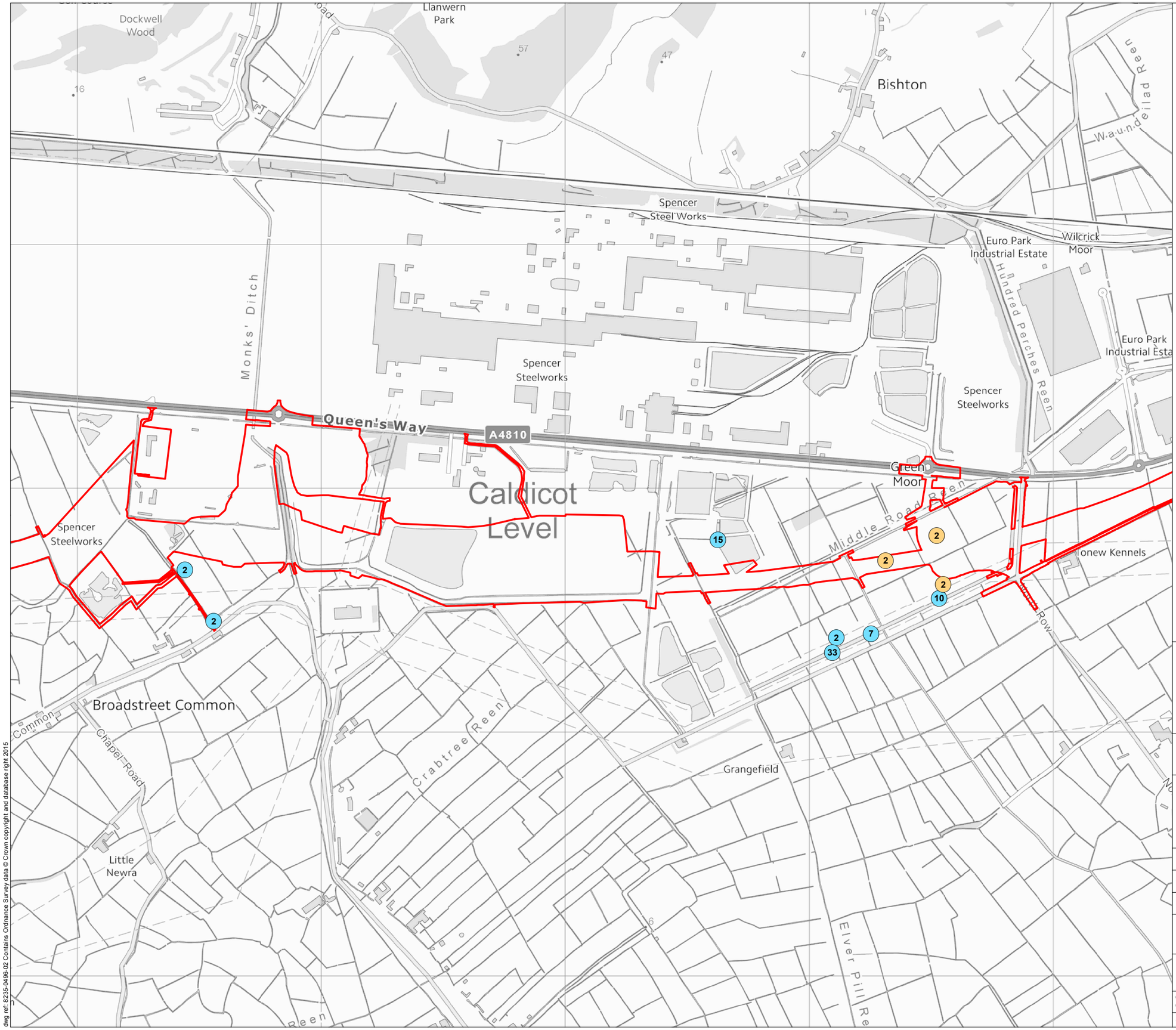
Figure: 4	Revision:
Date: March 2016	Status: AT ISSUE
Drawn: MS	Checked: KL

Scale: A3 @ 1:15,000

0 250 500 m

N

dwg ref: 8235-0492-03



Legend

Limit of Permanent and Temporary Works for New Section of Motorway

Wintering Bird Survey 2013/14

6 Gadwall

Wintering Bird Survey 2014/15

6 Gadwall

6 = Abundance (if recorded)

Llywodraeth Cymru
Welsh Government

M4CaN - SIAA

Gadwall presence in Wintering Bird Survey

Figure: 5	Revision:
Date: March 2016	Status: AT ISSUE
Drawn: MS	Checked: KL

Scale: A3 @ 1:15,000

0 250 500 m

N

dwg ref: 8235-0496-02

Appendix A: Consultation with NRW on SIAA

A1 NRW Comments on AIES Stage 1: Screening Report

Cyfoeth Naturiol Cymru
Natural Resources Wales

Ein cyf/Our ref:
Eich cyf/Your ref: M4 CaN-DJV-EAC-ZG_GEN_RP_EN_0001.V4

Rivers House
St Mellons Business Park
Cardiff
CF3 0EY

Ebost/Email: Jessica.poole@cyfoethnaturiolcymru.gov.uk
Ffôn/Phone: 0300 065 3174

Dr Peter Ireland
M4 CaN Environmental Coordinator
3rd Floor, Longcross Court
47 Newport Road
Cardiff
CF24 0AD

5 November 2015

Dear Peter

M4 CORRIDOR AROUND NEWPORT – NATURAL RESOURCES WALES' COMMENTS ON ASSESSMENT OF IMPACTS ON EUROPEAN SITES (AIES) - SCREENING REPORT

Thank you for giving Natural Resources Wales (NRW) the opportunity to comment on the draft AIES Screening Report.

Please note that our comments are made without prejudice to any comments we may subsequently wish to make when consulted on any draft Trunk Road Order, draft Side Road Order, Environmental Statement or the submission of more detailed information.

Our comments are restricted to those sites wholly or partially within Wales. We refer you to Natural England for comments on sites wholly or partially within Wales.

We note your comment in your covering email that this report may need to be amended in light of recent design iterations. We recommend, given the size of this report, that any amendments to subsequent versions of this report are clearly highlighted for ease of review.

We note and welcome that this report has taken account of the earlier work done on the Plan (Strategic) level Habitats Regulations Assessment (HRA) for the M4 Corridor around Newport as well as the views given by NRW on that document.

Our detailed comments on the Screening Report are given in the attached Annex. In summary, we agree with the assessment in relation to which sites should be screened either in or out at this stage, ie that you are unable to ascertain that there will not be likely to be a significant effect, either alone or in-combination with other plans and projects, on the following European sites:

- River Usk/Afon Wysg SAC
- Severn Estuary/ Môr Hafren SAC
- Severn Estuary SPA
- Severn Estuary Wetland of International Importance (Ramsar) Site
- Wye Valley and Forest of Dean Bat Sites /Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC

In most cases we agree with the assessment of likely significant effect against each qualifying feature assessed against all potential impacts/ pathways and effects, but disagree in some cases in relation to the River Usk SAC. Specifically our concern is in relation to the ruling out of Likely Significant Effect (LSE) at this stage on migratory fish features due to both direct land-take / habitat loss/fragmentation and physical presence-displacement/barrier/ flight lines/collision - please refer to attached Annex for detail.

I'd be happy to discuss this response if clarification of any of the points made is required.

Yours sincerely

Jessica Poole
NRW M4 Coordinator
SE Operations

Encs: Annex 1 – NRW's Detailed Comments on draft AIES Report

ANNEX 1

M4 CORRIDOR AROUND NEWPORT – NATURAL RESOURCES WALES' COMMENTS ON ASSESSMENT OF IMPACTS ON EUROPEAN SITES (AIES) SCREENING REPORT

NB We Refer to the Paragraph and Table numbering used in the report.

1.3.4 We note that this is an initial report, subject to change. Our comments are therefore made in this context

2.2.3 We note and welcome the continued aspiration that any new River Usk river crossing will be a clear span with no support structure within the wetted channel. This appears to be in accordance with the commitments made in the strategic level HRA accompanying the M4 Corridor around Newport Draft Plan consultation in 2013/14. However we seek assurance that "no support structure" means that there will be no permanent structure within the wetted channel once the bridge is operational. For clarity, we note that we have previously agreed with yourselves a definition of wetted channel, for these purposes, as the river channel at and below Mean High Water (MHW). Our views in relation to the assessment of impacts on the River Usk SAC are therefore made on this understanding.

3.5 Assessment Methodology – we welcome the inclusion of this section which clearly sets out how the assessment will be undertaken in accordance with the Habitats Regulations and following the Design Manual for Roads and Bridges (DMRB) guidance

4.1 Our comments are restricted to those sites wholly or partially within Wales. We refer you to Natural England for comments on those sites wholly or partially within England.

4.1.4 We agree with the assessment that Cardiff Beech Woods SAC, Aberbargoed Grasslands SAC, Cwm Clydach Woodlands / Coedydd Cwm Clydach SAC and Sugar Loaf Woodlands SAC are both at sufficient distance from the scheme, and given their qualifying features beyond the Zone of Influence and therefore can be screened out of further assessment

4.1.6 We agree, in relation to horseshoe bats, that only the Wye Valley and Forest of Dean Bat Sites SAC needs to be screened in for further consideration

4.1.8 We agree that the River Wye SAC can be screened out of any further assessment through the HRA process

4.1.9 We therefore agree that the following European sites are those which need to be subject to further assessment:

- River Usk/ Afon Wysg SAC
- Severn Estuary/Môr Hafren SAC
- Severn Estuary SPA
- Severn Estuary Ramsar Site
- Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC

5.1.1 We welcome the use of the Tyldesley (2011) guidance with respect to identifying relevant in-combination projects for inclusion in the assessment

5.1.19 We note that the tidal lagoon proposals linked to the Welsh coast of the Severn Estuary are identified as projects which need to be considered in-combination with the M4 Corridor around Newport project. We recognise the scale and likely significance of these projects. However, we look to yourselves to consider whether sufficient detail has yet been developed, in relation to the tidal lagoon project proposals, to enable you to undertaken meaningful in-combination assessment at this stage.

5.1.26 The Severn Estuary Shoreline Management Plan (SMP) 2 has now been approved by WG and is therefore no longer Draft

6.2.2 We agree with those measures identified here as means of reducing impacts on designated features. Their effectiveness in reducing impacts will depend on the detail of their implementation. We would therefore welcome the opportunity to advise further at an appropriate time to influence both design and proposed working practices.

Table 6.2 River Usk SAC

We disagree with the ruling out of Likely Significant Effect (LSE) at this stage on Migratory Fish features of the River Usk SAC due to both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision. We agree that this is likely to be the case during the operational phase but as yet we have not seen details of how the bridge will be constructed and so are unable to agree with respect to the construction phase situation. We may be able to revise this position on receipt of further detail. We agree with the conclusion for all other impact pathways for the migratory fish features of the River Usk SAC.

We agree with the ruling out of LSE, through all potential impact pathways on bullhead, brook lamprey and *Ranunculus* habitat.

We agree with the conclusions on LSE for all potential impact pathways on otter at this stage of project development.

Table 6.2 Severn Estuary SAC

We refer to our comments with respect to Migratory Fish features of the River Usk SAC which are also of relevance here.

We agree with all other conclusions with respect to LSE on all other features of the Severn Estuary SAC. This comment is made on the basis that the effects of construction of any new Usk crossing are contained to the immediate vicinity of the construction project. We are comfortable that this should be able to be achieved, but have not yet had sight of the Construction Environment Management Plan (CEMP) where such issues would be dealt with.

Table 6.2 Severn Estuary SPA and Ramsar Site

We agree with the conclusions reached with respect to LSE for all bird features and support the precautionary approach adopted. The full results of the wintering bird surveys which we have requested to be continued for the current winter period (2015-16) should help with the assessment of LSE here.

With respect to assemblage of migratory fish we refer you to comments made with respect to the River Usk SAC. We agree with the assessment in relation to likely impacts on eel.

We agree with the assessment in relation to the Habitat features of these two designations, given the caveat made above in .relation to the Severn Estuary SAC and the CEMP.

Table 6.2 Wye Valley and Forest of Dean Bat Sites SAC

We agree with the assessment with respect to both lesser horseshoe and greater horseshoe bat, at this point, but note that we may wish to change this view if ongoing survey were to record the presence of greater horseshoe bat.

7 Conclusions. We agree with how the 4, high level, questions are answered here including the deferral of questions c) and d) until the Appropriate Assessment phase, although note that our view with respect to potential impacts on the River Usk SAC alters the detail (not expressed in this section) in relation to the pathways for those impacts.

Tables 7.3-7.7 In principle we welcome the inclusion of these tables, as a means of summarizing the conclusions reached, but again recommend that in relation to the River Usk SAC, the text is re-evaluated in light of your consideration of our view that significant effect cannot be ruled out at this stage, with respect to likely impacts from both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision, on the migratory fish features.

A2 Welsh Government responses to NRW comments on AIES Stage 1: Screening Report

Note: References are to Paragraph and Table numbering used in the AIES Stage 1: Screening Report.

Reference	NRW Comment	Welsh Government Response
1.3.4	We note that this is an initial report, subject to change. Our comments are therefore made in this context	Comment acknowledged.
2.2.3	We note and welcome the continued aspiration that any new River Usk river crossing will be a clear span with no support structure within the wetted channel. This appears to be in accordance with the commitments made in the strategic level HRA accompanying the M4 Corridor around Newport Draft Plan consultation in 2013/14. However we seek assurance that "no support structure" means that there will be no permanent structure within the wetted channel once the bridge is operational. For clarity, we note that we have previously agreed with yourselves a definition of wetted channel, for these purposes, as the river channel at and below Mean High Water (MHW). Our views in relation to the assessment of impacts on the River Usk SAC are therefore made on this understanding.	Comment is acknowledged and Welsh Government reiterates the commitment to the River Usk crossing having no support structure within the wetted channel of the River Usk. See Section 2.2 of this SIAA and Chapter 2 of the ES for further detail.
3.5	Assessment Methodology – we welcome the inclusion of this section which clearly sets out how the assessment will be undertaken in accordance with the Habitats Regulations and following the Design Manual for Roads and Bridges (DMRB) guidance	Comment is acknowledged. See Section 3 of this SIAA for full details of the methods (using DMRB guidance) used in the SIAA.

Reference	NRW Comment	Welsh Government Response
4.1	Our comments are restricted to those sites wholly or partially within Wales. We refer you to Natural England for comments on those sites wholly or partially within England.	As detailed in Section 7 of this SIAA, Natural England were invited to make representations on the draft AIES Stage 1: Screening Report, but have not provided a response. During consultation on the SHRA, Natural England replied that based on the information provided that they would not expect the proposed works to affect any national or European protected sites within England, and therefore do not have comments on the proposals. They indicated that should NRW identify potential effects on the sites, they would comment further.
4.1.4	We agree with the assessment that Cardiff Beech Woods SAC, Aberbargoed Grasslands SAC, Cwm Clydach Woodlands / Coedydd Cwm Clydach SAC and Sugar Loaf Woodlands SAC are both at sufficient distance from the scheme, and given their qualifying features beyond the Zone of Influence and therefore can be screened out of further assessment	Comment is acknowledged.
4.1.6	We agree, in relation to horseshoe bats, that only the Wye Valley and Forest of Dean Bat Sites SAC needs to be screened in for further consideration	Comment is acknowledged. The full assessment of effects on features of the Wye Valley and Forest of Dean Bat Sites SAC is presented in Section 5.6 of this SIAA.

Reference	NRW Comment	Welsh Government Response
4.1.8	We agree that the River Wye SAC can be screened out of any further assessment through the HRA process	Comment is acknowledged.
4.1.9	We therefore agree that the following European sites are those which need to be subject to further assessment: River Usk/ Afon Wysg SAC; Severn Estuary/Môr Hafren SAC; Severn Estuary SPA; Severn Estuary Ramsar Site; and Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena SAC.	Comment is acknowledged and effects of the M4CaN on these sites, both alone and in-combination with other plans and projects, are assessed in Section 5 of this SIAA.
5.1.1	We welcome the use of the Tyldesley (2011) guidance with respect to identifying relevant in-combination projects for inclusion in the assessment.	Comment is acknowledged. The Tyldesley (2011) guidance was used in the SIAA to identify of projects and plans to be considered in-combination with the M4CaN (see Section 4.2 of this SIAA).
5.1.19	We note that the tidal lagoon proposals linked to the Welsh coast of the Severn Estuary are identified as projects which need to be considered in-combination with the M4 Corridor around Newport project. We recognise the scale and likely significance of these projects. However, we look to yourselves to consider whether sufficient detail has yet been developed, in relation to the tidal lagoon project proposals, to enable you to undertaken	As detailed in Section 4.2.5 of this SIAA, currently there is limited information on the Cardiff and Newport Tidal Lagoon projects and it is therefore not considered appropriate to include these projects within the in-combination assessment as the lack of information available on these projects will make a

Reference	NRW Comment	Welsh Government Response
	meaningful in-combination assessment at this stage.	meaningful in-combination assessment difficult to undertake. These projects will need to consider any effects of the M4CaN in-combination with these projects at the time of DCO submission.
5.1.26	The Severn Estuary Shoreline Management Plan (SMP) 2 has now been approved by WG and is therefore no longer Draft	Comment is acknowledged. The in-combination assessment (see Section 4.2 of this SIAA) was undertaken based on the approved SMP2.
6.2.2	We agree with those measures identified here as means of reducing impacts on designated features. Their effectiveness in reducing impacts will depend on the detail of their implementation. We would therefore welcome the opportunity to advise further at an appropriate time to influence both design and proposed working practices.	The comment is acknowledged. As detailed in Section 7 of this SIAA, monthly liaison meetings have been held with NRW, with other meetings to discuss particular aspects of the Scheme as required.
Table 6.2	River Usk SAC We disagree with the ruling out of Likely Significant Effect (LSE) at this stage on Migratory Fish features of the River Usk SAC due to both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision. We agree that this is likely to be the case during the operational phase but as yet we have not seen details of how the bridge will be constructed and so are unable to agree with respect to the construction phase situation. We may be able to revise this position on receipt of further	As detailed in Section 4.1 of this SIAA, details of bridge construction are fully detailed within Chapter 3: Scheme Construction of the ES and confirm that construction operations will not be undertaken within the wetted channel of the River Usk. Consequently, LSE on migratory fish features of the River Usk SAC are ruled out due to direct land take/habitat fragmentation and Physical Presence-

Reference	NRW Comment	Welsh Government Response
	detail. We agree with the conclusion for all other impact pathways for the migratory fish features of the River Usk SAC. We agree with the ruling out of LSE, through all potential impact pathways on bullhead, brook lamprey and Ranunculus habitat. We agree with the conclusions on LSE for all potential impact pathways on otter at this stage of project development.	displacement/barrier/flight lines/collision during the construction phase.
Table 6.2	Severn Estuary SAC We refer to our comments with respect to Migratory Fish features of the River Usk SAC which are also of relevance here. We agree with all other conclusions with respect to LSE on all other features of the Severn Estuary SAC. This comment is made on the basis that the effects of construction of any new Usk crossing are contained to the immediate vicinity of the construction project. We are comfortable that this should be able to be achieved, but have not yet had sight of the Construction Environment Management Plan (CEMP) where such issues would be dealt with.	Comment is acknowledged. See response on the River Usk SAC above.
Table 6.2	Severn Estuary SPA and Ramsar Site We agree with the conclusions reached with respect to LSE for all bird features and support the precautionary approach adopted. The full results of the wintering bird surveys which we have requested to be continued for the current winter period (2015-16) should help with the assessment of LSE here. With respect to assemblage of migratory fish we refer you to comments made with respect to the River Usk SAC. We agree with the assessment in relation to likely impacts on eel. We agree with the assessment in relation to the Habitat features of these two designations, given the caveat made above in relation to the Severn Estuary SAC and the CEMP.	Comments are acknowledged. Results of wintering bird surveys undertaken in 2015 are presented within Appendix 10.16 of the ES and considered within Section 5.4 of this SIAA. See response on the River Usk SAC migratory fish above.

Reference	NRW Comment	Welsh Government Response
Table 6.2	Wye Valley and Forest of Dean Bat Sites SAC We agree with the assessment with respect to both lesser horseshoe and greater horseshoe bat, at this point, but note that we may wish to change this view if ongoing survey were to record the presence of greater horseshoe bat.	Comment is acknowledged. The assessment of effects on this SAC presented within Section 5.6 considers both species of horseshoe bat.
7: Conclusions	We agree with how the 4, high level, questions are answered here including the deferral of questions c) and d) until the Appropriate Assessment phase, although note that our view with respect to potential impacts on the River Usk SAC alters the detail (not expressed in this section) in relation to the pathways for those impacts.	Comments are acknowledged. Answers to the 4 high level questions are presented in Section 7
Tables 7.3-7.7	In principle we welcome the inclusion of these tables, as a means of summarizing the conclusions reached, but again recommend that in relation to the River Usk SAC, the text is re-evaluated in light of your consideration of our view that significant effect cannot be ruled out at this stage, with respect to likely impacts from both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision, on the migratory fish features.	See response on the River Usk SAC migratory fish above. Appendix B presents the updated DMRB Screening Tables accounting for comments provided by NRW.

Appendix B: DMRB Screening Tables

Tables as presented in AIES Stage 1: Screening Report.

B1 River Usk SAC

Project name	**M4 CAN Project**	
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC	
Date	Author	Verified
April 2012	Nicole Price	Keith Jones
Description of Project Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with any other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	-A new section of 3-lane motorway between Junctions 23 and 29 of the M4 south of Newport (between Magor and Castleton), with complementary measures including: -Reclassification of the existing section of the M4 as a trunk road; -A M48-B4245 link: This will involve a connection between the M4, M48 and B4245 which would provide relief to Junction 23A and to the local road network. It would also provide improved access to proposed park and ride facilities at Severn Tunnel Junction; Provision of cycle friendly infrastructure: This will involve the provision of new infrastructure or improving existing infrastructure so as to promote the use of cycling over car use over a three mile distance; and -Provision of walking friendly infrastructure: The provision of new infrastructure or improving existing infrastructure so as to promote the use of walking over a three mile distance as an alternative to car use. -Predicted traffic volumes are currently unknown (data awaited). -The area covered by the scheme design has yet to be determined.	
Land-take within SAC	The Scheme will involve a small amount of land take (salt marsh) within the SAC for the East Pylon required for the new bridge across the River Usk. No loss within the river. No measurements as yet.	
Distance from the European Site or key interests of the site (from edge of the project assessment corridor)	The Scheme will run across the SAC via a new River Usk crossing. There will be no installation of bridge structures within the River Usk itself.	

Project name	M4 CAN Project
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The exact resource requirements are unknown however, suggested resource requirements are provided in Section 2 [of the AIES Stage 1: Screening Report].
Emissions (e.g. polluted surface water runoff – both soluble and insoluable pollutants, atmospheric pollution)	The proposed Scheme has potential to cause pollution of the SAC via water run-off during construction and operation. On-going maintenance of the bridge (e.g. painting etc.) also has potential to lead to water quality changes. The proposed Scheme has potential to result in air quality impacts during operation, however, this is thought to lead to improvements in air quality upstream of the new River Usk crossing and any effects will be localised.
Excavation requirements (e.g. impacts of local hydrogeology)	There would be some excavation within the SAC adjacent to the river for the East Pylon. No significant hydrogeology impacts are anticipated within the river as the new single span bridge would require no support structures within the river.
Transportation requirements	Not known
Duration of construction, operation etc.	Construction period Spring 2018-2021
Other	None
Description of avoidance and / or mitigation measures	
Nature of proposals	The main measure is that the new bridge across the River Usk would involve no installation of support structures within the river. Construction would follow CIRIA best practice EA guidance for pollution prevention. A CEMP will be developed to prevent/minimise impacts. Underpasses and fencing for otters Other measures as outlined in Section 6 and Section 7 [of the AIES Stage 1: Screening Report], see screened in tables.
Location	Across the site and to be determined following further surveys.
Evidence for effectiveness	Full details not yet available.
Mechanism for delivery	Full details not yet available.
Characteristics of European Site	

Project name	**M4 CAN Project**
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Name of European Site and its EU code	River Usk SAC UK0013007
Location and distance of the European Site from the proposed works	The Scheme would pass through the lower River Usk SAC via a new River Usk bridge.
European Site size	1007.71 ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	Annex I habitats that are present as qualifying feature, but not a primary reason for selection of the site: -Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Annex II species that are primary reason for designation of this site: -Sea lamprey (Petromyzon marinus) -Brook lamprey (Lampetra planeri) -River lamprey (Lampetra fluviatilis) -Twaite shad (Alosa fallax) -Atlantic salmon (Salmo salar) Bullhead (Cottus gobio) -Otter (Lutra lutra) Annex II species present as a qualifying feature, but not a primary reason for site selection: -Allis shad (Alosa alosa)

Project name	M4 CAN Project
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The status of the features is provided in Section 4, Table 4.1 [of the AIES Stage 1: Screening Report]. The following text is a summary of the effects that could affect the status of species. Fish: Barriers to migration and flow depletion; Impacts of acoustic noise/vibration and sediment/chemical barriers; Entrainment in water abstractions; Maintaining suitable quality spawning areas and nursery areas (e.g. elevated levels of fines can affect spawning success and water quality changes from. diffuse pollution and siltation, toxic pollutants) Development pressure in lower catchment can cause temporary physical, acoustic, chemical and sediment barrier effects. Otter: Maintaining undisturbed breeding habitat to support otters; maintaining food availability; provision of safe movement of otters around the catchment with the provision of ledges, tunnels and fencing on new road bridge schemes. The River Usk SAC provides a key movement corridor for otters passing between the relatively high densities in mid Wales and the south-east Wales coastal strip (Seven Estuary and Gwent Levels). The function of this aspect of the site should be protected through the maintenance of suitable resting sites (in terms of size, quality and levels of disturbance) through the major urban centre of Newport. There should be no increase in pollutants potentially toxic to otters. Water course habitat: Flow, substrate quality and water quality- unfavourable conditions promote algae and other species indicative of eutrophication; increase in invasive non-native species.
European Site conservation objectives	See Appendix C1 [of this SIAA Report].
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site	

Project name	**M4 CAN Project**
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
-Habitat loss/fragmentation of otter habitat (e.g. resting areas) during construction. -Physical presence-barrier to movement of otters during construction and operation. -Release of pollutants –water quality changes leading to physiological/behavioural/barrier effects in migratory fish and otters. -Risk of injury/becoming trapped in excavations during construction and potential vehicle collision effects (construction and operation); -Noise and vibration-disturbance/behavioural/barrier effects in migratory fish (construction) and otters (construction and operation). -Visual and lighting-disturbance/barrier effects to migratory fish and otters during construction and operation.	
Initial Assessment The key characteristics of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There will be some small amount of land-take within the SAC adjacent to the river, there may be some loss of adjacent areas outside of the SAC.
Disturbance to key species	Construction: -Habitat loss/fragmentation potential loss of otter habitat (resting sites). -Physical presence/increase use of the area leading to potential restriction in the movement of otters, outside of the SAC. -Disturbance of otters due to physical presence, noise and vibration, as well as visual and lighting. -Physiological changes in otters from changes in water quality. -Physiological/behavioural/barrier effects to fish from water quality, noise and vibration. -Behavioural/barrier effects to fish from lighting. Operation: -Potential for disturbance to otters from loss of otter habitat (resting sites). -Potential restriction in the movement/collision of otters from the physical presence/increase use of the area. -Disturbance to otters and barriers to movement from noise and vibration, as well as visual and lighting. -Physiological/behavioural and barrier effects in fish from changes in water quality.
Habitat or species fragmentation	Small amount of land take adjacent to the River Usk.

Project name	M4 CAN Project
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Reduction in species density	Impacts on fish and otters could potentially reduce numbers.
Changes in key indicators of conservation value (water quality etc)	Potential for localised air emissions and subsequent deposition on habitats is considered unlikely to lead to likely significant effects. Water quality changes could adversely affect fish and otters. It is likely that measures can be implemented including installation of highways drainage system to treat surface run-off prior to discharge. However, measures need to be developed and assessed as part of water quality assessment. Therefore precautionary approach taken.
Climate change	Sea level rise will affect intertidal habitat.
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	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 of riparian habitats and connectivity of habitats. Animals that move around and sometimes leave the site, such as migratory fish and otters, may also be affected by factors operating outside the site. The scheme will not affect hydromorphological and geomorphological processes. There may be some disturbance to otters in their resting habitat and their movement (e.g. along the river and across the Gwent Levels) due to the physical presence, increase use of the area, noise and vibration and lighting. There may also be some physiological/ behavioural/barrier effects to fish from water quality changes/noise and vibration as well as lighting effects
Interference with the key relationships that define the function of the site	
Indicate the significance as a result of the identification of impacts set out above in terms of:	
Reduction of habitat area	Some loss within the SAC of saltmarsh habitat (not a feature) adjacent to the River Usk, not considered to result in a LSE.

Project name	M4 CAN Project
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Disturbance to key species	Disturbance to species as outlined previously and these have potential for LSEs (also see Section 6 [of the AIES Stage 1: Screening Report]). These include temporary short-term effects on fish from disturbance from noise and vibration. Longer term effects from light and water quality changes during the operation of the scheme. A future water quality and noise assessments as well as development of lighting strategy are required to inform the significance of effects. Habitat loss/fragmentation of otter resting habitat and temporary restriction in movement during construction, therefore short-term effects. Longer term operational effects from physical presence and increase use leading to collision/barrier effects across the Gwent levels. Also water quality, noise/vibration, visual/lighting disturbance in the longer term. Otter surveys and further studies are required to inform the significance of effects more accurately.
Habitat or species fragmentation	As outlined previously and see Section 6 [of the AIES Stage 1: Screening Report].
Loss	No likelihood of effects beyond those identified above
Fragmentation	No additional effects beyond those identified above
Disruption	As outlined previously and in Section 6 [of the AIES Stage 1: Screening Report] potentially significant disruption to otters and fish, leading to restriction in movement and reduction in numbers.
Disturbance	For otters and fish as outlined above
Change to key elements of the site (e.g. water quality, hydrological regime etc.)	As outlined previously some potential for significant water quality changes within the River Usk SAC, no alteration of the hydrological regime.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant, or where the scale or magnitude of impacts is not known.	
	Potential for LSE associated with the scheme are: -Habitat loss/fragmentation of otter habitat and restriction in movement (e.g. resting areas); -Physiological changes in otters due to changes in water quality; -Potential for collision risk and subsequent injury/mortality in otters due to the presence of the scheme and increase in use of the area; -Disturbance to otters from noise and vibration, as well as visual and lighting and therefore normal movement; -Physiological/behavioural/barrier effects in fish from changes in water quality; and -Disturbance/physiological/behavioural/barrier effects in fish from noise and vibration as well as lighting.

Project name	**M4 CAN Project**
Natura 2000 site under consideration	River Usk/ Afon Wysg SAC
Outcome of screening stage	Significant effects are likely or cannot be excluded
Are the appropriate statutory environmental bodies in agreement with this conclusion?	NO: NRW disagreed that LSE could not be ruled out on migratory fish features of the River Usk SAC due to both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision during construction, due to a lack of detail in the AIES Stage 1: Screening Report on construction of the bridge over the River Usk. Chapter 2 of the ES provides the necessary detail, i.e. that no construction operations will be undertaken within the wetted channel of the River Usk (see also Section 4.1.5 of this SIAA Report).

B2 Severn Estuary SAC

Project name	**M4 CAN Project**	
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren	
Date	Author	Verified
April 2015	Nicole Price	Keith Jones
Description of Project Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with any other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	-A new section of 3-lane motorway between Junctions 23 and 29 of the M4 south of Newport (between Magor and Castleton), with complementary measures including: -Reclassification of the existing section of the M4 as a trunk road; -A M48-B4245 link: This will involve a connection between the M4, M48 and B4245 which would provide relief to Junction 23A and to the local road network. It would also provide improved access to proposed park and ride facilities at the Severn Tunnel Junction; Provision of cycle friendly infrastructure: This will involve the provision of new infrastructure or improving existing infrastructure so as to promote the use of cycling over car use over a three mile distance; and -Provision of walking friendly infrastructure: The provision of new infrastructure or improving existing infrastructure so as to promote the use of walking over a three mile distance as an alternative to car use. -Predicted traffic volumes not currently known (data awaited). -The area covered by the scheme design has yet to be determined.	
Land-take within SAC	The Scheme involves no land-take within this SAC.	
Distance from the European Site or key interests of the site (from edge of the project assessment corridor)	The Scheme is located 0.3 km from the Severn Estuary SAC.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The exact resource requirements are unknown however, suggested resource requirements are provided in Section 2 [of the AIES Stage 1: Screening Report].	

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren
Emissions (e.g. polluted surface water runoff – both soluble and insoluable pollutants, atmospheric pollution)	There could potentially be a change in water and air quality effects further upstream of this SAC. However, no significant effects are anticipated on this SAC.
Excavation requirements (e.g. impacts of local hydrogeology)	There will be no excavation within or adjacent to the SAC. No impacts are envisaged on the hydrogeology of the SAC.
Transportation requirements	Not known
Duration of construction, operation etc.	Construction period Spring 2018-2021
Other	None
Description of avoidance and / or mitigation measures	
Nature of proposals	The main measure is that the new bridge across the River Usk will involve no installation of support structures within the river, therefore reducing the potential for barrier effects in fish. Construction will follow CIRIA best practice EA guidance for pollution prevention. A CEMP will be developed to prevent/minimise impacts. Other measures as outlined in Section 6 [of the AIES Stage 1: Screening Report] and potential future measures in Section 7 [of the AIES Stage 1: Screening Report], see screened in tables.
Location	Measures will be implemented across the site, but those of particular relevance to this site will be those required with regard to the crossing of the River Usk.
Evidence for effectiveness	Full details not yet available
Mechanism for delivery	Full details not yet available
Characteristics of European Site	
Name of European Site and its EU code	Severn Estuary SAC/ Môr Hafren UK0013030
Location and distance of the European Site from the proposed works	The Scheme is some 0.3 km from the SAC at its closest point.
European Site size	73715.4ha

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren
Key features of the European Site including the primary reasons for selection and any other qualifying interests	Annex I habitats that are a primary reason for selection of this site: -Estuaries. -Mudflats and sandflats not covered by seawater at low tide. -Atlantic salt meadows (Glauco-Puccinellietalia maritimae). Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site: -Sandbanks which are slightly covered by sea water all the time. -Reefs. Annex II species that are a primary reason for selection of this site: -Sea lamprey. -River lamprey. -Twaite shad.
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The conservation of the site is dependent on the tidal regime and contains high sediment loads. The estuary is therefore vulnerable to large-scale interference, mainly as a result of human actions. These include land-claim, aggregate extraction, physical developments such as barrage construction and other commercial construction activities, flood defences, industrial pollution, oil spillage and tourism-based activities and disturbance.
European Site conservation objectives	See Appendix C2 [of this SIAA Report].
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site	
No direct impacts anticipated within the Severn Estuary SAC. During construction and operation, potential changes in water quality and lighting may lead to physiological/behavioural/ barrier effects in migratory fish, but only as they pass through the River Usk SAC during upstream and downstream migration. During construction of the East Pylon on land, adjacent to the River Usk and potentially the new bridge in the River Ebbw, sufficient noise and vibration may be generated to cause behavioural/barrier effects as the migratory fish pass through the River Usk (this will be dependent on construction methodology and outcome of noise assessments).	
Initial Assessment The key characteristics of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren
Reduction of habitat area	There will be no land-take within the SAC.
Disturbance to key species	No direct impacts anticipated within the Severn Estuary SAC. Disturbance to migratory fish, but only as they pass through the River Usk SAC during construction and operation from potential changes in water quality and lighting. Disturbance to fish as they pass through the Usk from noise and vibration during construction of the East Pylon on land, adjacent to the River Usk and potentially the new bridge in the River Ebbw (depending on construction methodology and outcome of noise assessments).
Habitat or species fragmentation	No species or habitat fragmentation within the SAC, potential for barrier effects for migratory fish in the River Usk.
Reduction in species density	Impacts on migratory fish, outwith the SAC could potentially reduce numbers.
Changes in key indicators of conservation value (water quality etc)	Potential for air emissions but not within the SAC, emissions thought to be taken away from this SAC and localised to areas outside of the SAC. Water quality changes could affect migratory fish, outside of the SAC and as they migrate through the River Usk.
Climate change	Sea level rise will affect intertidal habitat.
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	The only potential impact may be on the migratory fish species as the move out of the Severn Estuary SAC into the River Usk SAC, whereby they may be affected by water quality/noise and vibration (construction only) /lighting leading to physiological/behavioural/barrier effects. There would be no direct impacts within the Severn Estuary SAC that would interfere with the overall structure and function of the SAC.
Interference with the key relationships that define the function of the site	
Indicate the significance as a result of the identification of impacts set out above in terms of:	
Reduction of habitat area	No permanent loss within the SAC.

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren
Disturbance to key species	No direct impacts anticipated within the Severn Estuary SAC. Disturbance to migratory fish, but only as they pass through the River Usk during construction and operation from potential changes in water quality and lighting (long-term, without appropriate mitigation measures). Temporary disturbance to fish as they pass through the River Usk from noise and vibration during construction of the East Pylon on land, adjacent to the River Uskand potentially the new bridge in the River Ebbw (depending on construction methodology and outcome of noise assessments). Further studies are required to assess the magnitude of impacts and full development of measures.
Habitat or species fragmentation	No habitat fragmentation. For species potential barrier effects in fish outwith the SAC, within the River Usk SAC.
Loss	No likelihood of effects beyond those identified above
Fragmentation	No additional effects beyond those identified above
Disruption	Potentially significant disruption to migratory fish, outwith the SAC, leading to a reduction in numbers.
Disturbance	For fish as outlined above.
Change to key elements of the site (e.g. water quality, hydrological regime etc)	No potential for significant water quality changes within the Severn Estuary SAC.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant, or where the scale or magnitude of impacts is not known.	
	Potential for LSE include: -Physiological/behavioural/barrier effects in fish from changes in water quality during construction and operation; and -Behavioural/barrier effects in fish from noise and vibration as well as lighting during construction and operation.
Outcome of screening stage	Significant effects are likely or cannot be excluded.

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SAC/ Môr Hafren
Are the appropriate statutory environmental bodies in agreement with this conclusion?	NO: See Conclusion to River Usk SAC Screening Table (Appendix B1). NRW disagreed that LSE could not be ruled out on migratory fish features of the River Usk SAC due to both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision during construction, due to a lack of detail in the AIES Stage 1: Screening Report on construction of the bridge over the River Usk. Chapter 2 of the ES provides the necessary detail, i.e. that no construction operations will be undertaken within the wetted channel of the River Usk (see also Section 4.1.5 of this SIAA Report).

B3 Severn Estuary SPA

Project name	**M4 CAN Project**	
Natura 2000 site under consideration	Severn Estuary SPA	
Date	Author	Verified
April 2015	Nicole Price	Keith Jones
Description of Project Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with any other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	-A new section of 3-lane motorway between Junctions 23 and 29 of the M4 south of Newport (between Magor and Castleton), with complementary measures including: -Reclassification of the existing section of the M4 as a trunk road; -A M48-B4245 link: This will involve a connection between the M4, M48 and B4245 which would provide relief to Junction 23A and to the local road network. It would also provide improved access to proposed park and ride facilities at the Severn Tunnel Junction; Provision of cycle friendly infrastructure: This will involve the provision of new infrastructure or improving existing infrastructure so as to promote the use of cycling over car use over a three mile distance; and -Provision of walking friendly infrastructure: The provision of new infrastructure or improving existing infrastructure so as to promote the use of walking over a three mile distance as an alternative to car use. -Predicted traffic volumes not currently known (data awaited). -The area covered by the scheme design has yet to be determined.	
Land-take within SPA	The Scheme involves no land-take within this SPA.	
Distance from the European Site or key interests of the site (from edge of the project assessment corridor)	The Scheme is located 0.3 km from the SPA. However, the interest features may be present nearer to the scheme (future surveys will verify this).	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The exact resource requirements are unknown however, suggested resource requirements are provided in Section 2 [of the AIES Stage 1: Screening Report].	

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary SPA
Emissions (e.g. polluted surface water runoff – both soluble and insoluable pollutants, atmospheric pollution)	There could potentially be a change in water and air quality, outside and upstream of this SPA.
Excavation requirements (e.g. impacts of local hydrogeology)	There will be no excavation within or adjacent to the SPA. No impacts are envisaged on the local hydrogeology.
Transportation requirements	Not known
Duration of construction, operation etc.	Construction period Spring 2018-2021
Other	None
Description of avoidance and / or mitigation measures	
Nature of proposals	The main measure relevant to this site include: Construction will follow CIRIA best practice EA guidance for pollution prevention. A CEMP will be developed to prevent/minimise impacts. Other measures as outlined in Section 6 [of the AIES Stage 1: Screening Report] and potential future measures in Section 7 [of the AIES Stage 1: Screening Report], see screened in tables.
Location	Measures will be implemented across the site.
Evidence for effectiveness	Full details not yet available
Mechanism for delivery	Full details not yet available
Characteristics of European Site	
Name of European Site and its EU code	Severn Estuary SPA UK9015022
Location and distance of the European Site from the proposed works	The Scheme is located 0.3 km from the European site.
European Site size	24700.91 ha

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Severn Estuary SPA
Key features of the European Site including the primary reasons for selection and any other qualifying interests	During passage: Ringed plover (passage) (Charadrius hiaticula) Over wintering: Bewick's swan (wintering) (Cygnus columbianus bewickii) Dunlin (Calidris alpina alpina) Redshank (Tringa totanus) Shelduck (Tadorna tadorna) Curlew (Numenius arquata) Pintail (Anas acuta) Assemblage of nationally important populations of wintering waterfowl
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The conservation of the site features is dependent on the tidal regime. The range is the second highest in the world and the scouring of the seabed and strong tidal streams result in natural erosion of the habitats. The estuary is therefore vulnerable to large scale interference, including human actions. These include land-claim, aggregate extraction/dredging, physical developments such as barrage construction flood defences, pollution (industrial, oil spillage), eutrophication and tourism based activities and disturbance.
European Site conservation objectives	See Appendix C2 [of this SIAA Report].
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site	

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Severn Estuary SPA
There will be no direct impacts within the Severn Estuary SPA. -Habitat loss/fragmentation- no loss within the SPA, but potential for loss of roosting or foraging areas if located in the vicinity of the route and outside of the SPA during construction and operation. -Physical presence of the scheme- may lead to displacement of the features if, located in the vicinity of the route. Also potential interruption of flight lines/collision risk depending on bridge design during construction and operation. -Change in traffic flows/use of the area may lead to disturbance/displacement/collision/interruption of flight lines during construction and operation. -Noise and vibration has the potential to lead to disturbance/displacement if roosting sites within close proximity during construction and operation. -Visual and lighting leading to disturbance/behavioural/interruption of flight paths and subsequent effects on night behaviour patterns during construction and highway lighting. -	
Initial Assessment The key characteristics of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There will be no land-take within the SPA. There may be some loss of foraging area and roosting areas (to be determined during surveys)
Disturbance to key species	Disturbance to bird species, outside of the SPA as detailed above.
Habitat or species fragmentation	No species or habitat fragmentation within the SPA, but potential for outside of the SPA as described previously.
Reduction in species density	Potential for impacts to result in a reduction in species numbers (without appropriate mitigation measures).
Changes in key indicators of conservation value (water quality etc)	Potential for air emissions but not anticipated to affect the SPA, emissions thought to be taken away from this SPA and localised to areas outside of the SPA. Water quality changes not anticipated to affect these features.
Climate change	Sea level rise will affect intertidal habitat.
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	Potential impacts on the features are those as described previously outside of the SPA. However, it is not anticipated that there would be significant interference with key relationships that define the structure and function of the SPA as a whole.
Interference with the key relationships that define the function of the site	
Indicate the significance as a result of the identification of impacts set out above in terms of:	

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Severn Estuary SPA
Reduction of habitat area	No permanent loss within the SPA, as described previously potential for loss of foraging and roosting areas during construction and operation leading to LSE.
Disturbance to key species	As described previously
Habitat or species fragmentation	As described previously
Loss	No likelihood of effects beyond those identified above
Fragmentation	No additional effects beyond those identified above
Disruption	As described previously
Disturbance	As described previously
Change to key elements of the site (e.g. water quality, hydrological regime etc.)	Some potential for significant water quality changes (precautionary until measures are fully developed) within the River Usk SAC which could potentially affect SPA birds, but no local hydrological changes anticipated.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant, or where the scale or magnitude of impacts is not known.	
	Potential for LSE include: -Habitat loss/fragmentation- no loss within the SPA, but potential for loss of roosting or foraging areas if located in the vicinity of the route and outside of the SPA during construction and operation. -Physical presence of the scheme- may lead to displacement of the features if, located in the vicinity of the route. Also potential interruption of flight lines/collision risk depending on bridge design during construction and operation. -Change in traffic flows/use of the area may lead to disturbance/displacement/collision/interruption of flight lines during construction and operation. -Noise and vibration has the potential to lead to disturbance/displacement if roosting sites within close proximity during construction and operation. -Visual and lighting leading to disturbance/behavioural/interruption of flight paths and subsequent effects on night behaviour patterns during construction and highway lighting.
Outcome of screening stage	Significant effects are likely or cannot be excluded.

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Severn Estuary SPA
Are the appropriate statutory environmental bodies in agreement with this conclusion?	YES

B4 Severn Estuary Ramsar Site

Project name	**M4 CAN Project**	
Natura 2000 site under consideration	Severn Estuary Ramsar Site	
Date	Author	Verified
April 2015	Nicole Price	Keith Jones
Description of Project Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with any other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	-A new section of 3-lane motorway between Junctions 23 and 29 of the M4 south of Newport (between Magor and Castleton), with complementary measures including: -Reclassification of the existing section of the M4 as a trunk road; -A M48-B4245 link: This will involve a connection between the M4, M48 and B4245 which would provide relief to Junction 23A and to the local road network. It would also provide improved access to proposed park and ride facilities at the Severn Tunnel Junction; Provision of cycle friendly infrastructure: This will involve the provision of new infrastructure or improving existing infrastructure so as to promote the use of cycling over car use over a three mile distance; and -Provision of walking friendly infrastructure: The provision of new infrastructure or improving existing infrastructure so as to promote the use of walking over a three mile distance as an alternative to car use. -Predicted traffic volumes not currently known (data awaited). -The area covered by the Scheme design is still to be determined.	
Land-take within the Ramsar site	The Scheme involves no land-take within this Ramsar site.	
Distance from the European Site or key interests of the site (from edge of the project assessment corridor)	The Scheme is located 0.3 km from the Ramsar site. However, the interest features may be foraging or roosting on adjacent land to the Ramsar site and present nearer to the scheme (future surveys will verify this).	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The exact resource requirements are unknown however, suggested resource requirements are provided in Section 2 [of the AIES Stage 1: Screening Report].	

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
Emissions (e.g. polluted surface water runoff – both soluble and insoluable pollutants, atmospheric pollution)	There could potentially be a change in water and air quality outside and upstream of this Ramsar site. Only the water quality changes within the River Usk, has the potentially to affect the migratory fish species listed as part of this site.
Excavation requirements (e.g. impacts of local hydrogeology)	There will be no excavation within the Ramsar site. There may be some adjacent to the site. No impacts are envisaged on the local hydrogeology.
Transportation requirements	Unknown
Duration of construction, operation etc.	Construction period Spring 2018-2021
Other	None
Description of avoidance and / or mitigation measures	
Nature of proposals	The main measure relevant to this site include: Construction will follow CIRIA best practice EA guidance for pollution prevention. A CEMP will be developed to prevent/minimise impacts. Other measures as outlined in Section 6 [of the AIES Stage 1: Screening Report] and potential future measures in Section 7 [of the AIES Stage 1: Screening Report], see screened in tables.
Location	Measures will be implemented across the site, as appropriate.
Evidence for effectiveness	Full details not yet available
Mechanism for delivery	Full details not yet available
Characteristics of European Site	
Name of European Site and its EU code	Severn Estuary Ramsar Site UK11081
Location and distance of the European Site from the proposed works	The Ramsar site is located 0.3 km from the Scheme.
European Site size	24662.98 ha

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
Key features of the European Site including the primary reasons for selection and any other qualifying interests	Habitats: Sandbanks which are slightly covered by sea water all the time Estuaries Mudflats and sandflats not covered by seawater at low tide Atlantic salt meadows Migratory fish: Salmon Sea trout Sea lamprey River lamprey Allis shad Twaite shad European eel Bird assemblages of international importance Species with peak counts in winter: Bewick's swan European white-fronted goose Shelduck Gadwall Dunlin Redshank Species regularly supported during the breeding season: Lesser black-backed gull Species with peak counts in spring/autumn: Ringed plover Species with peak counts in winter: Eurasian teal Pintail
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	Factors (past, present or potential) adversely affecting the site's ecological character as identified from the Ramsar data sheet include dredging, erosion, recreational/tourism disturbance.

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
European Site conservation objectives	See Appendix C2 [of this SIAA Report].

Assessment Criteria
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.

There will be no direct impacts within the Severn Estuary Ramsar site.
(Also see Section 6 [of the AIES Stage 1: Screening Report])

Birds
-Habitat loss/fragmentation- no loss within the Ramsar site, but potential for loss of roosting or foraging areas, outside of the Ramsar site, if birds are located in the vicinity of the during construction and operation.
-Physical presence of the scheme- may lead to disturbance/displacement of the features if they are located in the vicinity of the route. Also potential interruption of flight lines/collision risk depending on bridge design during construction and operation.
-Change in traffic flows/use of the area may lead to disturbance/displacement/collision/interruption of flight lines during construction and operation.
Noise and vibration has the potential to lead to disturbance/displacement if roosting and foraging sites within close proximity during construction and operation.
-Visual and lighting leading to disturbance/behavioural/interruption of flight paths and subsequent effects on night behaviour patterns during construction and highway lighting.

Migratory Fish
-No habitat loss/fragmentation of key habitats within this site, however, potential for loss/fragmentation of eel habitat across the Gwent Levels during construction and operation.
-The physical presence of the new motorway may pose a barrier to the movement of eels across the Gwent Levels during construction and operation.
-No change in water quality within this site, although, there is potential for water quality effects (e.g. physiological/behavioural and barrier) on fish as they migrate through the River Usk and for eels across the Gwent Levels (construction and operation).
-Noise and vibration will not directly affect the features within this site. However, there is potential for disturbance/behavioural/ barrier effects as the features migrate through the River Usk during construction.
-Lighting leading to behavioural and barrier effects as the features migrate through the River Usk during construction and operation.

Habitats
-No impacts anticipated on habitat features.

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
Initial Assessment The key characteristics of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There will be no land-take within the Ramsar Site. There may be some loss of foraging area and roosting areas outside of the site (to be determined during surveys). Potential loss/fragmentation of eel habitat across the Gwent Levels.
Disturbance to key species	Disturbance to birds and migratory fish, outside of the Ramsar as detailed above.
Habitat or species fragmentation	No species or habitat fragmentation within the Ramsar, but potential for outside of the SPA as described previously.
Reduction in species density	Potential for impacts to result in a reduction in species numbers (without appropriate mitigation measures).
Changes in key indicators of conservation value (water quality etc.)	Potential for air emissions but not anticipated to affect the Ramsar site, emissions thought to be taken away from this site and potential effects localised. Water quality changes not anticipated to affect the features within the Ramsar site. Potential to affect migratory species as the pass through the River Usk and for eels across the Gwent Levels.
Climate change	Sea level rise will affect intertidal habitat.
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	Potential impacts on the features are those as described previously outside of the Ramsar site. However, it is not anticipated that there would be significant interference with key relationships that define the structure and function of the SPA as a whole.
Interference with the key relationships that define the function of the site	
Indicate the significance as a result of the identification of impacts set out above in terms of:	
Reduction of habitat area	No permanent loss within the Ramsar, as described previously potential for loss of foraging and roosting areas outside of the Ramsar during construction and operation leading to LSE.
Disturbance to key species	As described previously
Habitat or species fragmentation	As described previously
Loss	No likelihood of effects beyond those identified above

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Severn Estuary Ramsar Site
Fragmentation	No additional effects beyond those identified above
Disruption	As described previously
Disturbance	As described previously
Change to key elements of the site (e.g. water quality, hydrological regime etc.)	Some potential for significant water quality changes (precautionary until measures are fully developed) within the River Usk SAC, but not within Ramsar site and no local hydrological changes anticipated.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant, or where the scale or magnitude of impacts is not known.	

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
	Potential for LSE include: Birds -Habitat loss/fragmentation- no loss within the Ramsar site, but potential for loss of roosting or foraging areas, outside of the Ramsar site, if birds are located in the vicinity of the during construction and operation. -Physical presence of the scheme- may lead to disturbance/displacement of the features if they are located in the vicinity of the route. Also potential interruption of flight lines/collision risk depending on bridge design during construction and operation. -Change in traffic flows/use of the area may lead to disturbance/displacement/collision/interruption of flight lines during construction and operation. -Noise and vibration has the potential to lead to disturbance/displacement if roosting and foraging sites within close proximity during construction and operation. -Visual and lighting leading to disturbance/behavioural/interruption of flight paths and subsequent effects on night behaviour patterns during construction and highway lighting. Migratory Fish -No habitat loss/fragmentation of key habitats within this site, however, potential for loss/fragmentation of eel habitat across the Gwent Levels during construction and operation. -The physical presence of the new motorway may pose a barrier to the movement of eels across the Gwent Levels during construction and operation. -No change in water quality within this site, although, there is potential for water quality effects (e.g. physiological/behavioural and barrier) on fish as they migrate through the River Usk and for eels across the Gwent Levels (construction and operation). -Noise and vibration will not directly affect the features within this site. However, there is potential for disturbance/behavioural/ barrier effects as the features migrate through the River Usk during construction. -Lighting leading to behavioural and barrier effects as the features migrate through the River Usk during construction and operation.
Outcome of screening stage	Significant effects are likely or cannot be excluded.

Project name	M4 CAN Project
Natura 2000 site under consideration	Severn Estuary Ramsar Site
Are the appropriate statutory environmental bodies in agreement with this conclusion?	NO: See Conclusion to River Usk SAC Screening Table (Appendix B1). NRW disagreed that LSE could not be ruled out on migratory fish features of the River Usk SAC due to both direct land-take / habitat loss/fragmentation and Physical Presence-displacement/barrier/ flight lines/collision during construction, due to a lack of detail in the AIES Stage 1: Screening Report on construction of the bridge over the River Usk. Chapter 2 of the ES provides the necessary detail, i.e. that no construction operations will be undertaken within the wetted channel of the River Usk (see also Section 4.1.5 of this SIAA Report).

B5 Wye Valley and Forest of Dean Bat Sites / Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC

B6 SAC

Project name	**M4 CAN Project**	
Natura 2000 site under consideration	Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC	
Date	Author	Verified
April 2015	Nicole Price	Keith Jones
Description of Project Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with any other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	-A new section of 3-lane motorway between Junctions 23 and 29 of the M4 south of Newport (between Magor and Castleton), with complementary measures including: -Reclassification of the existing section of the M4 as a trunk road; -A M48-B4245 link: This will involve a connection between the M4, M48 and B4245 which would provide relief to Junction 23A and to the local road network. It would also provide improved access to proposed park and ride facilities at the Severn Tunnel Junction; Provision of cycle friendly infrastructure: This will involve the provision of new infrastructure or improving existing infrastructure so as to promote the use of cycling over car use over a three mile distance; and -Provision of walking friendly infrastructure: The provision of new infrastructure or improving existing infrastructure so as to promote the use of walking over a three mile distance as an alternative to car use. -Predicted traffic volumes not currently known (data awaited). -The area covered by the Scheme design is still to be determined.	
Land-take within the SAC site	The Scheme involves no land-take within this SAC.	
Distance from the European Site or key interests of the site (from edge of the project assessment corridor)	The Scheme is located 6.4 km from the SAC. However, lesser horseshoe bats have been recorded on the eastern edge of the M4 CAN (further bat surveys are to be undertaken to confirm).	

Project name	M4 CAN Project
Natura 2000 site under consideration	Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The exact resource requirements are unknown however suggested resource requirements are provided in Section 2 [of the AIES Stage 1: Screening Report].
Emissions (e.g. polluted surface water runoff – both soluble and insoluable pollutants, atmospheric pollution)	There will be no water and air quality changes to this SAC.
Excavation requirements (e.g. impacts of local hydrogeology)	There will be no excavation within this SAC. Construction at the eastern edge of the scheme could affect potential flight lines (commuting/foraging routes) and bat roosts, if present. No impacts are envisaged on the local hydrogeology.
Transportation requirements	Unknown
Duration of construction, operation etc.	Construction period Spring 2018-2021
Other	None
Description of avoidance and / or mitigation measures	
Nature of proposals	The main measure relevant to this site include: Construction will follow CIRIA best practice EA guidance for pollution prevention. A CEMP will be developed to prevent/minimise impacts. Other measures as outlined in Section 6 [of the AIES Stage 1: Screening Report] and potential future measures in Section 7 [of the AIES Stage 1: Screening Report], see screened in tables.
Location	Measures will be implemented across the site, as appropriate.
Evidence for effectiveness	Full details not yet available
Mechanism for delivery	Full details not yet available
Characteristics of European Site	
Name of European Site and its EU code	Wye Valley and Forest of Dean Bat Sites SAC UK0014794

Project name	**M4 CAN Project**
Natura 2000 site under consideration	Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC
Location and distance of the European Site from the proposed works	The SAC is located 6.4 km from the Scheme.
European Site size	142.7ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	Annex II species that are a primary reason for selection of this site: Lesser horseshoe bat Greater horseshoe bat
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	Qualifying bat species forage for food outside the SAC and their foraging/commuting areas could be affected by new road construction.
European Site conservation objectives	See Appendix C3 [of this SIAA Report].
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site	
Lesser horseshoe bat -Land take outside the SAC leading to habitat loss/fragmentation of roosts/foraging routes/severance of flight lines, if present in the area during construction or operation (to be confirmed by surveys). -Physical presence leading to restriction in movement through the severing of flight lines/collision risk. -Visual and lighting leading to restriction of bat movements during construction and operation. Greater horseshoe bat -No impacts anticipated (Also see Section 6 [of the AIES Stage 1: Screening Report])	
Initial Assessment The key characteristics of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There will be no land-take within the SAC. There may be some habitat loss/fragmentation of roosts/foraging routes outside the SAC.
Disturbance to key species	As described above

Project name	M4 CAN Project
Natura 2000 site under consideration	Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC
Habitat or species fragmentation	As described previously.
Reduction in species density	Potential for impacts to result in a reduction in species numbers (without appropriate mitigation measures and further surveys to confirm).
Changes in key indicators of conservation value (water quality etc)	Potential for some localise effects from air emissions but not anticipated to affect the SAC, due to the large distance between the Scheme and SAC. Water quality changes will not affect the features within the SAC.
Climate change	Changes in habitat quality and prey availability
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	Potential impacts on the features are those as described previously outside of the SAC. However, it is not anticipated that there would be significant interference with key relationships that define the structure and function of the SAC as a whole.
Interference with the key relationships that define the function of the site	
Indicate the significance as a result of the identification of impacts set out above in terms of:	
Reduction of habitat area	As described previously (precise areas to be confirmed)
Disturbance to key species	As described previously
Habitat or species fragmentation	As described previously (precise areas to be confirmed)
Loss	No likelihood of effects beyond those identified above
Fragmentation	No additional effects beyond those identified above
Disruption	As described previously
Disturbance	As described previously
Change to key elements of the site (e.g. water quality, hydrological regime etc)	No changes to water quality or alteration of the hydrological regime within this SAC, due to distance from Scheme.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant, or where the scale or magnitude of impacts is not known.	

Project name	M4 CAN Project
Natura 2000 site under consideration	Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC
	Potential for LSE include: -Land take leading to habitat loss/fragmentation of roosts/foraging routes/severance of flight lines outside the SAC, if present in the area during construction (to be confirmed by surveys). -Physical presence leading to restriction in movement through the severing of flight lines/collision risk -Visual and lighting leading to restriction of bat movements during construction and operation.
Outcome of screening stage	Significant effects are likely or cannot be discounted.
Are the appropriate statutory environmental bodies in agreement with this conclusion?	YES, but noted that NRW may wish to change this view if ongoing survey were to record the presence of greater horseshoe bat. Effects on greater horseshoe bats are also considered within Section 5.6 of this SIAA report.

Appendix C: Conservation Objectives

C1 River Usk SAC

CYNGOR CEFN GWLAD CYMRU
COUNTRYSIDE COUNCIL FOR WALES

CORE MANAGEMENT PLAN
INCLUDING CONSERVATION OBJECTIVES

FOR

RIVER USK SPECIAL AREA OF CONSERVATION

Version: 1.5

Date: 7th March 2008

Approved by: David Mitchell

More detailed maps of management units can be provided on request.
A Welsh version of all or part of this document can be made available on request.

Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

NATURA 2000

Ramsar

Llywodraeth Cynulliad Cymru
Welsh Assembly Government
CORFF NODDEDIG | SPONSORED BODY

CONTENTS

PREFACE

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

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

1. VISION FOR THE SITE

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

Our vision for the River Usk 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 are 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 maintains 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, are 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 aquatic plant communities that characterise parts of the river are not only attractive but also give a good indication of the overall quality of the environment. They contain the variety and abundance of species expected for this type of river, in conditions of suitably clean water and bed substrate combined with a relatively stable flow regime. Locally, there are patches of white-flowered water-crowfoots. In the more shaded reaches, aquatic plants may be scarce, consisting mainly of mosses and liverworts.

The special fish species found in the river, both residents such as the bullhead and brook lamprey, and migratory species such as the Atlantic salmon, sea lamprey and shad, which swim up river to spawn and go through their juvenile stages in the river, are present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat. The migratory fish are 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, allows a large otter population to thrive. They are found along the entire length of the river and its main tributaries.

The presence of the River Usk SAC and its special wildlife enhances 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 are recognised and promoted through appropriate land management. The river is 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: SO126219

Unitary authorities: Powys County Council, Monmouthshire County Council, Newport County Borough Council

Area (hectares): 1008.26

Designations covered:

River Usk (Upper Usk) SSSI
River Usk (Lower Usk) SSSI
River Usk (Tributaries) SSSI
Penllwyn-yr-hendy SSSI
Coed Dyrysiog SSSI
Coed Nant Menascin SSSI
Coed Ynysfaen SSSI

Detailed maps of the designated sites are available through CCW's web site:

http://www.ccw.gov.uk/interactive-maps/protected-areas-map.aspx

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

2.2 Outline Description

The River Usk SAC rises in the Black Mountain range in the west of the Brecon Beacons National Park and flows east and then south, to enter the Severn Estuary at Newport. The overall form of the catchment is long and narrow, with short, generally steep tributaries flowing north from the Black Mountain, Fforest Fawr and Brecon Beacons, and south from Mynydd Epynt and the Black Mountains. The underlying geology consists predominantly of Devonian Old Red Sandstone with a moderate base status, resulting in waters that are generally well buffered against acidity. This geology also produces a generally low to moderate nutrient status, and a moderate base-flow index, intermediate between base-flow dominated rivers and more flashy rivers on less permeable geology. The run-off characteristics and nutrient status are significantly modified by land use in the catchment, which is predominantly pastoral with some woodland and commercial forestry in the headwaters and arable in the lower catchment. The Usk catchment is entirely within Wales.

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 of riparian habitats and connectivity of habitats. Animals that move around and sometimes leave the site, such as migratory fish and otters, may also be affected by factors operating outside the site.

Hydrological processes, in particular river flow (level and variability) and water chemistry, determine a range of habitat factors of critical 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. Reduction in flows may reduce the ability of the adults of migratory fish to reach spawning sites. Water-crowfoot vegetation thrives in relatively stable, moderate flows and clean water. The flow regime should be characteristic of the river in order to support the functioning of the river ecosystem.

Geomorphological processes of erosion by water and subsequent deposition of eroded sediments downstream, create the physical structure of the river habitats. Whilst some sections of the river are naturally stable, especially where they flow over bedrock, others undergo constant and at times rapid change through the erosion and deposition of bed and bank sediments as is typical of meandering sections within floodplains (called 'alluvial' rivers). 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.

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-steam 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 habitats as breeding and resting sites. It is important that appropriate amounts of tree cover, in general at least 50% high canopy 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. 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. Naturally isolated feature populations that are identified as having important genetic distinctiveness should be maintained. 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, for example lesser horseshoe bats, 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. For example, salmon may be affected by barriers to migration in the Severn Estuary, inshore fishing and environmental conditions prevailing in their north Atlantic feeding grounds. Otters may be affected by developments that affect resting and breeding sites outside the SAC boundary.

2.3 Outline of Past and Current Management

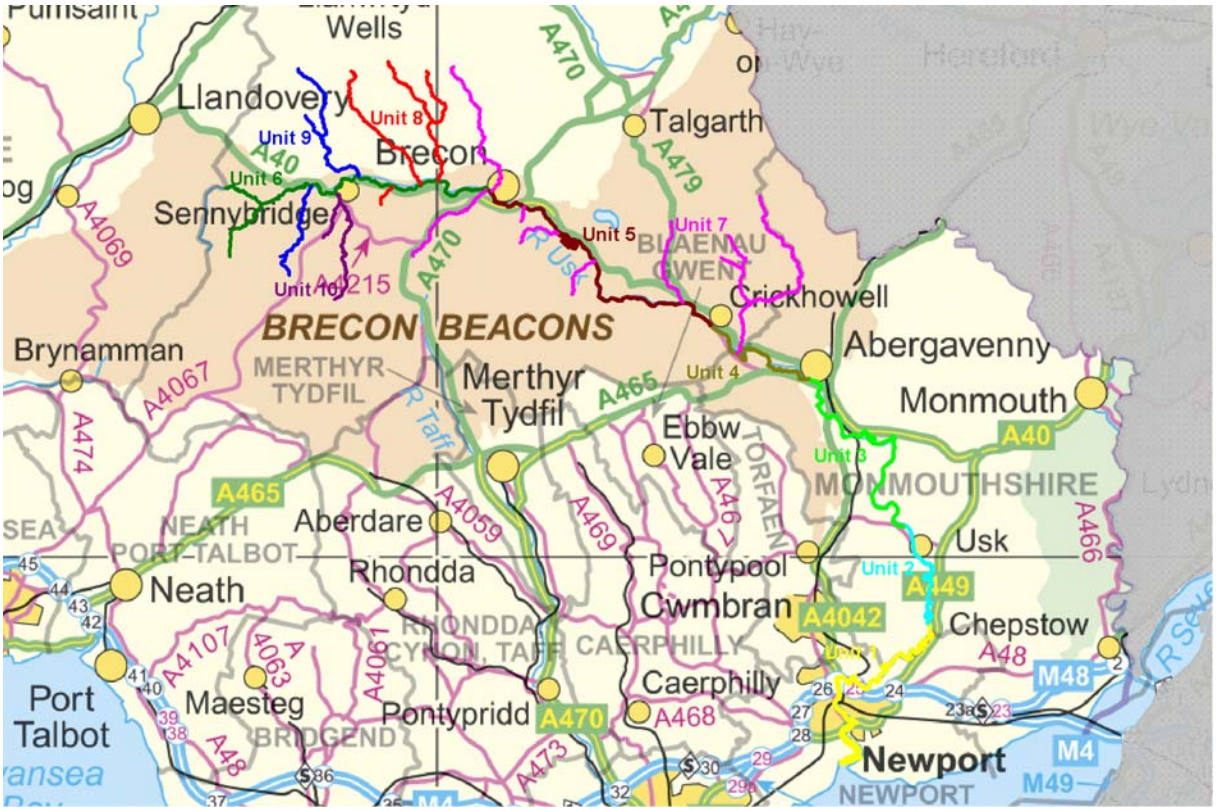
There are many different aspects to the management of this large and complex site that may affect its conservation status. These are summarised in the Site Management Statements for the component SSSIs.

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:

- SSSI boundaries
- Artificial barriers, where they significantly affect one or more of the features' range
- 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.

A map showing the management units referred to in this plan is shown below:



3. THE SPECIAL FEATURES

3.1 Confirmation of Special Features

Designated feature	***Relationships, nomenclature etc***	***Conservation Objective in part 4***
SAC features		
Annex II species that are a primary reason for selection of this site		
Sea lamprey *Petromyzon marinus*		1
Brook lamprey *Lampetra planeri* River Lamprey *Lampetra fluviatilis*	These two species are generally indistinguishable for the purposes of monitoring; however management requirements are similar	2
Twaite shad *Alosa fallax*	Management for this feature is effectively the same as for allis shad	3
Atlantic salmon *Salmo salar*		4
Bullhead *Cottus gobio*		5
European otter *Lutra lutra*		6
Annex I habitats and Annex II species present as qualifying features, but not primary reasons for site selection		
Allis shad *Alosa alosa*	Management for this feature is effectively the same as for twaite shad	3
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation		7
SPA features		
Not applicable		
Ramsar features		
Not applicable		
SSSI features		
To be added		

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:

River Usk (Lower Usk) SSSI	**Management unit**				
	1	**2**	**3**		
SAC	**[**	**[**	**[**		
SSSI	**[**	**[**	**[**		
CCW ownership					
SAC Features					
1. Sea lamprey	**KS**	**KS**	**KS**		
2. River lamprey	Sym	Sym	Sym		
3. Brook lamprey	x	Sym	Sym		
4. Twaite shad	**KS**	**KS**	**KS**		
5. Allis shad	Sym	Sym	Sym		
6. Atlantic salmon	Sym	Sym	Sym		
7. Bullhead	x	Sym	Sym		
8. European otter	**KS**	**KS**	**KS**		
9. Rivers with floating vegetation often dominated by water-crowfoot	x	**KH**	**KH**		
SSSI Features					
To be added					

- Twaite shad and sea lamprey spawn within Units 2 & 3 and migrate through Unit 1, where they may be subject to disturbance impacts, so are selected as key features in all units.
- Management for twaite shad and sea lamprey should also be sympathetic for Atlantic salmon, 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 feature 'Rivers with floating vegetation often dominated by water-crowfoot' occurs in Units 2 & 3 in this SSSI and is selected as a key habitat.

- The status of allis shad is uncertain in River Usk (Lower Usk) SSSI. It is assumed to be present in the same units as twaite shad.

River Usk (Upper Usk) SSSI	**Management unit**				
	4	**5**	**6**		
SAC	**[**	**[**	**[**		
SSSI	**[**	**[**	**[**		
CCW ownership					
SAC Features					
1. Sea lamprey	**KS**	**KS**	x		
2. River lamprey	Sym	Sym	Sym		
3. Brook lamprey	Sym	Sym	Sym		
4. Twaite shad	**KS**	**KS**	x		
5. Allis shad	Sym	Sym	x		
6. Atlantic salmon	Sym	Sym	**KS**		
7. Bullhead	Sym	Sym	Sym		
8. European otter	**KS**	**KS**	**KS**		
9. Rivers with floating vegetation often dominated by water-crowfoot	x	x	x		
SSSI Features					
To be added					

- Atlantic salmon is a key feature in Unit 6 due to the presence of spawning sites, although salmon may occasionally also spawn within Units 4 & 5.
- Twaite shad is recorded only infrequently in Unit 5 as their distribution is constrained by the barrier created by Crickhowell Bridge footings.
- Sea lamprey is recorded more frequently than shad within Unit 5 but may also be affected to an extent by Crickhowell Bridge. The natural range of sea lamprey may extend upstream into Unit 6, however the degree to which their distribution may be constrained by Brecon weir is poorly understood. Sea lamprey is assumed to be generally absent from Unit 6 due to natural range limits.
- Management for Atlantic salmon, twaite shad and sea lamprey is expected to 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 the features Allis shad and 'Rivers with floating vegetation often dominated by water-crowfoot' is uncertain in River Usk (Upper Usk) SSSI. Allis shad is assumed to be present in the same units as twaite shad.

River Usk (Tributaries) SSSI	**Management unit**				
	7	**8**	**9**	**10**	
SAC	**[**	**[**	**[**	**[**	
SSSI	**[**	**[**	**[**	**[**	
CCW ownership					
SAC Features					
1. Sea lamprey	x	x	x	x	
2. River lamprey	Sym	Sym	**KS**	**KS**	
3. Brook lamprey	Sym	Sym	**KS**	**KS**	
4. Twaite shad	x	x	x	x	
5. Allis shad	x	x	x	x	

6. Atlantic salmon	**KS**	**KS**	**KS**	**KS**	
7. Bullhead	Sym	Sym	Sym	Sym	
8. European otter	**KS**	**KS**	**KS**	**KS**	
9. Rivers with floating vegetation often dominated by water-crowfoot	**x**	**x**	**x**	**KH**	
SSSI Features					
Atlantic salmon	**KS**	**KS**	**KS**	**KS**	
Brook lamprey	Sym	Sym	**KS**	**KS**	
Bullhead	Sym	Sym	Sym	Sym	
European otter	**KS**	**KS**	**KS**	**KS**	

- Atlantic salmon spawns in all tributaries within this SSSI and so is selected as a key feature in all units.
- Twaite shad, allis shad and sea lamprey are thought not to occur within this SSSI.
- River/brook lamprey are selected as key features within Units 9 & 10, which are thought to contain a higher proportion of suitable ammocoete habitat compared to other units so are expected to hold important populations of these features[4]. Monitoring confirms this to an extent[2].
- Unit 10 is the only unit within this SSSI known to contain the feature 'Rivers with floating vegetation often dominated by water-crowfoot'. The good stands of water-crowfoot dominated vegetation justify its selection as a key feature in this unit.

4. CONSERVATION OBJECTIVES

Background to Conservation Objectives:

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

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

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

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

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

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

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

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

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

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

- Conservation planning and management.

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

- Assessing plans and projects.

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

- Monitoring and reporting.

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

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

b. Format of the conservation objectives

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

Each conservation objective consists of the following two elements:

1. Vision for the feature
2. Performance indicators

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

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

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

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

The ecological status of the water course is a major determinant of FCS for all features. The required conservation objective for the water course is defined below.

4.1 Conservation Objective for the water course

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 and quality, physical habitat and community composition and 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. In the case of the Usk Tributaries SSSI, the SAC habitat is not underpinned by a river habitat SSSI feature. In this case, the target is to maintain the characteristic physical features of the river channel, banks and riparian zone.

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, eg. 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 Usk Catchment Abstraction Management Strategy 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 Usk 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 Usk 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 Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, will be considered in assessing plans and projects.

4.1.15 Levels of suspended solids will be agreed between EA and CCW for each Water Framework Directive water body in the Usk 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.

4.2 Conservation Objective for Features 1-5:
- Sea lamprey *Petromyzon marinus* **(EU Species Code: *1095*) ;**
- Brook lamprey *Lampetra planeri* **(EU Species Code : *1096*) ;**
- River lamprey *Lampetra fluviatilis* **(EU Species Code : *1099*) ;**
- Twaite shad *Alosa fallax* **(EU Species Code : *1103*) ;**
- Allis shad *Alosa alosa* **(EU Species Code : *1102*) ;**
- Atlantic salmon *Salmo salar* **(EU Species Code : *1106*) ;**
- Bullhead *Cottus gobio* **(EU Species Code : *1163*)**

Vision for features 1-5

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

FCS component		Supporting information / current knowledge
4.2.1	**The conservation objective for the water course as defined in 4.1 above must be met**	
4.2.2	**The population of the feature in the SAC is stable or increasing over the long term.**	Refer to sections 5.1 to 5.5 for current assessments of feature populations Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Fish stocking can adversely affect population dynamics through competition, predation, and alteration of population genetics and introduction of disease.
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 eg. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions eg. food supply (as described in sections 2.2**	Some reaches of the Usk SAC are more suitable for some features than others e.g. the Senni has important populations of brook/river lamprey and salmon but is not used by shad due to its small size and distance from the estuary. 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 water course given in section 4.1 are secured. The characteristic channel morphology provides the diversity of water depths, current velocities and

	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	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 e.g. through Brecon and upstream of Abergavenny, adversely affects the processes that maintain suitable habitat for the SAC features. Hydrological processes in the Usk are currently affected by large abstractions, especially at Prioress Mill and Brecon Weir. However, there are many smaller abstractions not considered to cause a problem at present. Shad and salmon 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 artificial barriers to migration in the Usk. It is likely that this loss of habitat affects their maintenance in the SAC on a long-term basis.

Performance indicators for features 1-5

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

Sea lamprey *Petromyzon marinus* : ***Performance indicators for feature condition***			
Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Distribution within catchment	Suitable habitat adjacent to or downstream of known spawning sites should contain *Petromyzon* ammocoetes.	This attribute provides evidence of successful spawning and distribution trends. Spawning sites known to have been used within the previous 10 years and historical sites considered still to have suitable habitat, are shown in Annex 4. Spawning locations may move within and between sites due to natural processes or new sites may be discovered over time. Silt beds downstream of all sites identified in Annex 4 will be sampled for presence or absence of ammocoetes. Where apparently suitable habitat at any site is unoccupied feature condition will be considered unfavourable.	1-5

b) Ammocoete density	Ammocoetes should be present in at least four sampling sites each not less than 5km apart.	This standard CSM attribute establishes a minimum occupied spawning range, within any sampling period, of 15km. In the Usk, spawning sites within units 2 to 5 will be assessed against this attribute.	2-5
	Overall catchment mean >0.1m^{-2} (Harvey & Cowx 2003)[1]	Although this attribute is not used in CSM for sea lamprey, baseline monitoring in the Usk gave an overall catchment mean of 2.27 ammocoetes m^{-2} in suitable habitat[2], therefore 0.1 m^{-2} is a conservative threshold value for unfavourable condition.	

Brook lamprey *Lampetra planeri* and River lamprey *Lampetra fluviatilis* :
Performance indicators for feature condition

Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Age/size structure of ammocoete population	Samples < 50 ammocoetes ~ 2 size classes Samples > 50 ammocoetes ~ at least 3 size classes	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.	2-10
b) Distribution of ammocoetes within catchment	Present at not less that 2/3 of sites surveyed within natural range	The combined natural range of these two species in terms of ammocoete distribution includes all units above the tidal limit ie. all except unit 1 Presence at less than 2/3 of sample sites will lead to an unfavourable condition assessment.	2-10
	No reduction in distribution of ammocoetes	Reduction in distribution will be defined as absence of ammocoetes from all samples within a single unit or sub-unit/tributary, and will lead to an unfavourable condition assessment.	
c) Ammocoete density	Optimal habitat: >10m^{-2} Overall catchment mean: >5m^{-2}	Optimal habitat comprises beds of stable fine sediment or sand ≥15cm deep, low water velocity and the presence of organic detritus, as well as, in the Usk, shallower sediment, often patchy and interspersed among coarser substrate.	2-10

Twaite shad *Alosa fallax* and Allis shad *Alosa alosa* :
Performance indicators for feature condition

Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Spawning distribution	No decline in spawning distribution	Spawning distribution is assessed by kick sampling for eggs and/or observations of spawning adults. A representative sample of	1-5

		sites within units 2 to 5 will be monitored at 3 yearly intervals. Absence from any site in 2 consecutive surveys will result in an unfavourable condition assessment.	
Performance indicators for factors affecting the feature			
a) Flow	Targets are set in relation to river/reach type(s)	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.	1-5

Atlantic salmon *Salmo salar* :			
Performance indicators for feature condition			
Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Adult run size	Conservation Limit complied with at least four years in five (see 5.4)	CSM guidance states: Total run size at least matching an agreed reference level, including a seasonal pattern of migration characteristic of the river and maintenance of the multi-sea-winter component. As there is no fish counter in the Usk, adult run size is calculated using rod catch data. Further details can be found in the EA Usk Salmon Action Plan.	All
b) Juvenile densities	Expected densities for each sample site using HABSCORE	CSM guidance states: These should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality. Assessed using electrofishing data.	6-10
Performance indicators for factors affecting the feature			
Water quality			
a) Biological quality	Biological GQA class A	This is the class required in the CSM guidance for Atlantic salmon, the most sensitive feature.	6-10
b) Chemical quality	RE1	It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3)	All
Hydromorphology			
a) Flow	Targets are set in relation to river/reach type(s)	Targets equate to those levels agreed and used in the Review of Consents (see Annex 1)	All

Bullhead *Cottus gobio* : ***Performance indicators for feature condition***			
Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Adult densities	No less than 0.2 m^{-2} in sampled reaches	CSM guidance states that densities should be no less than 0.2 m^{-2} in upland rivers (source altitude >100m) and 0.5 m^{-2} in lowland rivers (source altitude ≤100m). A significant reduction in densities may also lead to an unfavourable condition assessment.	2-10
b) Distribution	Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current	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.	2-10
c) 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.	2-10

4.3 Conservation Objective for Feature 6:
- European otter *Lutra lutra* **(EU Species Code: *1355*)**

Vision for feature 6
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

FCS component		Supporting information / current knowledge
4.3.1	**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.**	Refer to section 5.9 for current assessment of feature population
4.3.2	**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 Usk SAC is considered to form potentially suitable breeding habitat for otters. The size of breeding territories may**	Survey information shows that otters are widely distributed in the Usk catchment. While the breeding population in the Usk is not currently considered to 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 Usk.

	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.	
4.3.3	**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.**	Restrictions on the movement of otters around the SAC, and between adjoining sites are currently a particular concern in the reach through Newport as a result of a continued decrease in undisturbed suitable riparian habitat.

Performance indicators for feature 6

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

Performance indicators for feature condition			
Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Distribution	Otter signs present at 90% of Otter Survey of Wales sites	Ref: CCW Environmental Monitoring Report No 19 (2005)[3]	All
b) Breeding activity	2 reports of cub/family sightings at least 1 year in 6	Ref: CCW Environmental Monitoring Report No 19 (2005)[3]	All
c) Actual and potential breeding sites	No decline in number and quality of mapped breeding sites in sub-catchments (see Ref)	Ref: CCW Environmental Monitoring Report No 19 (2005)[3] In the Usk catchment, 77 actual or potential breeding sites have been identified, distributed throughout the catchment on the main river and tributaries.	All

4.4 Conservation Objective for Feature 7:
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Vision for feature 7

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

FCS component		Supporting information / current knowledge
4.4.1	**The conservation objective for the water course as defined in 4.1 above must be met**	
4.4.2	**The natural range of the plant communities represented within this feature should be stable or increasing in the SAC. The natural range is taken to mean those reaches where predominantly suitable habitat exists over the long term. Suitable habitat and associated plant communities may vary from reach to reach. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms eg. depth and stability of flow, stability of bed substrate, and ecosystem structure and functions eg. nutrient levels, shade (as described in section 2.4). Suitable habitat for the feature need not be present throughout the SAC but where present must be secured for the foreseeable future, except where natural processes cause it to decline in extent.**	More information is required on the natural range and distribution of this feature in the Usk. Important examples of the feature may be present outside currently known locations. Sympathetic management will be promoted wherever the feature is present. Species indicative of unfavourable condition for this feature eg. filamentous algae associated with eutrophication, invasive non-native species, should be maintained or restored below an acceptable threshold level, indicative of high ecological status, within the SAC.
4.4.3	**The area covered by the feature within its natural range in the SAC should be stable or increasing.**	Important stands of the feature are known to occur within site management unit nos. 2, 3 & 10. Management to maintain or increase the feature within these units will be a priority. Adverse factors may include elevated nutrient levels, shading or altered flow and/or sediment transport regimes.
4.4.4	**The conservation status of the feature's typical species should be favourable. The typical species are defined with reference to the species composition of the appropriate JNCC river vegetation type for the particular river reach, unless differing from this type due to natural variability when other typical species**	More information on the typical species expected to be found with each management unit in the SAC is required.

may be defined as appropriate.

Performance indicators for feature 7

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

Performance indicators for feature condition			
Attribute	***Specified limits***	***Comments***	***Relevant unit(s)***
a) Distribution within catchment	Distribution within site units 2,3 & 10	*Ranunculus* spp. will be present with an MTR species cover score of at least 5 in: Any three representative sample 100m stretches of suitable habitat between Usk Town bridge and the bridge at Newbridge-on-Usk: AND In one representative sample 100m stretch of suitable habitat along the Senni	2,3,10
b) Typical species	Species list for reference vegetation type	Should conform to appropriate JNCC type or other list for site unit as appropriate. Details to be confirmed	2,3,10
Performance indicators for factors affecting the feature			
Negative indicators			
a) Native species	Cover of indicators of eutrophication maintained below threshold over the medium to long term	CSM guidance states: Care should be taken with the setting of these targets as thresholds may vary considerably by site and conservation goals. For the Usk SAC: Algae indicative of eutrophication *(Enteromorpha* spp., *Cladophora* spp. and *Vaucheria* spp.) should not have an MTR cover value of greater than 5 (ie.10%) in 3 consecutive years in: Any three representative sample 100m stretches of suitable habitat between Usk Town bridge and the bridge at Newbridge-on-Usk: AND In one representative sample 100m stretch of suitable habitat along the Senni	2,3,10
b) Alien / introduced species	No impact on native biota from alien or introduced species	In the CSM guidance, the SERCON scoring system for naturalness of aquatic and marginal macrophytes and naturalness of banks and riparian zone, are used to assess this attribute. SERCON protocols have not been applied in the Usk SAC, therefore assessment of this attribute relies on locally defined thresholds and expert judgement. Details to be confirmed	

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: Sea lamprey *Petromyzon marinus*

Conservation status

Status: Unfavourable: Unclassified. Sea lamprey monitoring showed that overall catchment mean ammocoete density considerably exceeded the JNCC target threshold and also complied with targets for spawning site and ammocoete distribution. A caveat on the latter is uncertainty over whether the natural range of sea lamprey extends above Brecon weir: this is assumed not to be the case.

Factors leading to an unfavourable assessment are the presence of probable partial barriers further downstream (notably Crickhowell Bridge), and flow depletion resulting from abstractions including Brecon canal and Prioress Mill public water supply abstraction. The latter in particular has been shown to have effects both on a seasonal timescale by reducing spate flows during the migration period and on a diurnal timescale by substantially depleting flows during the night time to the extent that sea lamprey nests and nursery areas are likely to be exposed above the water level. The effect of the Brecon canal abstraction has been shown to comprise a substantial depletion of flows, at least locally, during low flow periods with a resulting reduction in river depth downstream of the off-take weir.

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. Crickhowell Bridge is considered to be the most significant barrier to fish migration in the Usk. Management to reduce or remove the effect of this barrier is a high priority for the River Usk SAC. An assessment of options will be carried out in conjunction with the other relevant competent authorities.

The impact of acoustic (ie 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 resulting from a small number of major abstractions was highlighted in the Review of Consents process. As a result of this process, flow targets have been set which are considered likely to significantly reduce or remove the impacts on SAC features. These targets (given in Annex 1) are expressed as, 1) a flow duration curve using recent daily mean flow data, used to set abstraction licence conditions including ‘hands-off flows’, 2) hourly maximum abstraction rates for certain licences to reduce or remove the effect of diurnal flow variations. 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 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.

5.2 Conservation status and management requirements of Feature 2: Brook lamprey *Lampetra planeri* and River lamprey *Lampetra fluviatilis*

Conservation status

Status: Favourable. Brook/river lamprey monitoring showed that overall catchment mean ammocoete density considerably exceeded the JNCC target threshold and also complied with targets for ammocoete distribution[1].

It has not been possible to distinguish between these two species during monitoring, due to the reliance on juvenile stages (ammocoetes). Anecdotal evidence suggests that both species are likely to be present in many reaches, though brook lamprey are expected to predominate in the headwaters and river lamprey may be the more abundant species in the main channel and the lower reaches of larger tributaries. More information on the relative abundance of these two species in different parts of the Usk 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.

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 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.

5.3 Conservation status and management requirements of Feature 3: Twaite shad *Alosa fallax* and Allis shad *Alosa alosa*

Conservation status

Status: Unfavourable: Unclassified. Monitoring of these species in the Usk 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.

These methods do not distinguish between the two species. Allis shad is thought to be rare, with no recent records in the Usk, 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. This attribute is not currently assessed in the Usk due to the absence of a fish counter.

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 and physical barriers to migration.

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 Usk 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. Crickhowell Bridge is considered to be the most significant barrier to fish migration in the Usk. Management to reduce or remove the effect of this barrier is a high priority for the River Usk SAC. Other barriers that may be significant include Trostrey Weir and Radyr Weir . An assessment of options will be carried out in conjunction with the other relevant competent authorities.

Development pressure in the lower catchment can cause temporary physical, acoustic, chemical and sediment barrier effects that need to be addressed in the assessment of specific plans and projects. 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. Land on both sides of the river in Newport is potentially highly contaminated. Contamination of the river can arise when this is disturbed e.g. as a result of development. Contamination can also arise from pollution events (which could be shipping or industry related). Barriers resulting from vibration, chemicals, low dissolved oxygen and artificially high sediment levels must be prevented at key times (generally March to June). The possible barrier effects that might be caused by the installation of an acoustic salmonid fish counter should also be evaluated.

The impact of flow depletion resulting from a small number of major abstractions was highlighted in the Review of Consents process. As a result of this process, flow targets have been set which are considered likely to significantly reduce or remove the impacts on SAC features. These targets (given in Annex 1) are expressed as, 1) a flow duration curve using recent daily mean flow data, which is used to set abstraction licence conditions including ‘hands-off flows’, 2) hourly maximum abstraction rates for certain licences to reduce or remove the effect of diurnal flow variations. There are also requirements for screening of intakes to reduce or remove the impact of impingement and entrainment on juvenile shad drifting downstream and post-spawning adult shad.

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, with whitebait and shrimp fishing being of particular concern. Changes in fishing methods need to be promoted to minimize captures, whilst 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.

5.4 Conservation status and management requirements of Feature 4: Atlantic salmon *Salmo salar*

Conservation status

Status: Unfavourable: Unclassified. Monitoring of Atlantic salmon in the Usk relies on two methods,

i. Estimation of adult run size from angling catch returns,
ii. Electro-fishing for juveniles in nursery areas.

The estimate of adult numbers is converted into an estimate of numbers of eggs deposited which is compared against an Egg Deposition Target (EDT), calculated by considering the area of suitable spawning habitat within the catchment. The equivalent adult run to achieve the EDT is described in terms of a Conservation Limit, which must be exceeded 4 years in 5 for the Management Target to be considered attained. Electro-fishing for juveniles is either quantitative or semi-quantitative, and estimated juvenile densities are classified in one of six categories A to F. The monitoring guidance produced by the LIFE in UK Rivers project recommends that ideally juvenile densities should be compared to predicted densities for the sample reach using the HABSCORE model[6]. These targets are calculated and monitored by the Environment Agency as part of the Salmon Action Plan for the Usk.

The current unfavourable status results from a precautionary assessment of feature distribution and abundance, in particular the results of juvenile surveys, and from the presence of adverse factors, in particular flow depletion and localised water quality failures.

Management requirements

The Atlantic salmon is the focus for much of the management activity carried out on the Usk. The relatively demanding water quality and spawning substrate quality requirements of this feature mean that reduction in diffuse pollution and siltation impacts is a high priority. 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 Wye and Usk Foundation through their Usk Project have carried out much of this work in recent years. Other work has included removal of weirs and construction of fish passes to ease artificial barriers to salmon migration, and reduction in exploitation pressure through buying out net fisheries in the estuary.

Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg and fry survival. Clean substrate free from excessive siltation should predominate at suitable spawning sites. Spawning habitat is defined as stable coarse substrate without an armoured layer, in the pebble to cobble size range (16-256 mm) but with the majority being <150 mm. Water depth during the spawning and incubation periods should be 15-75 cm. Fry habitat is indicated by water of <20 cm deep and a gravel/pebble/cobble substrate. Parr habitat is indicated by water 20-40 cm deep and similar substrate. Holding areas are defined as pools of at least 1.5 m depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence. Coarse woody debris should not be removed from rivers as it plays a significant role in the formation of new gravel beds, and provides cover for fish and a source of food for invertebrates.

In the Usk 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.

In all river types, artificial barriers should be made passable. The impact of existing barriers in the Usk 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. Complete or partial natural barriers to potentially suitable spawning areas should not be modified or circumvented.

Development pressure in the lower catchment can cause temporary physical, acoustic, chemical and sediment barrier effects that need to be addressed in the assessment of specific plans and projects. Land on both sides of the river in Newport is potentially highly contaminated. Contamination of the

river can arise when this is disturbed eg as a result of development. Contamination can also arise from pollution events (which could be shipping or industry related) e.g. chemical spillage, low dissolved oxygen.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Intake screens must meet statutory requirements under the Salmon & Freshwater Fisheries Act.

There is currently no stocking of salmon into the Usk. The management objectives for SAC salmon populations are to attain naturally self-sustaining populations. Salmon stocking should not be routinely used as a management measure. Salmon stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population. Therefore, there is a presumption against salmon stocking in the Usk SAC.

The presence of artificially high densities of other fish can create unacceptably high levels of predatory and competitive pressure on juvenile salmon and the aim should be to minimise these risks in considering any proposals for stocking. Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges.

Controls on exploitation should include migratory passage to the SAC within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the SAC from rod fisheries. Net Limitation Orders are used to control the estuarine fishery. Exploitation of salmon by rod fisheries is regulated by EA licensing and byelaws controlling the fishing season and allowable methods.

5.5 Conservation status and management requirements of Feature 5: Bullhead *Cottus gobio*

Conservation status

Status: Unfavourable: Unclassified. The current unfavourable status results from the presence of adverse factors, in particular flow depletion and localised water quality failures. Records obtained from juvenile salmon monitoring show that bullhead are widespread in the main river and tributaries. There is a need for quantitative information on bullhead abundance, which will be addressed by targeted monitoring in 2007.

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. 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.

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.

5.6 Conservation status and management requirements of Feature 6: European otter *Lutra lutra*

Conservation status

Status: Favourable. The conservation status of otters in the Usk 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

The catchment should be capable of supporting at least 18 breeding females, 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 that 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.

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.

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 retro-fitted.

Certain areas of the SAC are critical to the movement of otters both within the system and to adjacent sites. The Usk SAC provides a key movement corridor for otters passing between the relatively high densities in mid Wales and the south-east Wales coastal strip (Seven Estuary and Gwent Levels). The function of this aspect of the site should be protected through the maintenance of suitable resting sites (in terms of size, quality and levels of disturbance) through the major urban centre of Newport.

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.

5.7 Conservation status and management requirements of Feature 7: Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Conservation status

Status: Unfavourable: Unclassified. This feature is not identified as one of the primary reasons for designation of the River Usk SAC; its distribution being apparently limited by the availability of suitable hydromorphological conditions. Important stands have been identified in the lower reaches of the main river below Abergavenny down to the tidal limit, and in the upper reaches of a headwater stream, the Afon Senni. These reaches may represent a sub-type of the feature where large submerged and floating leaved flowering plants, in particular *Ranunculus*, are dominant. Habitat suitability studies[4] suggest that the natural range of the feature may be more widespread within the SAC. More widespread sub-types may consist of communities dominated by aquatic bryophytes. Where necessary, examples of these sub-types may be identified as priorities for management, for example through the management of riparian vegetation to preserve shade and humidity. Further understanding of the distribution and status of this feature and its natural range within the River Usk SAC is required.

The present unfavourable status of the feature results from the over-abundance of invasive non-native species of bankside plant communities, which are included within the feature definition. These are predominantly giant hogweed and Himalayan balsam in the lower reaches of the main river.

Management requirements

Factors that are important to the favourable conservation status of this feature include flow, substrate quality and water quality, which in turn influence species composition and abundance. These factors often interact, producing unfavourable conditions by promoting the growth of a range of algae and other species indicative of eutrophication. Under conditions of prolonged low flows and high nutrient status, epiphytic algae may suppress the growth of aquatic flowering plants. Favourable management for this feature is therefore largely dependent on ensuring that sufficient depth, velocity and duration of flow and sufficiently low phosphate levels are maintained within the natural range of the vegetation.

A favourable flow regime can be defined with reference to naturalised flows (removing the influence of artificial abstractions and discharges from flow records). While more sophisticated analysis of depth and velocity has been carried out locally for the Review of Consents process, a flow level criterion is generally applied to regulate abstractions. Based on current available information, the recent level of flow depletion downstream of major abstractions in the River Usk SAC is not considered to be damaging to this feature, either through limiting its range or adversely affecting its community composition[5].

The conservation objectives require that the area covered by the feature is stable or increasing within its natural range, which is likely to require catchment-wide measures to control diffuse pollution from agriculture, as the principal source of phosphate. Measures should be targeted initially at those reaches identified as holding important stands of this vegetation, in particular the Afon Senni.

Invasive non-native plants are a detrimental impact on this feature. Giant hogweed, Himalayan balsam and Japanese knotweed should be actively managed to control their spread and hopefully reduce their extent in the SAC.

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.

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
001	000467	Tidal reach	Development pressures in Newport leading to increased disturbance and pollution risk.	Yes
002	000468	Prioress Mill to tidal limit	Dwr Cymru Prioress Mill abstraction causing flow depletion and fish entrainment. Invasive weeds affect river bank areas.	Yes
003	000469	Llanfoist Bridge to Prioress Mill	Trostrey Weir forms a partial barrier to migration of shad. Invasive weeds affect river bank areas.	Yes
004	000470	Crickhowell Bridge to Llanfoist Bridge	Trostrey Weir and Llanfoist Bridge form a partial barrier to migration of shad. Tipped waste affects a significant length of river bank at Llanfoist. Invasive weeds affect river bank areas.	Yes
005	000471	Brecon Weir to Crickhowell Bridge	Crickhowell Bridge forms a near-total barrier to migration of shad. Canal abstraction at Brecon Weir causes localised significant flow depletion at low flows. Himalayan balsam is invasive over large areas of river bank.	Yes
006	000472	Usk Reservoir to Brecon Weir & Afon Hydfer	Brecon Weir forms a partial barrier to fish migration. The main River Usk is partially regulated by Usk Reservoir. Forestry affects the upper part of Afon Hydfer. Agriculture and forestry affect run-off regime and water quality.	Yes
007	000473	Usk Tributaries, Brecon downstream	Partial barriers to fish migration at several locations. Caerfanell is regulated by Talybont Reservoir. Grwynne Fawr is regulated by Grwynne Fawr Reservoir. Agricultural land management affects run-off regime and water quality.	Yes
008	000474	Camlais, Bran & Ysgir	Agricultural land management affects run-off regime and water quality.	Yes
009	000475	Crai & Cilieni	Crai is regulated by Cray Reservoir. Agricultural land management affects run-off regime and water quality.	Yes
010	000476	Afon Senni	Agricultural land management affects run-off regime and water quality.	Yes
011	000488	Upper Nant Menascin	No known significant issues.	No

7. GLOSSARY

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

Action	A recognisable and individually described act, undertaking or **project** of any kind, specified in section 6 of a **Core Management Plan** or **Management Plan**, as being required for the **conservation management** of a site.
Attribute	A quantifiable and monitorable characteristic of a **feature** that, in combination with other such attributes, describes its **condition**.
Common Standards Monitoring (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[2]: Favourable: maintained; Favourable: recovered; Favourable: un-classified Unfavourable: recovering; Unfavourable: no change; Unfavourable: declining; Unfavourable: un-classified Partially destroyed; Destroyed.
Conservation management	Acts or undertaking of all kinds, including but not necessarily limited to **actions,** taken with the aim of achieving the **conservation objectives** of a site. Conservation management includes the taking of statutory and non-statutory measures, it can include the acts of any party and it may take place outside site

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

	boundaries as well as within sites. Conservation management may also be embedded within other frameworks for land/sea management carried out for purposes other than achieving the conservation objectives.
Conservation objective	The expression of the desired **conservation status** of a **feature,** expressed as a **vision for the feature** and a series of **performance indicators**. The conservation objective for a feature is thus a composite statement, and each feature has one conservation objective.
Conservation status	A description of the state of a **feature** that comprises both its **condition** and the state of the **factors** affecting or likely to affect it. Conservation status is thus a characterisation of both the current state of a feature and its future prospects.
Conservation status assessment	The process of characterising the **conservation status** of a **feature** with particular reference to whether the aspirations for it, as expressed in its **conservation objective**, are being met. The results of conservation status assessment can be summarised either as 'favourable' (i.e. conservation objectives are met) or unfavourable (i.e. conservation objectives are not met). However the value of conservation status assessment in terms of supporting decisions about **conservation management**, lies mainly in the details of the assessment of feature **condition**, **factors** and trend information derived from comparisons between current and previous conservation status assessments and condition assessments.
Core Management Plan	A CCW document containing the conservation objectives for a site and a summary of other information contained in a full site **Management Plan**.
Factor	Anything that has influenced, is influencing or may influence the **condition** of a **feature**. Factors can be natural processes, human activities or effects arising from natural process or human activities, They can be positive or negative in terms of their influence on features, and they can arise within a site or from outside the site. Physical, socio-economic or legal constraints on **conservation management** can also be considered as factors.
Favourable condition	See **condition** and **condition assessment**
Favourable conservation status	See **conservation status** and **conservation status assessment**[3]
Feature	The species population, habitat type or other entity for which a site is designated. The ecological or geological interest which justifies the designation of a site and which is the focus of conservation management.
Integrity	See **site integrity**
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

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

	management requirements. A complete management plan may not reside in a single document, but may be contained in a number of documents (including in particular **the Core Management Plan**) and sets of electronically stored information.
Management Unit	An area within a site, defined according to one or more of a range of criteria, such as topography, location of **features**, tenure, patterns of land/sea use. The key characteristic of management units is to reflect the spatial scale at which **conservation management** and **monitoring** can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management and monitoring in different parts of a site, and for facilitating communication with those responsible for management of different parts of a site.
Monitoring	An intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. In **Common Standards Monitoring**, the formulated standard is the quantified expression of favourable **condition** based on **attributes**.
Operational limits	The levels or values within which a **factor** is considered to be acceptable in terms of its influence on a **feature**. A factor may have both upper and lower operational limits, or only an upper limit or lower limit. For some factors an upper limit may be zero.
Performance indicators	The **attributes** and their associated **specified limits**, together with **factors** and their associated **operational limits,** which provide the standard against which information from **monitoring** and other sources is used to determine the degree to which the **conservation objectives** for a **feature** are being met. Performance indicators are part of, not the same as, conservation objectives. See also **vision for the feature**.
Plan or project	**Project:** Any form of construction work, installation, development or other intervention in the environment, the carrying out or continuance of which is subject to a decision by any public body or statutory undertaker. **Plan**: a document prepared or adopted by a public body or statutory undertaker, intended to influence decisions on the carrying out of **projects.** Decisions on plans and projects which affect Natura 2000 and Ramsar sites are subject to specific legal and policy procedures.
Site integrity	The coherence of a site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it is designated.
Site Management Statement (SMS)	The document containing CCW's views about the management of a site issued as part of the legal notification of an SSSI under section 28(4) of the Wildlife and Countryside Act 1981, as substituted.
Special Feature	See **feature**
Specified limit	The levels or values for an **attribute** which define the degree to which the attribute can fluctuate without creating cause for

	concern about the **condition** of the **feature**. The range within the limits corresponds to favourable, the range outside the limits corresponds to unfavourable. Attributes may have lower specified limits, upper specified limits, or both.
Unit	See **management unit**
Vision for the feature	The expression, within a **conservation objective**, of the aspirations for the **feature** concerned. See also **performance indicators.**
Vision Statement	The statement conveying an impression of the whole site in the state that is intended to be the product of its **conservation management.** A 'pen portrait' outlining the **conditions** that should prevail when all the **conservation objectives** are met. A description of the site as it would be when all the **features** are in **favourable condition**.

8. REFERENCES AND ANNEXES

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[3] Morgan P (2005). *Current and potential distribution, condition and breeding success of the otter (Lutra lutra) in the River Usk catchment.* CCW Environmental Monitoring Report No.19

[4] Geodata Institute (2005). *Fluvial audit of the Upper Usk Tributaries.* CCW

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[6] Cowx IG & Fraser D (2003). *Monitoring the Atlantic Salmon.* Conserving Natura 2000 Rivers Monitoring Series No.7, English Nature, Peterborough.
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ANNEX 1 – STANDARDS USED IN THE USK REVIEW OF CONSENTS FOR FLOW

The flow target used in the Environment Agency (EA) Resource Assessment and Management Framework (RAM) for the River Usk 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. Within the River Usk SAC, all reaches above Abergavenny are classified as having Very High sensitivity to abstraction, and below Abergavenny as High sensitivity. At other times of year the flow objective is derived from the CAMS River Flow Objective and recent actual abstraction scenario, whichever is the more stringent. At low flows this is equivalent to the HDERF objective. Some licences including the major public water supply abstractions in the lower river have Hands-off Flow conditions, which prevent abstraction during low flows.

Table 1 HDERF1 - River flow thresholds for SAC/SSSI rivers

EW band (sensitivity)	Maximum % reduction from daily naturalised flow		
	>Qn50	Qn50-95	<Qn95
Very High	10	10	1-5
High	15	10	5-10

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 USK REVIEW OF CONSENTS FOR PHOSPHATE

Source: 'Usk Phosphate Target setting' Environment Agency Wales Ref. No: EASE/TM/04/03

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 Usk 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 1. River size classification

River class	**GQA flow band**
1 – Headwaters	1 –2
2 – River	3 – 8
3 – Large river	9 – 10

Table 2. GQA Flow Bands

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

When the SIMCAT model of the Usk was built, Hydrology provided flow gauge information, flow estimates and headwater flow estimates (see Usk SIMCAT Final Model Build Report). The information from these was used to determine the GQA flow band and hence the river class.

The main River Usk is classed as a 'river' from just below Usk reservoir to the tidal limit. The SAC tributaries will obviously start off as headwaters but invariably reach 'river' size by the time they enter the main river Usk. In order to differentiate the point at which the tributary changed from 'headwater' to 'river' class, detailed flow data along the length of the tributaries would be required rather than the usual two flow estimates that we currently have. Therefore, to keep the classification simple, the SAC tributaries will be classed as 'river' along their entire lengths.

1.2 Determining the Geological Class

Table 3. Geological classification

A. Hard upland geologies (all land over 330m)	Igneous, plus Cambrian to Devonian series and Carboniferous. Low porosity, poor geology with hill farming and v. low population density
B. Other Cambrian – Devonian, and Carboniferous	Hard mudstones, sandstones, limestones. Improved pasture plus some arable, low population density
C. Jurassic and Cretaceous limestones	Soft limestones and chalk. More intensive agriculture and higher 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 Usk catchment is predominantly Old Red Sandstone 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)

Geological class	1. Headwaters	2. River	3. Large river
A			
Natural	Undetectable	0.02	0.02
Standard	**0.02**	**0.04**	**0.06**
Threshold	*0.04*	*0.06*	*0.10*
B			
Natural	0.02	0.02	0.03
Standard	**0.06**	**0.06**	**0.10**
Threshold	*0.10*	*0.10*	*0.10*
C			
Natural	0.02	0.02	0.02
Standard	**0.04**	**0.06**	**0.06**
Threshold	*0.06*	*0.10*	*0.10*
D			
Natural	0.02	0.02	0.03
Standard	**0.06**	**0.06**	**0.10**
Threshold	*0.10*	*0.10*	*0.20*
E			
Natural	0.02	0.03	0.03
Standard	**0.06**	**0.10***	**0.10***
Threshold	*0.10*	*0.20**	*0.20**

The Usk 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 USK REVIEW OF CONSENTS FOR WATER QUALITY

Table 1 sets out the targets specified in the EA Appropriate Assessment for the River Usk Review of Consents. RE1 applies to all of the designated SAC reaches of the River Usk (RE2 applies to some non-designated tributaries).

Table 1 River ecosystem (RE) classification

	Dissolved O xygen (% sat) 10%ile	**Biological Oxygen Demand (mg/l) 90%ile**	**Total Ammonia (mg N/l) 90%ile**	**Un-ionised Ammonia (mg N/l) 95%ile**	**pH (lower limit as 5%ile, upper limit as 95%ile)**	**Hardness (mg/l $CaCO_3$) Mean**	**Dissolved Copper (µg/l) 95%ile**	**Total Zinc (µg/l) 95%ile**
RE1	80	2.5	0.25	0.021	6.0-9.0	≤10 >10 and ≤50 >50 and ≤ 100 >100	5 22 40 112	30 200 300 500
RE2	70	4.0	0.6	0.021	6.0-9.0	≤10 >10 and ≤50 >50 and ≤ 100 >100	5 22 40 112	30 200 300 500

C2 Severn Estuary SAC, SPA and Ramsar Site

The Severn Estuary / Môr Hafren European Marine Site

comprising :

The Severn Estuary / Môr Hafren Special Area of Conservation (SAC)

The Severn Estuary Special Protection Area (SPA)

The Severn Estuary / Môr Hafren Ramsar Site

Natural England & the Countryside Council for Wales' advice given under Regulation 33(2)(a) of the Conservation (Natural Habitats, &c.) Regulations 1994, as amended.

June 2009

NATURAL ENGLAND

Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

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CONTENTS

4.2 Conservation objectives for SPA European Marine Site interest features

4.3 Conservation objectives for the Severn Estuary / Môr Hafren Ramsar Site

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Appendixes

SUMMARY

This document contains Natural England and the Countryside Council for Wales' (CCW's) advice issued under Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994, for the *Severn Estuary European Marine Site (EMS,) which comprises the Special Area of Conservation (SAC), Special Protection Area (SPA), and Ramsar site*, namely conservation objectives and advice on operations. It also includes an explanation of the purpose and format of Natural England and CCW's "Regulation 33 advice".

Section 1 provides the legal basis and practical requirements for setting conservation objectives for Natura 2000 sites, as understood by Natural England and CCW. It also briefly explains the legal and practical basis of the operations advice.

Section 2 details the qualifying features for the Severn Estuary SAC, SPA and Ramsar site under the EU Habitats and Birds directives and the Convention on Wetlands of International Importance.

Section 3 provides a description of the features of the Severn Estuary EMS

Section 4 contains Natural England and CCW's advice as to the conservation objectives (Regulation 33(2)(a)) for SAC, SPA and Ramsar site. This section also includes the favourable condition tables for the SAC, SPA and Ramsar site.

Section 5 contains Natural England and CCW's advice on operations which may cause deterioration or disturbance of the habitats and species for which the SAC, SPA and Ramsar 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 these sites and the requirements of the Habitats Regulations and government policy.

Section 6 contains the references.

Section 7 contains a glossary of terms.

Appendices 1-9 provide maps of the extent of the SAC, SPA and Ramsar designations; the indicative extent of the habitat features, and sub features where information is available; and the low-tide distribution of birds.

Appendices 10-11 provide additional background information useful to the understanding of this advice.

Notes :

CCW and Natural England's predecessor English Nature, issued advice under Regulation 33(2)(a) and 33(2)(b) in relation to the SPA in February 2005 which is now superseded by this document.

This advice does not cover the terrestrial areas of the Severn Estuary SPA (ie ground which lies behind flood defences and which are not subject to the tidal influence of the estuary and are not therefore within the European Marine Site.

CCW and Natural England also issued advice under Regulation 33(2)(a) in relation to the cSAC in June 2008 which is also superseded by this document.

1. Introduction

This document provides advice under Regulation 33 (2) for the Severn Estuary European Marine Site (EMS), which comprises the following sites :

- Severn Estuary Special Area of Conservation (SAC)*
- Severn Estuary Special Protection Area (SPA)
- Severn Estuary Ramsar Site

(*At the time of issue of this document the Severn Estuary has been accepted by the European Commission as a Site of Community Importance (SCI) but formal notices have not yet been issued (expected to take place in 2009). Given the imminent notification of the SAC the Severn Estuary SCI is referred to as SAC throughout this document).

The indicative extent and relationship of these designated sites is shown in Appendix 1

This document:

- is designed to help relevant and competent authorities responsible for complying with the requirements of the Habitats Directive to understand the international importance of the site and the underlying physical and ecological processes supporting the habitats and species for which each of the above designated sites has been selected.
- is intended to assist the relevant authorities to develop, if considered appropriate, a management scheme under Regulation 34 of the Habitats Regulations, under which they shall exercise their functions in accordance with the requirements of the Directive;
- contains Natural England and CCW's advice to competent authorities as to the conservation objectives of each of the above designated sites, for the purpose of considering plans and projects in accordance with Article 6 of the Habitats Directive and Parts IV and IVa of the Habitats Regulations. Natural England and CCW will provide more detailed advice to competent authorities to assess the implications of particular plans or projects, where appropriate, at the time those plans or projects are being considered.

Anyone proposing to undertake plans or projects with a potential impact on site features are encouraged to consult Natural England or CCW early in the planning stages to identify possible issues of concern.

The advice in this document is subject to review by Natural England and CCW, for example to:

- add further advice on monitoring requirements in order to assess the degree to which the conservation objectives are being achieved in future;
- add further advice on operations likely to damage the features for which the SPA, SAC and Ramsar Site are selected (under Habitats Regulation 33(2)(b));
- take account of new information about the SPA, SAC and Ramsar site or its features, or any future changes to the designations.

Notes :

CCW and Natural England's predecessor English Nature, issued advice under Regulation 33(2)(a) and 33(2)(b) in relation to the SPA in February 2005 which is now superseded by this document.

This advice does not cover the terrestrial areas of the Severn Estuary SPA (ie ground which lies behind flood defences are which are not subject to the tidal influence of the estuary and are not therefore within the European Marine Site.

CCW and Natural England also issued advice under Regulation 33(2)(a) in relation to the cSAC in June 2008 which is also superseded by this document.

1.1 Natura 2000

The European Union Habitats[1] and Birds[2] Directives are international obligations which set out a number of actions to be taken for nature conservation. They represent 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[3].The Habitats Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, and sets out measures to maintain or restore, natural habitats and species of European Union interest at favourable conservation status[4].

European sites include Special Areas of Conservation (SACs) designated under the 1992 Habitats Directive, which support natural habitats and species of European importance, and Special Protection Areas (SPAs) classified under the 1979 Birds Directive, which support internationally important wild bird populations. UK and Welsh Assembly Government policy also requires that Ramsar sites should receive the same level of protection as European sites[5].

The Habitats Directive is given effect in the UK largely through the Conservation (Natural Habitats, &c.) Regulations 1994 ("the Habitats Regulations")[6]. 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 will form a network of conservation areas to be known as 'Natura 2000'. Where SAC or SPA consist of marine areas they are referred to as European Marine Sites.[7]

There are various sources of guidance on the legal framework for European sites and European Marine Sites.[8]

A note on Ramsar :
The Convention on Wetlands of International Importance especially as Waterfowl Habitats (Ramsar Convention) was signed in Ramsar, Iran in 1971. The broad objectives of the Convention are to stem the loss and progressive encroachment on wetlands now and in the future, including through the designation of Ramsar sites.

A habitat can qualify as a Ramsar site for its representation of a wetland, or for the plant or animal species, including waterbirds, that it supports.

In accordance with Office of the Deputy Prime Minister (2005) *Planning Policy Statement 9: Biological and Geological Conservation*, Welsh Office Planning Guidance *Technical Advice Note No. 5* (TAN5), the DETR and NAW statements *Ramsar Sites in England* (November 2000) and *Ramsar Sites in Wales* (February

[1] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
[2] Council Directive 79/409/EEC on the conservation of wild birds.
[3] 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] A habitat or species is defined as being at favourable conservation status 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.
[5] Office of the Deputy Prime Minister (2005) *Planning Policy Statement 9: Biological and Geological Conservation,* Welsh Assembly Government (2006) *Draft Revised Technical Advice Note 5 Nature Conservation and Planning,* DETR (2000) *Ramsar sites in England*, National Assembly for Wales (20010, *Ramsar sites in Wales*.
[6] SI 1994/2716, HMSO, London. http://www.legislation.hmso.gov.uk/si/si1994/uksi_19942716_en_1.htm)
[7] "Marine areas" are defined in the Habitats Regulations as areas "continuously or intermittently covered by tidal waters or any part of the sea in or adjacent to Great Britain up to the limit of territorial waters."
[8] *European Marine Sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the Preparation and Application of Management Schemes* (DETR & The Welsh Office, 1998), Office of the Deputy Prime Minister (2005) *Planning Policy Statement 9: Biological and Geological Conservation,* Welsh Assembly Government (2006*) Draft Revised Technical Advice Note 5 Nature Conservation and planning,* CCW (undated) *Natura 2000: European wildlife sites.*

2001); Ramsar sites classified under the Convention on Wetlands of International Importance should be given the same consideration as European sites when considering plans and projects that may affect them.

1.2 The role of Natural England and the Countryside Council for Wales

Regulation 33 of the Habitats Regulations requires Natural England and the Countryside Council for Wales (CCW) to advise the relevant authorities[9] for each European Marine Site in, or partly in, England and 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 Natural England and CCW's advice under Regulation 33 in relation to the designated sites which comprise the Severn Estuary EMS.

The Conservation (Natural Habitats &c.) Regulations 1994, as amended transpose the Habitats Directive into law in Great Britain. They give Natural England and CCW a statutory responsibility to advise relevant authorities as to the conservation objectives for European Marine Sites and Ramsar Sites in England and Wales and to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the sites have been designated. This information will be a key component of any management scheme that may be developed for this site. It will also aid competent authorities in defining the scope and nature of 'appropriate assessment' which the Habitats Directive requires to be undertaken for 'plans and projects' having a significant effect on the European site (Habitats Regulations 20, 48, 50, 60-62 and 85B). Note that Natural England and CCW will also advise competent authorities on individual plans and projects as they arise. Natural England and CCW are also competent and relevant authorities under the Habitats Regulations.

1.3 The precautionary principle

The advice on operations contained within this package has been made based on the precautionary principle and any actions which may need to be taken in response to concerns identified as a result of monitoring undertaken by Natural England and the Countryside Council for Wales will also be made on this basis. All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences. Moreover, it is important, when considering whether the information available is sufficient, to take account of the associated balance of likely costs, including environmental costs, and benefits (DETR & the Welsh Office, 1998).

1.4 The role of other competent and relevant authorities

The Conservation (Natural Habitats &c.) Regulations 1994 require competent authorities to exercise their functions so as to secure compliance with the requirements of the Habitats and Birds Directives. The term "competent authority" includes all public bodies and statutory undertakers. The Regulations identify a number of competent authorities as "relevant authorities", with particular functions in relation to European Marine Sites. In addition to their duties as competent authorities, under Regulation 34 the relevant authorities may establish a management scheme for a European Marine Site under which they shall exercise their relevant functions. Such a management scheme should be guided by the information contained in this document. Relevant authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site. This may include consideration of issues outside the boundary of the European Marine Site.

[9] The types of bodies that are "relevant authorities" are identified in Regulation 5 of the Habitats Regulations.

Relevant authorities should ensure that all plans for the area integrate with the management scheme for the European Marine Site. Such plans may include Shoreline Management Plans, the Environment Agency's Flood Risk Management Strategy and Catchment Flood Management Plans, Local Development Plans/ Frameworks, Sites of Special Scientific Interest management plans, local Biodiversity Action Plans and sustainable development strategies for estuaries. This must occur to ensure that there is only a single management scheme through which all relevant authorities exercise their duties under the Conservation (Natural Habitats &c.) Regulations 1994.

Relevant authorities also need to have regard to changing circumstances of the European Marine Site and may therefore need to modify the management scheme and/or the way in which they exercise their functions so as to maintain the favourable condition of interest features concerned in the long term. There is no requirement for relevant authorities to take any actions outside their statutory functions. For the purposes of this document the term 'interest feature' refers to any of the habitat types or species for which the European Marine Sites have been designated.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, Natural England and CCW are empowered to use their bylaw-making powers under Regulation 36 of the Habitats Regulations 1994.

None of the information contained in this document legally binds any organisation (including Natural England and 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 on 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"[10], if such a scheme is established.

1.5 Responsibilities under other conservation designations

In addition to its SAC, SPA and Ramsar Site status, parts of the Severn Estuary are also notified as Sites of Special Scientific Interest (SSSIs) under the 1981 Wildlife and Countryside Act and Bridgwater Bay is also a National Nature Reserve. The obligations of relevant authorities and other organisations under such designations are not directly affected by the advice contained in this document.

Relevant authorities and others may have obligations towards the conservation of habitats and species that are not features for which the Severn Estuary European Marine Site has been designated, and such obligations are not affected by this document.

1.6 Role of advice 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 4 (conservation objectives and favourable condition tables) and 5 (operations advice) should be read in conjunction with these explanatory notes.

The information contained in this document is based on best available knowledge at time of writing and is subject to review at Natural England and CCW's discretion.

As referred to under section 1.1. above, there are various sources of guidance on the legal framework for European sites and European Marine Sites.[11]

[10] Regulation 34 of the Habitats Regulations.

[11] European Marine Sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the Preparation and Application of Management Schemes (DETR & The Welsh Office, 1998), Office of the Deputy Prime Minister (2005) Planning Policy Statement 9: Biological and Geological Conservation, Welsh Assembly Government (2006) Draft Revised Technical Advice Note 5 Nature Conservation and planning, CCW (undated) Natura 2000: European wildlife sites.

1.6.1 Outline of legal context and purpose of conservation objectives

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 as follows;

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

Conservation status of a natural habitat 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.

The conservative [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(i).

Conservation status of a species 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;

The conservation status of a species 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

In addition, the Birds Directive requires that, in relation to certain species of birds listed in Annex 1 of the Directive and regularly occurring migratory species, special measures are taken in order to ensure their survival and reproduction in their area of distribution. The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable. Annex 1 species that regularly occur at levels over 1% of the national population meet the SPA qualifying criteria.

Therefore, the conservation objectives for the Severn Estuary SAC, SPA and Ramsar site represents Natural England and the Countryside Council for Wales' current judgement of the appropriate contribution of the site to the achievement of the favourable conservation status of the habitats and species of the European Marine Site. The conservation objectives in this document are intended to guide relevant and competent authorities in the exercise of their functions to comply with the requirements of the Directives outlined above.

1.7 Condition

Natural England and CCW use the term "favourable condition" for the condition represented by the achievement of the conservation objectives, in other words the desired condition for a designated habitat or a species on an individual site.

On many terrestrial European sites, we know sufficient about the required condition of qualifying habitats to be able to define favourable condition with confidence. In contrast understanding the functioning of large, varied, dynamic marine and estuarine sites, which experience a variety of pressures resulting from historic and current activities, is much more difficult. Consequently it is much harder to precisely define favourable condition in sites like the Severn Estuary. In general the conservation objectives provided are based on a working assumption that the current condition of the features is favourable for most attributes. Nevertheless there are certain instances where the assumption does not apply. In particular some of the intertidal habitats of the Severn are subject to coastal squeeze. Where existing problems *have* been identified, the relevant objectives reflect this.

If it becomes evident that the condition of other features is significantly degraded, and is therefore unfavourable, then restorative management actions will need to be undertaken to return the interest feature to favourable condition. In future revisions of our advice under Regulation 33, Natural England and CCW will keep our assumption under review in light of ongoing and future monitoring and our developing understanding of the features and the factors affecting them.

1.8 Favourable Condition Tables

The detailed information regarding the measures and targets that may be used during site monitoring to determine whether favourable condition is being achieved in practice is presented within the Favourable Condition Tables in section 4.

The favourable condition table specifies the following (in columns from left to right):

- **Features**: interest features for which the SAC, SPA or Ramsar site is selected.
- **Subfeatures**: ecologically important sub-divisions of an interest feature. In the case of a habitat interest feature, subfeatures would be component habitats or communities (eg. defined by type and/or by geographic location within the site). In the case of species interest features, subfeatures include the population itself, or any ecologically relevant subdivisions of the population, and any habitats or communities on which it/they depend.
- **Attributes**: particular characteristics of the features or sub-features which provide an indication of the condition of the feature (eg. total population size, extent of a habitat type).
- **Measures**: what exactly about the attributes will be measured, in terms of the units of measurement to be used, arithmetic nature and an indication of the frequency at which the measurement is taken. An indication of the method that is likely to be used to obtain the observed values of attributes. The method is closely linked to the way in which the measure is expressed. It is important to note that in many cases the precise monitoring method to be used may not be known at this stage.
- **Targets**: These define the attribute values that equate to favourable condition. If changes are observed that are 'significantly' different from the target, this will act as a trigger for further investigation as to the cause of the change, or remedial management action. In general the targets in the favourable condition table are subject to natural processes as set out in the conservation objectives; i.e. where natural processes alone dictate that targets are not met this will not result in the condition of the feature being classed as unfavourable. The term 'subject to natural processes' is explained further in Section 4.1.
- **Comments**: notes on the rationale for the use of each attribute and measure.

The favourable condition table is intended to supplement the conservation objectives, including with respect to the management of established and ongoing activities, future requirements of monitoring and reporting on the condition of the features of the site and, together with the conservation objectives, informs the scope and

nature of any appropriate assessment that may be needed. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under the Habitats Regulations. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. Natural England and CCW will provide more detailed advice to competent and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

The favourable condition table specifies the main types of information that Natural England and CCW may use to assess the condition of interest features. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying species and habitats to be able to define measures and associated targets for all attributes. In European Marine Sites favourable condition is generally harder to define precisely since our knowledge of features is still developing. Accordingly, in the absence of such information, condition of interest features in European Marine Sites will, in the first instance, be assessed against targets based on their condition at the time the sites were selected, which may need to be established through baseline surveys in many cases.

The information contained within the favourable condition table is not necessarily what will be monitored but provides a basis for discussions with management and advisory groups. The attributes and associated measures and targets may be modified over time. The selection of attributes is based on the current understanding of the habitats and species and the available measuring techniques.

The appropriateness of individual attributes as indicators of condition will be reviewed as more knowledge of the condition of interest features is obtained and/or survey and monitoring techniques develop. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site.

The favourable condition table will be an important, but not the only, driver of the site monitoring programme. Other data, such as results from compliance monitoring and appropriate assessments, will also have an important role in assessing condition of interest features. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. Natural England and the Countryside Council for Wales will be responsible for collating the information required to assess condition, some of which may be collected by other organisations, and for judging the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

The conservation objectives and associated Favourable Condition Tables in this document are intended to guide relevant and competent authorities in the exercise of their functions to comply with the requirements of the Directives outlined above.

1.9 Advice on operations

1.9.1 Legal context

Natural England and 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:

- the necessary conservation measures are established which correspond to the ecological requirements of the habitats and species on the site;
- 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 Natural England and 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.[12] 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.

1.9.2 Practical requirements

Operations manifest themselves through one or more factors[13]. 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.[14] 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'.[15] 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 operations. 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.

Natural England and CCW's advice to the relevant authorities is that, as a minimum, the extent and management of the operations identified in Section 5 should be reviewed in the context of the conservation objectives. The advice should also help to 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.

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[12] The term also includes what the Habitats Directive and Regulations call "plans and projects" (see footnote 9).

[13] 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.)

[14] 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.

[15] Adapted from Hiscock, K. [ed] 1996. *Marine Nature Conservation Review: rationale and methods.* Peterborough: JNCC.

The advice in Section 5 of this document is not a list of prohibited operations, or operations necessarily requiring consultation with, or consent[16] from, Natural England or CCW. 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 Natural England, CCW and the relevant authorities.

Note : The advice on operations previously issued for the SPA in February 2005 is superseded by the advice given in Section 5.

[16] However, in relation to land included within the European Marine Site, which has been notified as a Site of Special Scientific Interest (SSSI), owners or occupiers require Natural England or 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 Natural England or 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).

2. Qualifying features under the EU Habitats and Birds Directives and the Convention on Wetlands of International Importance

Table 1 shows the wide range of nature conservation features for which the estuary is valued and the interrelationship of these features by designation. This table outlines features of European and International importance in their own right and others of national importance for which the Severn Estuary has been designated as a Site of Special Scientific Interest (SSSI) but which form an intrinsic part of the Severn ecosystem and therefore contribute to the overarching "estuary" feature of the SAC and Ramsar Site.

Table 1 : Summary of Notified features of each designation :

Feature	**SAC**	**SPA**	**Ramsar Site**	**SSSI (Nationally important feature)**
Estuary	Yes	*Supporting habitat to designated bird interests*	Yes	(Yes)
Subtidal sandbanks	Yes	No – outside boundary of SPA	No – outside boundary of Ramsar Site	*No – outside boundary of SSSI*
Intertidal Mud and Sand	Yes	*Supporting habitat to designated bird interests*	*Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests*	Yes
Atlantic salt meadow / salt marshes	Yes	*Supporting habitat to designated bird interests*	*Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests*	Yes
Reefs	Yes	No	*Intertidal Sabellaria contiguous with subtidal reefs is a component of the hard substrates subfeature of the Ramsar "estuaries" feature*	No – outside boundary of SSSI
Migratory fish (river & sea lamprey & twaite shad)	Yes	No	Yes	(Yes)
Migratory fish (salmon, eel, sea trout and Allis Shad)	*Part of notable species sub-feature of estuary feature*	No	Yes	(Yes)
Assemblage of fish species (>100 species)	*Notable species sub-feature of estuary feature*	No	*Notable species sub-feature of estuary feature)*	(Yes)
Internationally important populations of migratory bird species	*Notable species sub-feature of estuary feature*	Yes	Yes Internationally important populations of waterfowl	Yes
Internationally important populations of wintering bird species	*Notable species sub-feature of estuary feature*	Yes		Yes
Assemblage of nationally important populations of waterfowl	*Notable species sub-feature of estuary feature*	Yes	Yes	Yes
Hard substrate habitats (Rocky shores)	*Notable species sub-feature of estuary feature*	*Supporting habitat to designated bird interests*	*Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests*	Yes
Freshwater grazing marsh / Neutral grassland	No	*Supporting habitat to designated bird interests within SPA but outside European Marine Site* ***and therefore not addressed in this Regulation 33 advice document***		Yes (currently England only)

2.1 Qualifying interest features of the Severn Estuary / Môr Hafren SAC

The Severn Estuary has been designated an SAC on the basis that it supports occurrences of habitat types and species listed in Annexes I and II respectively of the Habitats Directive that are considered important in a European context and meeting the criteria in Annex III of the Directive. These are the interest features of the SAC and are listed in the Table 2 and their relationships are shown in Figure 1.

The designation includes an overarching **"estuaries"** feature within which **subtidal sandbanks**, **intertidal mudflats and sandflats, Altlantic salt meadows** and **reefs** (of *Sabellaria alveolata*) and **three species of migratory fish** are defined as both features in their own right and as sub-features of the estuary feature.

In addition **hard substrate habitats** including **eel grass beds,** the estuary-wide **assemblage of fish species** and the **assemblage of waterfowl species** (for which the Ramsar Site and SPA are specifically designated) are identified as **notable estuarine assemblages** which are an intrinsic part of the estuary ecosystem – these are therefore covered by the "estuaries" feature.

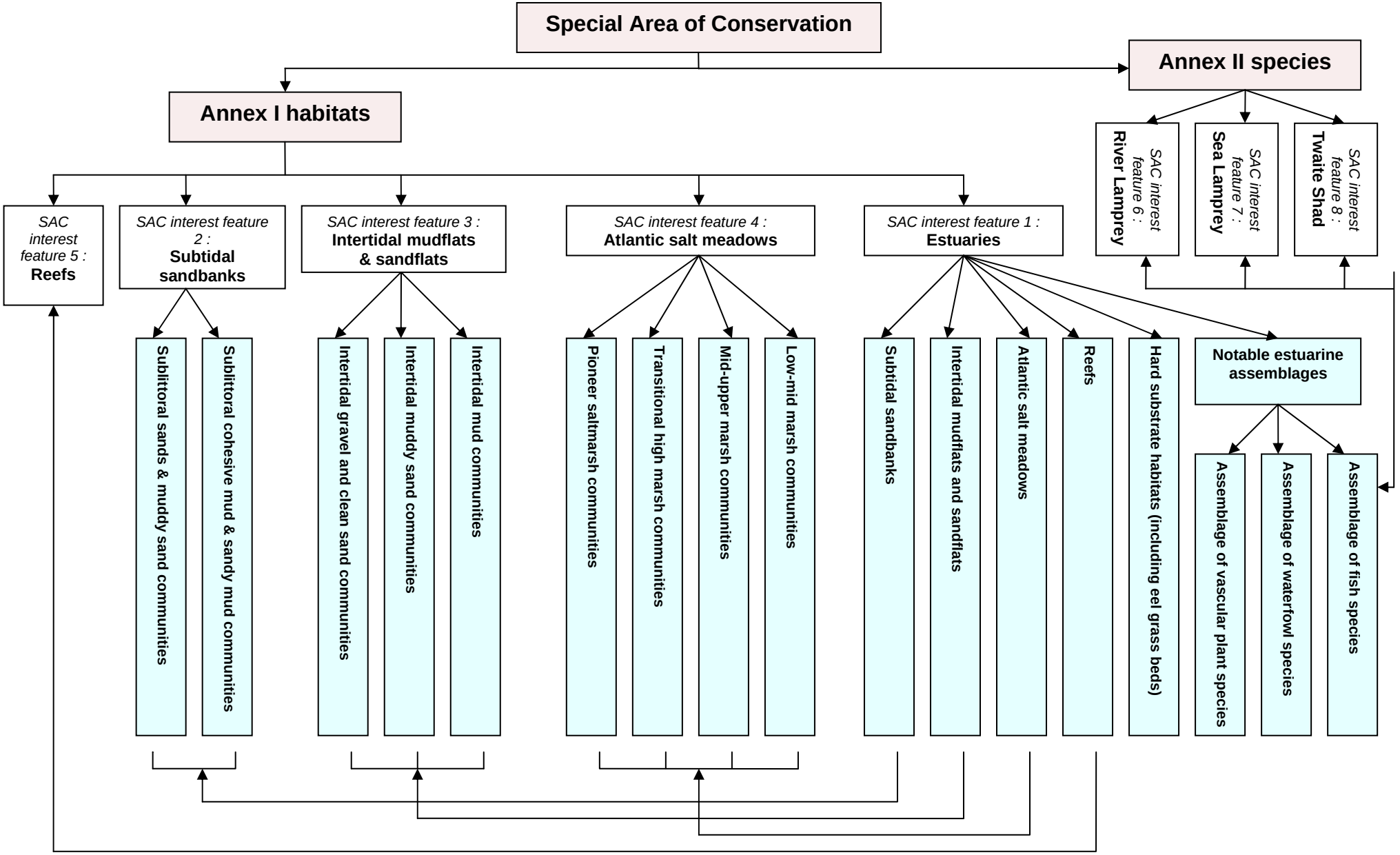
Table 2 : Interest features of the SAC

Feature name	**Scientific term**[10]	**EU Code**[17]
Annex I habitat types		
SAC interest feature 1: **Estuaries**	Estuaries	1130
SAC interest feature 2: **Subtidal sandbanks**	Sandbanks which are slightly covered by seawater all the time	1110
SAC interest feature 3: **Intertidal mudflats and sandflats**	Mudflats and sandflats not covered by seawater at low tide	1140
SAC interest feature 4: **Atlantic salt meadows**	Atlantic salt meadows (*Glauco puccinellietalia maritimae)*	1330
SAC interest feature 5: **Reefs**	Reefs	1170
Annex II species		
SAC interest feature 6: **River lamprey**	*Lampetra fluviatilis*	1099
SAC interest feature 7: **Sea lamprey**	*Petromyzon marinus*	1095
SAC interest feature 8: **Twaite shad**	*Alosa fallax*	1103

Each interest feature has a conservation objective in Section 4 of this document.

[17] European Commission (2007) Interpretation Manual of EU Habitats EUR27 July 2007, and Natura 200- Standard Data Form Explanatory Notes, Appendix C.

Figure 1 : Flow chart showing the relationship between the interest features of the Severn Estuary SAC (shown in white boxes) and their component sub features (shown in blue boxes). NB Some habitats that are sub features of the Annex II estuary feature are also features in their own right with their own sub features.



2.2 Qualifying interest features of the Severn Estuary / Môr Hafren SPA

The Severn Estuary was classified as an SPA on 13 July 1995 (subsuming a previously designated SPA called the Upper Severn Estuary) . The 1995 citation accompanying the classification is the baseline for the advice issued in this document. The qualifying interest features of the Severn Estuary SPA are shown in Table 3.

It should be noted that since designation changes in bird numbers have occurred in relation to the qualifying thresholds, which have themselves changed. These changes are highlighted by the SPA review published by the JNCC and details are also shown in Table 3. These changes are likely to be the subject of formal changes to the SPA designation in due course, however at present the legally protected species remain those in the original 1995 citation. (Note : Further information on the peak counts of the SPA species and waterfowl assemblage between 1988/9 and 2006/07 are given in Appendix 11.)

The SPA within the European Marine Site boundary includes saltmarshes and the adjacent extensive areas of intertidal mud, sand and rocky shores. All these habitats provide essential food and resting places for the wide range of wintering and migratory waterfowl and are therefore identified as key "supporting habitats" for the conservation of these species. The relationship between the features and supporting habitats supporting habitats is shown in Table 3. The supporting habitats are mapped in Appendix 8 to show their distribution and extent.

Notes relating to Table 3

**1* *Severn Estuary SPA original citation from July 1995 (though updated by Natural England in July 2002, version 2.3).*

**2* *JNCC Severn Estuary SPA Review, dated 2001 available from the JNCC www.jncc.gov.uk/pdf/SPA/UK9015022.pdf (Stroud, DA, et al., 2001)*

**3* *JNCC Natura 2000 Standard Data Form, May 2006, version 1.1.*

**4* *5 year peak mean, 1988/89 – 1992/93.*

**5* *5 year peak mean, 1991/92 – 1995/96.*

**6* *5 year peak mean, 01/04/1998.*

Table 3 : The qualifying interest features and supporting habitats of the Severn Estuary SPA.

Species	Original SPA citation (1995) *[1]	SPA Review (2001) *[2]	Natura 2000 form (2006) *[3]	Notes	Supporting habitats
Internationally important populations of regularly occurring Annex 1 species [under Article 4.1 of the EU Birds Directive].					
SPA interest feature 1 : **Bewick's swan** *Cygnus columbianus bewickii*	✓	✓	✓	Over-wintering	**Intertidal mudflats and sandflats** **Saltmarsh**
Internationally important populations of regularly occurring migratory bird species [under Article 4.2 of the EU Birds Directive].					
SPA interest feature 2 : **European white-fronted goose** *Anser albifrons albifrons*	✓	x	✓	Over-wintering	**Intertidal mudflats and sandflats** **Saltmarsh** **Hard substrate habitats** (Freshwater coastal grazing marsh, improved grassland and open standing waters also occur within the SPA but these habitats lie outside EMS boundary)
SPA interest feature 3 : **Dunlin** *Calidris alpina alpina*	✓	✓	✓		
SPA interest feature 4 : **Redshank** *Tringa totanus*	✓	✓	✓		
SPA interest feature 5 : **Shelduck** *Tadorna tadorna*	✓	✓	✓		
SPA interest feature 6 : **Gadwall** *Anas strepera*	✓	x	✓		
Curlew *Numenius arquata*	x	✓	x		
Pintail *Anas acuta*	x	✓	x		
Ringed plover *Charadrius hiaticula*	x	✓	x	On passage	
SPA interest feature 7 **: Internationally important assemblage of waterfowl** (wildfowl & waders) [under Article 4.2 of the EU Birds Directive].					
Bewick's swan *Cygnus columbianus bewickii*	✓	✓	The Natura 2000 data form does not list separate waterfowl species within this assemblage.	The wintering waterfowl assemblage includes all regularly occurring waterfowl. Species that qualify as a listed component of the assemblage include all the internationally important regularly occurring migratory species as well as the Annex 1 wintering species. The list also includes species present in nationally important numbers or species whose populations exceed 2,000 individuals In the original citation, in winter, it is stated that the area regularly supported 68,026 individual waterbirds *[4]. In the SPA Review it is stated that the area regularly supports 93,986 individual waterfowl in winter *[5]. In the Natura 2000 form, in winter, it is stated that the area regularly supports 84,317 waterfowl *[6].	**Intertidal mudflats and sandflats** **Saltmarsh** **Hard substrate habitats** (Freshwater coastal grazing marsh, improved grassland and open standing waters also occur within the SPA but these habitats lie outside EMS boundary)
European white-fronted goose *Anser albifrons albifrons*	✓	✓			
Dunlin *Calidris alpina alpina*	✓	✓			
Redshank *Tringa totanus*	✓	✓			
Shelduck *Tadorna tadorna*	✓	✓			
Gadwall *Anas strepera*	✓	✓			
Wigeon *Anas penelope*	✓	✓			
Teal *Anas crecca*	✓	✓			
Pintail *Anas acuta*	✓	✓			
Pochard *Aythya ferina*	✓	✓			
Tufted duck *Aythya fuligula*	✓	✓			
Ringed plover *Charadrius hiaticula*	✓	x			
Grey plover *Pluvialis squatarola*	✓	✓			
Curlew *Numenius arquata*	✓	✓			
Whimbrel *Numenius phaeopus*	✓	✓			

Species	Original SPA citation (1995) *[1]	SPA Review (2001) *[2]	Natura 2000 form (2006) *[3]	Notes	Supporting habitats
Spotted redshank *Tringa erythropus*	✓	x			
Lapwing *Vanellus vanellus*	x	✓			
Mallard *Anas platyrhynchos*	x	✓			
Shoveler *Anas clypeata*	x	✓			

Information on populations of bird species using the Severn Estuary European Marine Site at the time the SPA was classified is contained in Table 4 and their relationships are shown in Figure 2.

Table 4 : Information on populations of bird species using the Severn Estuary European Marine Site at the time the Severn Estuary SPA was classified (1995).

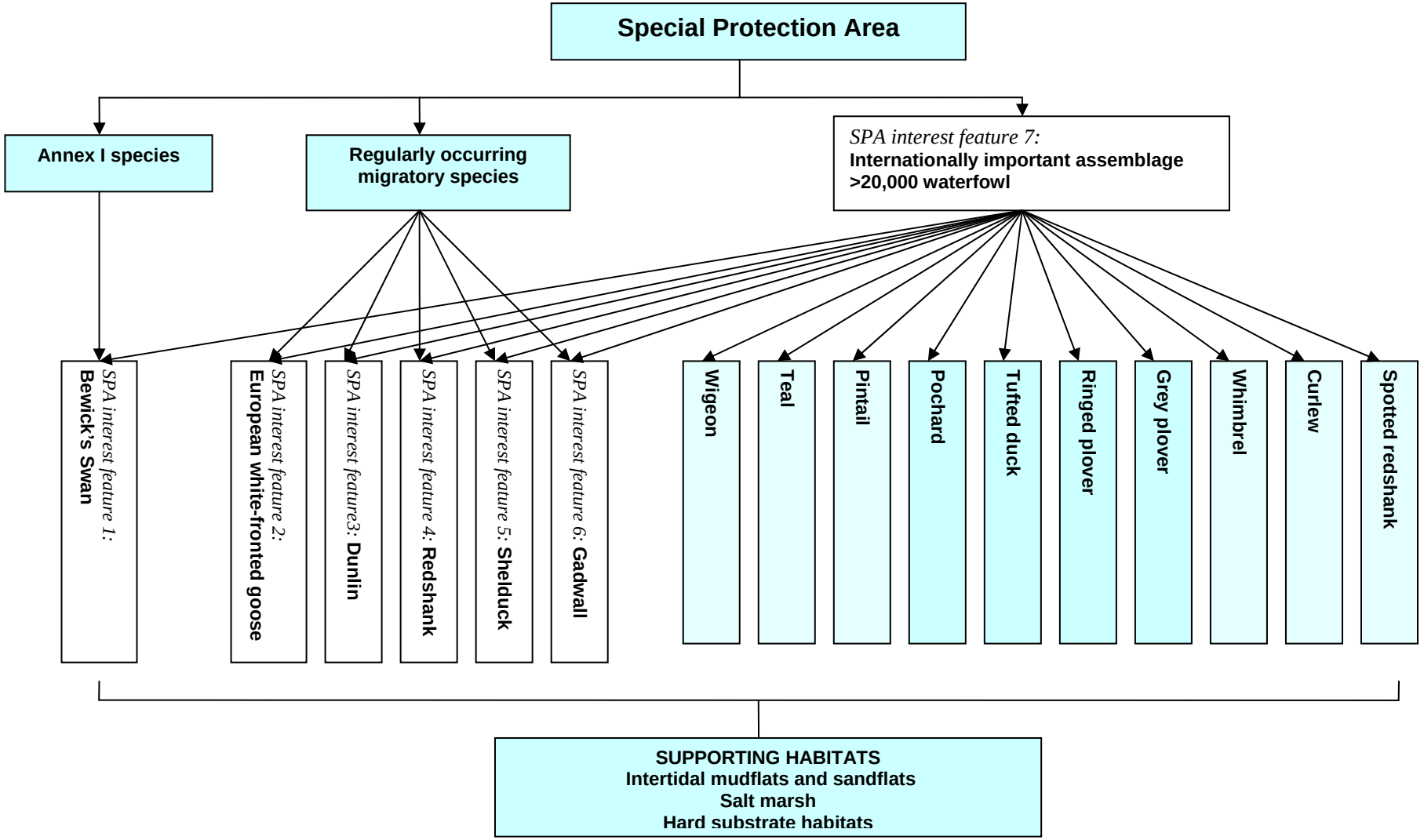
Internationally important populations of regularly occurring Annex 1 species		
Species	**Population (5 yr peak mean :1988/9 to 1992/3)**	
SPA interest feature 1: **Bewick's swan**	289 birds	4.1% Great Britain 1.7% NW Europe
Internationally important populations of regularly occurring migratory bird species		
Species (wintering)	**Population (5 yr peak mean: 1988/9 to 1992/3)**	
SPA interest feature 2: **European white-fronted goose**	3,002	50% British, 1% North West Europe
SPA interest feature 3: **Dunlin**	41,683	2.9% East Atlantic flyway
SPA interest feature 4: **Redshank**	2,013	1.3% East Atlantic flyway
SPA interest feature 5: **Shelduck**	2,892	1.2% North West Europe
SPA interest feature 6: **Gadwall**	330	2.8 % NW Europe
SPA interest feature 7: **An internationally important assemblage of waterfowl** *(Assemblage includes above species plus the following listed nationally important populations)*		
Importance	**Population (5 yr peak mean: 1988/9 to 1992/3)**	
The Severn Estuary supports over 20,000 wintering waterfowl.	68,026 individual birds comprising 17,502 wildfowl and 50,524 waders	
Nationally important bird populations within internationally important assemblage of waterfowl		
Species	**Population (5 yr peak mean: 1988/9 to 1992/3)**	
Wigeon	3,977 birds	1.6% Great Britain
Teal	1,998	2.0% Great Britain
Pintail	523	2.1% Great Britain
Pochard	1,686	3.8% Great Britain
Tufted duck	913	1.5% Great Britain
Ringed plover	227	1.0% Great Britain
Grey plover	781	3.7% Great Britain
Curlew	3,096	3.4% Great Britain
Whimbrel	246	4.9% Great Britain
Spotted redshank	3	1.5% Great Britain

Notes :
1. Previous advice issued in respect of the Severn Estuary SPA in February 2005 excluded Gadwall for the listed species of internationally important populations of regularly occurring migratory birds as they were considered not to use the European Marine Site area to any significant degree. Further recent evidence (2002/03 Low Tide Bird Counts) has demonstrated that this species does make use of areas within the European Marine Site and has consequently now been included.
2. The SPA review has identified that since the classification of the Severn Estuary SPA in 1995 the Severn Estuary now supports nationally important populations of Mallard, Lapwing and Shoveler.

(Note : Further information on the peak counts of the SPA species and waterfowl assemblage between 1988/9 and 2006/07 are given in Appendix 11.)

Each interest feature has a conservation objective in Section 4 of this document. Reference should also be made to sections of this document that relate to the Severn Estuary SAC interest features (particularly with respect to the conservation requirements of the supporting habitats) and the Severn Estuary Ramsar Site interest features.

Figure 2 : Flow chart showing the relationship between the qualifying bird species features (in white boxes) of the Severn Estuary SPA and their supporting habitats



2.3 Qualifying interest features of the Severn Estuary/ Môr Hafren Ramsar Site

The Severn Estuary was classified as a Ramsar Site on 13 July 1995 (subsuming a previously designated Upper Severn Estuary Ramsar Site). The 1995 citation is the basis for the advice issued in this document as this defines the legally protected species covered by the Ramsar designation at this time.

It should be noted that a number of changes have been made to the criteria since the listing of the Severn Estuary Ramsar Site and it is these new (2005) criteria which are now presented on the JNCC website used by many authorities as a reference source. For completeness qualification under both the criteria used at the time of 1995 Ramsar designation and the revised 2005 criteria have been outlined in Table 5 which provides a confirmation of the defined Ramsar features for which Conservation Objectives have been written.

The qualifying interest features of the Severn Estuary Ramsar Site overlap with those of the Severn Estuary SPA and SAC. To facilitate the development of integrated objectives across the designations the Ramsar criteria have been interpreted and the Ramsar features defined so that they are consistent with those already identified in the SAC and SPA sections of this document.

Table 5 : confirmation of Ramsar features in context of 1995 and 2005 Ramsar criteria

Ramsar Features (for which conservation objectives have been written)	**Criteria at designation (1995)** (original criteria)	**Revised Criteria (2005)** (criteria currently used on JNCC website)
Ramsar interest feature 1: ***Estuaries** *- characteristic physical form and flow, estuarine habitat communities and species assemblages*	**Criterion 1** : qualifies due to its immense tidal range affecting both the physical environment and biological communities present	**Criterion 1** : qualifies due to immense tidal range (second-largest in world), this affects both the physical environment and biological communities.
- estuarine habitat communities and species assemblages	**Criterion 2b** : qualifies due to its unusual estuarine communities, reduced species diversity and high productivity. The high tidal range leads to strong tidal streams and high turbidity, producing communities characteristic of the extreme physical conditions of liquid mud and tide swept sand and rock	**Criterion 3** : qualifies due to its unusual estuarine communities, reduced diversity and high productivity
Ramsar interest feature 2: **Assemblage of migratory fish species :** Sea Lamprey River Lamprey Twaite Shad Allis Shad Salmon Sea Trout Eel	**Criterion 2c** : qualifies as it is important for the run of migratory fish between sea and river via estuary. Species include Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla*.	**Criterion 4** : qualifies as it is important for the run of migratory fish between sea and river via estuary. Species include Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla*.
** The wider estuarine fish assemblage is covered as a "notable species assemblage" sub feature of the SAC "Estuaries" feature*		**Criterion 8** : qualifies as the fish assemblage of the whole estuarine and river system is one of the most diverse in Britain, with over 110 species recorded.

Table continued …

<table>
<tr><th>Ramsar Features
(for which conservation objectives have been written)</th><th>Criteria at designation (1995)
(original criteria)</th><th>Revised Criteria (2005)
(criteria currently used on JNCC website)</th></tr>
<tr><td>Ramsar interest feature 3:
Bewick's Swan

Ramsar interest feature 4:
European white-fronted goose

Ramsar interest feature 5: Dunlin
Ramsar interest feature 6: Redshank
Ramsar interest feature 7: Shelduck
Ramsar interest feature 8: Gadwall

ie Internationally important <u>populations</u> of waterfowl</td><td>Criterion 3c : qualifies by regularly in winter supporting internationally important populations (1% or more) of species of waterfowl

Bewick's swan
European white-fronted goose
Dunlin
Redshank
Shelduck
Gadwall</td><td rowspan="2">Criterion 6 : qualifies as it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Species with peak counts in winter - at designation:
Tundra/Bewick's swan
Greater /European white-fronted goose
Dunlin
Common redshank
Common shelduck
Gadwall

Populations identified subsequent to designation:
Ringed plover (spring/autumn)
Eurasian teal (winter)
Northern pintail (winter)
Lesser black-backed gull (breeding)</td></tr>
<tr><td rowspan="3">Ramsar interest feature 9:
Internationally important <u>assemblage</u> of waterfowl

This feature incorporates :

• waterfowl which contribute to the total peak winter count (criterion 3a)
• the above internationally important wintering populations (qualifying under criterion 3c)
• the migratory passage species (qualifying under criterion 2c)
• the nationally important populations (identified under other notable features of the Ramsar Site citation)

The species are as follows :
(w = wintering and p = passage):

Bewick's swan (w)
European white-fronted goose (w)
Shelduck (w)
Dunlin (w, p)
Redshank (w, p)
Gadwall (w)
Ringed plover (w, p)
Whimbrel (p)
Teal (w)
Pintail (w)
Wigeon (w)
Pochard (w)
Tufted duck (w)
Grey plover (w)
Curlew (w)
Spotted redshank (w)</td><td>Qualifies under Criterion 2c as it is particularly important for migratory birds during passage periods in spring and autumn. Nationally important populations of :

Ringed plover
Dunlin
Whimbrel
Redshank</td></tr>
<tr><td>Criterion 3a : qualifies by regularly supporting in winter over 20,000 waterfowl - (1988/89 to 1992/93 average peak count was 68,026 waterfowl: 17,502 wildfowl and 50,524 waders)</td><td>Criterion 5 : qualifies as it supports an assemblage of international importance - (1998/99-2002/2003 5 year peak mean was 70,919 waterfowl</td></tr>
<tr><td>Other notable features :
Nationally important wintering populations of:

Wigeon, teal, pintail, pochard, tufted duck, ringed plover, grey plover, curlew and spotted redshank. Also nationally important breeding population of Lesser Black backed gull</td><td></td></tr>
</table>

Each interest feature has a conservation objective in Section 4 of this document.

Reference should also be made to sections of this document that relate to the Severn Estuary SAC interest features (particularly with respect to the conservation requirements of the supporting habitats) and the Severn Estuary SPA interest features.

Information on the populations of bird species using the Severn Estuary Ramsar Site at the time of designation is contained in Table 6 and their relationships are shown in Figure 3. Ramsar interest feature 9 incorporates both wintering and passage populations of some birds and hence some species are included more than once in the lists given in Table 6.

Table 6 : Information on populations of bird species using the Severn Estuary Ramsar Site at the time of classification (1995)

Ramsar interest features3 to 8: **Internationally important <u>populations</u> of wintering waterfowl** (1995 Ramsar Criterion 3c)		
Species	**Population (5 yr peak mean: 1988/9 to 1992/3)**	
Ramsar interest feature 3: **Bewick's swan**	289	4.1% Great Britain, 1.7% North West Europe
Ramsar interest feature 4: **European white-fronted goose**	3,002	50% British, 1% North West Europe
Ramsar interest feature 5: **Dunlin**	41,683	2.9% East Atlantic flyway, 9.6% British
Ramsar interest feature 6: **Redshank**	2,013	1.3% East Atlantic flyway, 2.6% British
Ramsar interest feature 7: **Shelduck**	2,892	1.2% NW European, 3.9 % British
Ramsar interest feature 8: **Gadwall**	330	2.8 % NW European, 5.5 % British

Ramsar interest feature 9: **Internationally important <u>assemblage</u> of waterfowl (**1995 Ramsar Criterion 2c, 3a and 3c) *(Assemblage includes above wintering species populations plus the following listed nationally important populations (migratory passage and wintering species)*	
International importance (1995 Ramsar Criterion 3a)	**Population (5 yr peak mean: 1988/9 to 1992/3)**
Regularly supporting in winter over 20,000 waterfowl.	68,026 individual birds comprising 17,502 wildfowl and 50,524 waders

Nationally important bird populations within internationally important assemblage of waterfowl (1995 Ramsar Criterion 2c and other nationally important populations)		
Species	**Population (5 yr peak mean: 1987/8 to 1991/2)**	
Dunlin	3,510 (spring migration) 5,500 (autumn migration)	1.7 % British passage 2.7 % British passage
Redshank	2,456 (autumn migration)	2 % British passage
Ringed plover	442 (spring migration) 1,573 (autumn migration)	1.4 % British passage 5.2 % British passage
Whimbrel	246 (spring migration) 66 (autumn migration)	4.9 % British passage 1.3 % British passage
	Population (5 yr peak mean: 1988/9 to 1992/3)	
Wigeon	3,977 birds	1.6% Great Britain
Teal	1,998	2.0% Great Britain
Pintail	523	2.1% Great Britain
Pochard	1,686	3.8% Great Britain
Tufted duck	913	1.5% Great Britain
Grey plover	781	3.7% Great Britain
Curlew	3,096	3.4% Great Britain
Spotted redshank	3	1.5% Great Britain

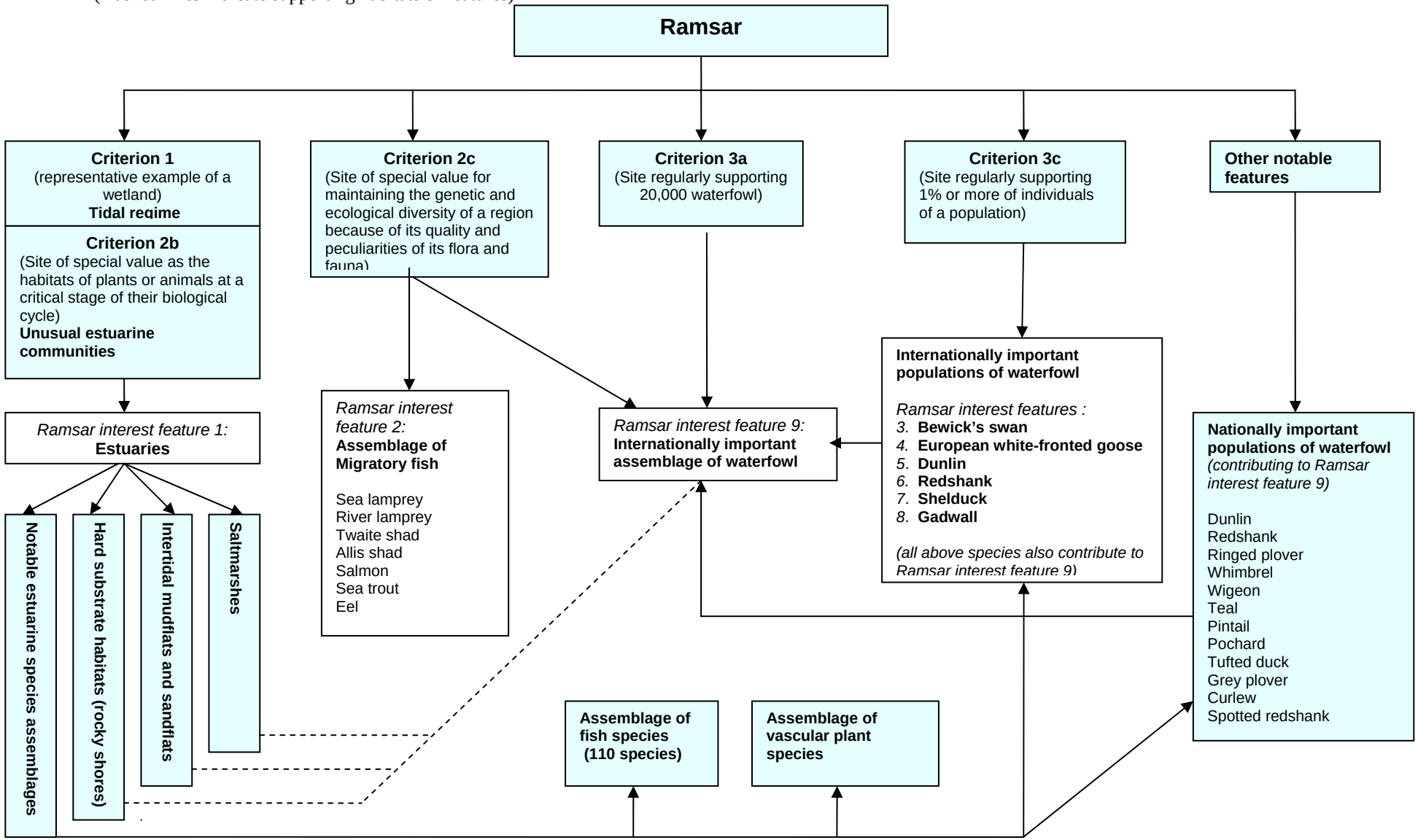
(Note : Further information on the peak counts of the SPA species and waterfowl assemblage between 1988/9 and 2006/07 are given in Appendix 11.)

The Ramsar Site within the European Marine Site boundary includes saltmarshes and the adjacent extensive areas of intertidal mud, sand and rocky shores. All these habitats provide essential food and resting places for the wide range of wintering and migratory waterfowl and are therefore identified as key "supporting habitats" for the conservation of these species. The relationship between the Ramsar Site bird features (Ramsar interest features 3 to 9) and their supporting habitats is shown in Table 7. The supporting habitats are mapped in Appendix 8 to show their distribution and extent.

Table 7 : A summary of the qualifying bird features and associated supporting habitats within the Severn Estuary Ramsar Site

Designation	**Qualifying feature**	**Protected Supporting habitats**		
		Estuary		
		Intertidal mudflats and sandflats	**Hard substrate habitats (rocky shores)**	**Saltmarsh**
Ramsar Site (*classified 13 July 1995)*	*Ramsar interest features 3 to 8 :* Internationally important populations of individual species of waterfowl	✓	✓	✓
	Ramsar interest feature 9: Internationally important assemblage of waterfowl	✓	✓	✓

Figure 3 : Flow chart showing the relationship between the interest features (in white boxes) for which the Severn Estuary Ramsar Site qualifies.
(Dashed lines indicate supporting habitats of features)



3. General description of the Severn Estuary and its designated features

Introduction

The Severn Estuary is the largest example of a coastal plain estuary in the United Kingdom and one of the largest estuaries in Europe. The overall area of the European and International conservation designations is 73,715.4 ha (see Appendix 1) of which roughly two thirds is composed of subtidal habitats (stable sandbanks and shifting sediments of gravel, sand and mud) and one third is composed of intertidal habitats (tide washed mud and sand, saltmarshes and rocky shores).

The estuary lies in the broad Severn Vale, with most of the sediments on the margins of the estuary having accumulated since the last ice age. As with many other estuaries in England and Wales, it has been a focus for human activity, a location for settlement, a source of food, water and raw materials and a gateway for trading and exploration. The Estuary and its coastal hinterland support the cities of Cardiff, Bristol, Newport and Gloucester. Today, major industries are sited around the Estuary's shores. There are modern port installations, chemical processing companies and nuclear power stations among others. Exploitation of the natural resources includes commercial shrimp fishing and fishing for salmon using putchers, lave nets, draught nets and bag nets. The Severn supports an important eel and elver fishery. Aggregate extraction also occurs within the estuary.

Alongside all these competing activities, the Estuary also supports a wide array of habitats and species of international importance for nature conservation.

Human activity has increasingly influenced the character of the marginal wetland mudflats and marshes, with extensive land claim occurring during and since the Roman period. Sediment flows and fluxes affecting the estuary are of particular importance for estuarine processes and ecology and the morphology of the estuary is constantly changing due to the complex hydrodynamics. Sediment deposits provide essential material to maintain the mudflats, sandflats and saltmarsh. Estuary-wide fluctuations in the wind-wave climate over recent centuries have led to major movements of the high-tide shoreline, and some reclaimed lands have been lost (Allen, 1990, Atkins, W.S. 2004). In addition, the Severn Estuary CHaMP (ABPMer, 2006) predicts losses of intertidal mudflats and sandflats and saltmarsh habitats over the next 100 years in response to rising sea-level.

A number of habitats and species have also been recognised through the designation of several Sites of Special Scientific Interest (most notably, the Upper Severn Estuary, Severn Estuary and Bridgwater Bay SSSIs in the 1980's) which underpin the European and International designations.

The following sections briefly describe each of the main habitat and species features covered by the three designations and the inter-relationships between them. All feature descriptions are based on best available knowledge at the present time and in some cases this is limited. For example there is limited information on the extent of the subtidal reef habitat within the estuary. Maps showing the distribution of the habitats are indicative only and the advice in this document is provided on the basis of current knowledge and may be subject to change as knowledge improves.

3.1 Estuaries

3.1.1 Range

Estuaries are habitat complexes which comprise an interdependent mosaic of subtidal and intertidal habitats, which are closely associated with surrounding terrestrial habitats. Many of these habitats, such as mudflats and sandflats not covered by sea water at low tide, saltmarshes, sandbanks which are slightly covered by sea water all the time and reefs, are identified as Annex I habitat types in their own right.

Estuaries are defined as the downstream part of a river valley, subject to the tide and extending from the limit of brackish water. There is a gradient of salinity from freshwater in the river to increasingly marine conditions towards the open sea.

Estuaries are widespread throughout the Atlantic coasts of Europe. Approximately one-quarter of the area of estuaries in north-western Europe occurs in the UK. The UK has over 90 estuaries[18].

The selection of estuary sites has taken account of the UK's EU responsibility for this habitat type, and the SAC series contains a high proportion of the total UK resource. Sites have been selected to represent the geographical range of estuaries in the UK, and to encompass examples of the four geomorphological sub-types (coastal plain, bar-built, complex, and ria estuaries) and the associated range of communities. Selection has generally favoured larger estuaries, as they display a wider variety of habitats, but smaller estuaries have also been selected where they have specific features of interest, such as undisturbed transitions from marine to terrestrial habitats, or are representative of a particular geomorphological sub-type.

The Severn Estuary is the largest example of a coastal plain estuary in the UK, and one of the largest estuaries in Europe. It contributes approximately 30% of the UK Natura 2000 resource for estuaries, by area.[19]

3.1.2 Extent and Distribution

The extent of the Estuary feature is 73678 ha.

The Severn Estuary SAC covers the extent of the tidal influence from an upstream limit between Frampton and Awre in Gloucestershire out seawards to a line drawn between Penarth Head in Wales and Hinckley point in Somerset. It includes subtidal and intertidal areas landward to the line of high ground and flood defences (banks and walls) that provide the limit of tidal inundation.

The Estuary is an over-arching feature which incorporates all aspects of the physical, chemical and biological attributes of the estuary as an ecosystem. The physical nature of the tidal regime determines not only the structure of the estuary and individual habitats but also the conditions affecting it and the biological communities it therefore supports.

3.1.3 Structure and Function

The Severn Estuary is important for its immense tidal range, which affects both the physical environment and the diversity and productivity of the biological communities. The tidal range is the second largest in the world, reaching in excess of 13 m at Avonmouth[20]. This macrotidal environment is partly due to the estuary's funnel shape which concentrates the tidal wave as it moves up the Bristol Channel. Tidal currents

[18] JNCC website

[19] Based on Natura 2000 Standard data forms for all UK Natura 2000 sites which have estuaries as a feature- source: JNCC website http://www.jncc.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H1130

[20] Data on tidal range can be found on the Proudman Oceanographic Laboratory website http://www.pol.ac.uk/ntslf/tides/?port=0060 .

are also amplified and exceed 7 metres per second close to Avonmouth (British Geological Survey, 1996). These factors make the estuary important in representing one of the most dynamic estuarine systems in the UK , Europe and the world.

There are several major rivers, including the Taff, Usk, Wye, Severn, Avon and Parrett which feed into the estuary, and influence the salinity regime. Together these rivers tend to produce a marked east-west salinity gradient and a range of conditions varying from brackish to fully saline, depending on the season and rainfall, which in turn influences the occurrence and distribution of habitats and species throughout the estuary and its fringes.

Fine sediments which are mainly derived from erosion of the intertidal zone and suspended sediments in river water entering the estuary create high turbidity, which has its highest average level between Avonmouth and the outer part of Bridgwater Bay (British Geological Survey, 1996, ABPMer, 2006). The strong tidal currents create a highly dynamic environment and the resultant scouring of the seabed and high turbidity give rise to low diversity communities. The Severn has an extreme type of hydrodynamic and sedimentary regime which distinguishes it from other estuaries and which dominates the whole system. It is estimated that the estuary carries 10 million tons of suspended sediments on spring tides (Kirby & Parker,1983; Kirby, 1986). Such conditions were initiated by the start of sea-level rise in late glacial times, with some evidence for steady sedimentation persisting for at least 5000 years, during which there has been a steady rise in sea level of 5 m, a trend which is continuing at present (British Geological Survey, 1996). Defra guidance[21] indicates sea –level rise for Wales and the South West to be 3.5 mm per annum to 2025, rising to 8 mm per annum (2025-2055), 11.5 mm (2055-2085) and 14.5 mm (2085-2115).

3.1.4 Typical Habitats and Species

The extreme hydrodynamic and sedimentary conditions essentially determine the type of habitats and species present and result in characteristic animal and plant communities. Typical species for each habitat are given in the individual habitat sections.

The predominant unconsolidated sediments are muds and sands which form the basis of the structure of the estuarine habitats which include saltmarshes (section 3.5), intertidal mud and sand flats (section 3.4) and subtidal sand banks (section 3.3), mixed mud and sand, rock outcrops, boulder and shingle shores (section 3.7) as well as biogenic (worm built) reefs (section 3.6). There are also sandy beaches on the southern shores in the outer part of the estuary, backed by sand dunes.

The intertidal zone of mudflats, sandbanks, rocky platforms and saltmarsh is one of the largest and most important in Britain and this range of habitats provide an ecosystem of great importance for a wide range of fish (section 3.8) and bird (section 3.9) species – for feeding, breeding, resting and migration.

3.1.5 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

[21] Defra, 2006. Flood and Coastal Defence Appraisal Guidance FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts October 2006

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 migrate 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 Common Standards Monitoring Guidance for 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[22]; 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.

3.2 Subtidal sandbanks

3.2.1 Range

Sandbanks which are slightly covered by sea water all the time (subtidal sandbanks) consist of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum (but sometimes including channels or other areas greater than 20 m deep). The habitat comprises distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) which may arise from horizontal or sloping plains of sandy sediment. Where the areas of horizontal or sloping sandy habitat are closely associated with the banks, they are included within the Annex I type.

Sandbanks which are slightly covered by sea water all the time occur widely on the Atlantic coasts of north-west Europe, and occur widely around the UK coast. They are widespread in inshore waters (within 12 nautical miles of the coast) and also occur offshore in the southern North Sea and in the Irish Sea (between 12 and 200 nautical miles).

The UK SAC series includes large sublittoral sandbanks showing good habitat structure and function. The selected sites represent the range of variation within the four main sub-types (gravelly and clean sands, muddy sands, eelgrass beds, and maerl beds), which are often associated with different physiographic features (e.g. estuaries, open coast, bays, sea lochs). The differing character of this habitat around the UK coast has also been taken into account.

The Severn Estuary subtidal sandbanks can be considered to contribute to the gravelly and clean sand sandbank resource. The Severn Estuary contributes approximately 3% of the UK Natura 2000 resource for subtidal sandbanks, by area.[23]

[22] A flood hydrograph is a dual plot of river discharge (line) and rainfall (bars) over time

[23] Based on Natura 2000 Standard data forms for all UK Natura 2000 sites which have estuaries as a feature- source: JNCC website http://www.jncc.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H1130

3.2.2 Extent and Distribution

The subtidal sandbanks are largely restricted to the middle and outer parts of the estuary. The sand banks of the Middle and Welsh Grounds are relatively permanent sandbank features in the Severn Estuary, along with other long established sandbank features at Cardiff Grounds and in Bridgwater Bay. The tops of these banks are intertidal, and the permanently submerged parts of the banks are considered to contribute to the subtidal sandbanks habitat

There are other areas of subtidal sandbank habitat within the Estuary, again sometimes the top of the bank may be exposed at low tide, with the submerged sections contributing to the subtidal sandbanks habitat. These banks are more ephemeral in nature, but are still considered part of the feature, and reflect the dynamic nature of the Severn Estuary. The areas where ephemeral subtidal sandbanks are known to occur include areas offshore from Avonmouth and at English Grounds (near Clevedon).

The approximate area of the more permanent subtidal sandbanks is 1,300 hectares and there are approximately 10,440 hectares of associated ephemeral sandbanks. Areas of associated sediments have been defined by using the sediment environments of the Bristol Channel Marine Aggregates Resources and Constraints project, commissioned by the National Assembly for Wales (Posford Duvivier and ABP, 2000). Further detail is given in section 4.1.2.1.

3.2.3 Structure and Function

The subtidal area of the Severn Estuary is subject to strong tidal currents resulting in the high mobility of sediments which range from gravely to muddy sands. The high mobility of the sediments and high turbidity means that these habitats only support animals that can tolerate the shifting seabed and scouring action of suspended sand.

As described above the subtidal sandbanks habitat includes some long established and relatively permanent sandbank features and associated sediments which form more ephemeral sandbanks. The sediments of both the more permanent sandbank features and the associated sediments (ephemeral banks) together comprise the subtidal sandbanks feature of the SAC (see map in Appendix 3).

These subtidal areas play an important role in holding and supplying sediment for other habitats notably the intertidal mud and sandflats, saltmarshes and reef features and it is likely that subtidal invertebrate communities play a role as a food resource for some species of the fish assemblage feature of the SAC and Ramsar Site.

3.2.4 Typical species

The subtidal sandbanks feature has two distinct sub-features composed of communities which are determined principally by the degree of sediment mobility, grade of sediments, mix of sediments (in terms of proportions of sand and mud) and salinity.

The first sub-feature is composed of sand and muddy sand communities dominated by worms, and burrowing shrimps which can tolerate the high sediment mobility. The second sub feature is composed of mud and sandy mud dominated communities which are slightly more stable and support a greater abundance of burrowing worms.

The typical species of these communities include a range of worms, shrimps, snails and bivalves. The species diversity of these habitats is often low but overall biomass can be high.

3.2.5 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.

3.3 Intertidal mudflats and sandflats

3.3.1 Range

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They form a major component of Estuaries and Large shallow inlets and bays in the UK but also occur extensively along the open coast and in lagoonal inlets. The physical structure of the intertidal flats ranges from mobile, coarse-sand beaches on wave-exposed coasts to stable, fine-sediment mudflats in estuaries and other marine inlets. This habitat type can be divided into three broad categories (clean sands, muddy sands and muds), although in practice there is a continuous gradation between them. Within this range the plant and animal communities present vary according to the type of sediment, its stability and the salinity of the water.

Mudflats and sandflats not covered by sea water at low tide are a widespread habitat type on coasts of Atlantic Europe, particularly around the North Sea, and occur widely throughout the UK.

Sites have been selected to encompass the range of geographical, physical and ecological variation shown by this habitat type in the UK. Examples of clean sands, muddy sands, and mudflats have all been included. Sites with large areas of intertidal flats, as well as a range of environmental conditions and an associated diversity of communities, were favoured.

The intertidal part of the Severn Estuary supports extensive mudflats and sandflats. These cover an area of approximately 20,300 ha - the fourth largest area in a UK estuary and representing approximately 7 % of the total UK resource of this habitat type (approximately 10% of the UK Natura 2000 resource for Intertidal mudflats and sandflats, by area.[24])

The intertidal mudflats and sandflats of the Severn Estuary are representative of estuarine mudflats and sandflats influenced by strong tidal streams and extreme silt loading.

3.3.2 Extent and Distribution

The Intertidal mudlfats and sandflats feature in the Severn Estuary covers an area of approximately 20,300ha.

The Intertidal mudflats and sandflats feature is distributed throughout the Severn Estuary with extensive mudflats fronting the Welsh shore and Bridgwater Bay, and large banks of clean sands in the more central parts of the estuary at Middle and Welsh Grounds.

3.3.3 Structure and Function

This habitat type can be divided into three broad categories (which form the three main sub-features identified for this feature in the Severn Estuary), clean sands and gravels, muddy sands, and muds, although in practice there is a continuous gradation between them (Countryside Council for Wales, 2006; English Nature, 2006). The composition of the sediments and level of consolidation are the most important factors in determining the fauna of these communities and individual species distribution is largely dependant on the salinity which limits the penetration of marine species upstream where freshwater influences are strongest.

[24] Based on Natura 2000 Standard data forms for all UK Natura 2000 sites which have estuaries as a feature- source: JNCC website http://www.jncc.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H1130

The gravel and clean sand communities occur predominantly in the mid and upper parts of the estuary forming large banks in the centre the estuary (Frampton Sands, Lydney Sands, Oldbury Sands, Bedwyn Sands and the Welsh Grounds) through which the main tidal channel flows keeping sediments mobile.

The sandy mud communities occur in restricted locations forming the transition between the clean sand and mud communities particularly in the mid estuary and at the lowest extremes of the tide and at the flanks of the main channel.

The mud communities form in the sheltered edges of the estuary particularly where the coastline forms natural embayments and are predominantly found in the mid to outer estuary at Bridgewater Bay and on the Cardiff and Newport frontages although a narrow fringe of these communities is present throughout the estuary. These communities take the form of firm mud banks adjacent to the saltmarshes often with a liquid mud surface kept fluid by the high tidal currents.

3.3.4 Typical Species

Muddy areas in the Estuary such as those between Cardiff to Newport are generally soft and mobile, colonised by high densities of relatively few species characterised by *Hediste diversicolor* and *Macoma balthica.* Other typical species include *Nephtys hombergii*, *Hydrobia ulvae*, *Tubificoides benedii*, *Streblospio shrubsolii*, *Pygospio elegans*, and Enchytraeidae. *Corophium volutator* is also widespread in these muddy areas especially near the mudflat saltmarsh boundary. In some mid shore areas with sandier sediments *Arenicola marina*, and *Macoma balthica* are present.

Lower shore coarse sand banks such as Bedwyn and Oldbury, are dominated by mobile species such as *Bathyporeia pelagica*, *Eurydice pulchra*, and *Nephtys cirrosa.* The south side of the lower estuary has pockets of littoral muddy sand on the upper shore characterised by *Macoma balthica*, *Hydrobia ulvae*, *Bathyporeia pelagica*, and *Nephtys hombergii*. Lower down the shore the sediments become muddier and support species such as *Scoloplos armiger*, *Aphelochaeta marioni* and *Hediste diversicolor.*

Upstream of Sudbrook the infauna becomes less diverse as the salinity decreases. Mud flats here support ragworm *Hediste diversicolor*, patchy Baltic tellin *Macoma balthica* and laver spire shell *Hydrobia ulvae*, with occasional peppery furrow shell *Scrobicularia plana* near the back of the shore. Within the pills along the site and in the upper reaches towards the road crossing the soft mud often supports few species including *Hediste diversicolor* and *Oligochaeta* spp.

The high biomass of invertebrates in the mudflats of the Severn provide an important food source for a diverse range and large number of fish and benthic predators. These intertidal areas are therefore important in supporting the fish assemblage subfeature of the SAC and Ramsar Site.

Mudflats also provide a valuable feeding, roosting and resting area for a wide range of species of wading birds and waterfowl and are therefore important supporting habitats for the wintering and passage bird features of the SPA and Ramsar Site.

3.3.5 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 muflats 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.

3.4 Atlantic salt meadow

3.4.1 Range

Atlantic salt meadows develop when halophytic vegetation colonises soft intertidal sediments of mud and sand in areas protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration. A wide range of community types is represented and the saltmarshes can cover large areas, especially where there has been little or no enclosure on the landward side. The vegetation 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, for invertebrates and for wintering or breeding waterfowl.

This Annex I type is predominantly found on Atlantic coasts in western Europe. Atlantic salt meadows occur on North Sea, English Channel and Atlantic shores. There are more than 29,000 ha of the habitat type in the UK, mostly in the large, sheltered estuaries of south-east, south-west and north-west England and in south Wales. Smaller areas of saltmarsh are found in Scotland.

Sites have been selected to cover the geographical range and ecological variation of Atlantic salt meadows in the UK. The sites selected are for the most part the largest examples of this habitat type, with good structure and function, and which support a well-developed zonation of plant communities within the saltmarsh. There are transitions to other high-quality habitat assemblages at many of the sites that have been selected. Sites with complete sequences of vegetation and transitions to other habitats, such as sand dunes, represent the range of variation of the habitat type, and this has been an important consideration in site selection.

The Severn Estuary holds the largest aggregation of saltmarsh in the south and south-west of the UK. It covers approximately 1,400 ha, representing about 4% of the total area of saltmarsh in the UK (Dargie, 2000).

3.4.2 Extent and Distribution

The Severn Estuary is fringed by saltmarsh. The huge tidal range in the Severn Estuary has led to extensive saltmarsh community development with an expanded zonation.

3.4.3 Structure and Function

The saltmarshes of the Severn Estuary have four principal zones corresponding to the four main sub-features that have been identified for this feature. Two of these zones (the lower to mid marsh communities and the mid to upper marsh communities) contain the principle saltmarsh types which are defined as Atlantic salt meadow as per the Annex 1 habitat description. However these occur in an intimate mosaic and in transition with the communities of the other two zones (in the pioneer saltmarsh and transitional high marsh communities) which are therefore considered in this advice as part of the feature. Section 4.1.4.1 and Table 11 provide further details of these zones and their typical species.

The pioneer saltmarsh communities play an important role in saltmarsh development as colonising plants (*eg Spartina sp.and Salicornia sp*.) stabilise and trap sediments. The upper marsh transitions to terrestrial and freshwater habitats support a range of nationally scarce and uncommon plant species and support tidal debris strandlines of value for invertebrates which are important components of the estuary feature.

Some of the saltmarshes show a sequence of saltmarsh cliffs or steps related to past cycles of accretion and erosion and in places the saltmarshes are also cut transversely by "pills" where freshwater streams enter the estuary. These features add diversity to the saltmarsh by initiating new patterns of species zonation. Recent monitoring has identified that there is a complicated present day pattern of erosion and accretion of the saltmarshes throughout the estuary and some parts appear to be exhibiting the effects of coastal squeeze – the constriction of saltmarsh habitats between rising sea levels and hard defences at the back of the saltmarsh .

Saltmarshes and mudflats have an important role to play in estuarine processes, both through the recycling of nutrients within the estuary and through their role as soft sea defences, dissipating wave energy. They are highly productive biologically, providing organic material that support other features within the marine ecosystem and they also have an important physical role, acting as a sediment store to the estuary as a whole.

Saltmarshes also provide a valuable feeding and roosting and resting areas (particularly at high tide) for a wide range of species of waterfowl and are therefore very important supporting habitats for the wintering and passage bird features of the SPA and Ramsar Site. The habitats within the "pills" provide important shelter and feeding habitats for both fish and bird species.

The Severn Estuary saltmarshes are generally grazed by sheep and/or cattle. Grazing is a significant factor in determining the plant communities found within them and their value for dependant species such as birds and rare plants.

3.4.4 Typical Species

The saltmarsh communities present relate to the four principal zones referred to above.

The low to mid marsh communities include transitional low saltmarsh with *Puccinellia maritima*, annual *Salicornia* sp. and *Suaeda maritima; Aster tripolium* (rayed) saltmarsh; *Puccinellia maritima* saltmarsh; *Atriplex portulacoides* saltmarsh; and *Juncus maritimus - Triglochin maritima* saltmarsh.

The mid to upper marsh communities include *Festuca rubra* saltmarsh; *Artemisia maritime* saltmarsh; and *Juncus maritimus* salt-marsh.

The transitional high marsh communities include *Spergularia marina - Puccinellia distans* saltmarsh; *Elytrigia atherica* saltmarsh; *Elytrigia repens* saltmarsh; *Festuca rubra - Agrostis stolonifera - Potentilla anserina* inundation grassland; *Festuca arundinacea* coarse grassland; *Agrostis stolonifera - Alopecurus geniculatus* inundation grassland; *Phragmites australis* reedbed; *Bolboshoenus maritimus* swamp; and *Agrostis stolonifera* sub-community.

The pioneer saltmarsh communities include *Spartina anglica* saltmarsh; Annual *Salicornia* saltmarsh; and *Suaeda maritima* saltmarsh.

Several notable species are also present *Alopecurus bulbosus, Althaea officinalis, Bupleurum tenuissimum, Hordeum marinum, Puccinellia rupestris, Trifolium squamosum, Lepidium latifolium, Allium oleraceum, and Petroselinum segetum (Dargie 1998).*

3.4.5 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.

The Severn Estuary saltmarshes do not generally contain a pattern of creeks and pans more typical of extensive saltmarshes in estuaries with less extreme tidal ranges. Instead the saltmarshes are dissected by "pills" (steep sided natural drainage channels cutting through the saltmarsh) where freshwater streams flow into the estuary. These are often deep and steep sided funnel shaped features, often with pioneer vegetation established along their banks although in many cases the natural structure of the pill is truncated by tidal flaps or flow valves. In a few locations natural salt pans occur within the saltmarshes.

Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins.

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.

3.5 Reef

3.5.1 Range

Reefs are rocky marine habitats or biological concretions that rise from the seabed. They are generally subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to the air at low tide. Intertidal areas are only included within this Annex I type where they are connected to subtidal reefs. Reefs are very variable in form and in the communities that they support. Two main types of reef can be recognised: those where animal and plant communities develop on rock or stable boulders and cobbles, and those where structure is created by the animals themselves (biogenic reefs).

Rocky reefs are extremely variable, both in structure and in the communities they support. A wide range of topographical reef forms meet the EU definition of this habitat type. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. In contrast to the variety of rocky reefs, there is somewhat less variation in biogenic reefs, but the associated communities can vary according to local conditions of water movement, salinity, depth and turbidity. The main species which form biogenic reefs in the UK are blue mussels *Mytilus edulis*, horse mussels *Modiolus modiolus*, ross worms *Sabellaria* spp., the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*.

Reefs occur widely around the UK coast, and are found in both inshore and offshore waters. There is a far greater range and extent of rocky reefs than biogenic concretions. Only a few invertebrate species are able to develop biogenic reefs, and these have a restricted distribution and extent in the UK.

The Severn Estuary has areas of biogenic reefs, formed by the tube-dwelling polychaete worm *Sabellaria alveolata*. *Sabellaria alveolata* reefs in the UK are predominantly an intertidal habitat but the Severn Estuary

is one of the few places where *Sabellaria alveolata* reefs occur extensively in the subtidal, as well as the intertidal.

3.5.2 Extent and Distribution

There are patches of intertidal *Sabellaria alveolata* reef throughout the Estuary, although it tends to be more common on the English side. The subtidal *Sabellaria alveolata* tends to be in the outer parts of the Estuary, southwest of a line between Clevedon and Newport. The exact distribution of subtidal *Sabellaria alveolata* reef in the Severn Estuary is unknown, partly due to the difficulties in sampling this habitat.

3.5.3 Structure and Function

Sabellaria alveolata is a species of small worm which constructs tubes using sand particles, to build honeycomb-like structures. *Sabellaria alveolata* reefs are often also known as honeycomb worm reefs.

These biogenic reefs tend to increase habitat diversity for other species (Holt et al 1998), sometimes leading to higher species diversity within *Sabellaria* reefs compared to the surrounding sediment or rock habitats (Dubois et al 2002). *Sabellaria alveolata* reefs cycle through different phases, from newly settled worms through vigorous fast growing reef to older, more biodiverse hummocks (Cunningham et al, 1984). At other sites each of these phases tends to have a different community of plants and animals associated with it, so all phases are considered important for biodiversity (Collins, 2001; Dubois et al, 2002).

In order to thrive, *Sabellaria alveolata* requires an abundance of suitable coarse sand to support tube building (and therefore reef growth), as well as the availability of suitable substrates (pebbles, cobbles, boulders, bedrock) to attach to. Larval supply is also important and *Sabellaria* larvae are thought to stay in the water column for one to six months (Jackson 2008). The worms are filter feeders and therefore food within the water column (suspended detritus material) is also needed. *Sabellaria* larvae are thought to settle preferentially in areas where *Sabellaria* reef has been present in the past (Holt et al, 1998).

3.5.4 Typical Species

The *Sabellaria alveolata* reef biotopes which have been recorded in the Severn Estuary are *Sabellaria alveolata on variable salinity sublittoral mixed sediment* and *Sabellaria alveolata reefs on sand-abraded eulittoral rock.*

In the Severn Estuary (both subtidal and intertidal) the presence of *Sabellaria alveolata* reefs generally increases species diversity, relative to the surrounding rock or sediment, although the diversity of *Sabellaria alveolata* reefs in the Severn is still thought to be comparatively low compared to other areas of the UK. Species commonly found associated with subtidal *Sabellaria alveolata* reef from infaunal samples include *Eulalia tripunctata, Mediomastus fragilis, Typosyllis armillaris, Melinna cristata, Harpinia pectinata, Ampharete grubei, Golfingia vulgaris, Pygospio elegans, Arenicola marina, Autolytus sp, Sphenia binghami* and *Harmothoe impar* (Mettam et al. 1994 and Marine Recorder database).
Species found in intertidal *Sabellaria alveolata* reefs in the Severn Estuary at Goldcliff and Lavernock point include *Crangon crangon, Actinia equina, Cancer pagarus, Porcellana platycheles, Littorina spp., Pholas dactylus, Elminius modestus, Fucus serratus, Corralina officinalis and Enteromorpha spp.*(O'Riordan, 2006).

3.5.5 Natural Processes

Little is known about the nature of the *Sabellaria alveolata* reef in the Severn Estuary, especially in the subtidal. However, at other sites *Sabellaria alveolata* is known to have a very variable recruitment and the cover in any one area may vary greatly over a number of years (Wilson, 1974). A typical life span of 4-5 years for worms in colonies forming reefs on bedrock and large boulders has been reported from other areas (Wilson, 1971), with a likely maximum of around 9 years (Gruet, 1982; Wilson, 1971). However, it is suspected that there are many colonies on intertidal cobble and small boulder scars on moderately exposed shores where shorter lifespans are likely due to the unstable nature of the substratum (Holt et al, 1998). As

mentioned above, *Sabellaria alveolata* reefs cycle through several different phases, all of which are considered important for biodiversity.

3.6 Other estuarine habitats : Hard substrate habitats (rocky shores) and eel grass beds

3.6.1 Extent and Distribution

There is approximately 1,500 ha of hard substrate habitat within the Severn Estuary, consisting of boulders, rock, mussel/cobble scars, rocky pools and shingle (Countryside Council for Wales, 2006; English Nature, 2006). The largest areas of hard substrate are located towards the outer estuary at Brean Down, Anchor Head and Sand Point together with rocky platforms and cliffs at Clevedon and Portishead. There are also extensive rock platforms at English stones, Aust and Beachley.

Beds of eelgrass (*Zostera* spp.), the largest in Wales, occur on some of the more sheltered mixed hard substrate areas around the Welsh side of the Second Severn Crossing.

3.6.2 Structure and Function

Hard substrate habitats in the Severn Estuary display different characteristics to other areas in Wales. Where there is bedrock, fucoid algae cover is dense but with little associated flora and fauna. Areas of soft clay rock around Penarth also support the boring bivalves *Barnea candida* and *Pholas datylus*. Pebble and cobble shores tend to be dominated by barnacles mostly *Elminius modestus*, and sparse rough periwinkles and winkles. In the sublittoral fringe on bedrock, cobbles and pebbles, hydroids, bryozoans, sponges and barnacles dominate. These species form communities that are usually associated with subtidal habitats (adapted from Brazier et al 2007).

These habitats provide a wide range of services for estuarine species. They are important components of the SAC Estuary feature, important supporting habitats for the wintering and passage bird features of the SPA and Ramsar Site and also important supporting habitats for the fish assemblage of the SAC and Ramsar designations.

Seagrass beds are one of the most productive habitats of shallow water coastal ecosystems supporting large numbers of algae, invertebrates and fish and are an important food source for several species of ducks and geese including wigeon and European white-fronted geese. The *Zostera* beds in the Severn are unusual in that they occur in an area of mixed cobbles, sand and mud with large boulders, in other parts of Wales they are associated with mudflats. Both species of *Zostera* occur within the bed. On more dry elevated areas of sediment *Zostera noltii* can be found, whereas wet depressions and channels are dominated by *Zostera marina*. *Zostera* coverage can be patchy but locally abundant. Hard substrata within the *Zostera* bed is dominated by fucoid algae, ephemeral green algae and barnacles.

3.6.3 Typical Species

Typical fauna and flora of rocky and mixed shore areas of the Severn include spiral wrack, bladder wrack, eggwrack and serrated wrack, periwinkles, limpets, barnacles and whelks. On lower shore rock, cobbles and pebbles barnacles dominate including the barnacle *Balanus crenatus* and hydroids *Tubularia indivisa* and *Sertularia cupressina* the bryozoan *Alcyonidium diaphanum* and mermaids glove sponge *Haliclona oculata* .

Both species of eelgrass, *Zostera marina*, and *Z. noltii* have been recorded in the estuary. These are of restricted distribution in British estuaries. It is unusual to have both species in one location.

3.6.4 Natural Processes

The extent and distribution of the rocky shore habitat is 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 rocky habitats throughout the estuary.

Seagrass beds typically occur in sheltered environments such as shallow inlets and are usually found on soft sediments. The Zostera beds in the Severn are unusual in that they occur in an area of mixed cobbles gravel sand and mud.

3.7 Fish

3.7.1 Introduction

The fish fauna of the Severn Estuary is very diverse (Potts & Swaby 1994, Bird 2008). More than 110 species of fish have been identified including a wide range of migratory species and estuarine specialists and some more typically marine and freshwater species reflecting the influence of the wider Bristol Channel and major rivers entering the estuary (Severn, Wye, Usk, Avon Parrett).

3.7.2 Fish features of the Severn Estuary European Marine Site

The Severn Estuary is of particular importance for migratory fish. The estuary is one of the most important British estuaries for three rare species - river lamprey *Lampetra fluviatilis,* sea lamprey *Petromyzon marinus* and twaite shad *Alosa fallax* which are designated features of the SAC. These species together with salmon *Salmo salar*, sea trout *Salmo trutta*, eel *Anguilla anguilla* and allis shad *Alosa alosa* are also a designated feature of the Ramsar Site.

The wider assemblage of fish species, which includes the migratory species, estuarine specialists and the more typically marine and freshwater species, is a designated feature of the Ramsar Site and a component of the estuary feature of the SAC.

3.7.3 Supporting habitats

The estuary habitats, tidal stretches of the feeding rivers and saltmarsh morphological features such as drainage channels, known locally as “pills” and “rhines” (“reens” in Wales) provide important feeding, breeding and sheltered nursery areas for a wide range of fish.

3.7.4 Migratory fish

The river and sea lamprey are a primitive type of fish having a distinctive suckered mouth but no jaws. Although numbers of lamprey have declined over the last 100 years, the UK is still one of their strongholds. Sea and river lampreys spend their adult life in the sea or estuaries but spawn and spend the juvenile phase in rivers. They use the Severn Estuary as a migratory passage to and from their spawning and nursery grounds in the rivers.

Allis and twaite shad are the only two members of the herring family found in fresh water in the UK. Both look like large herring and were formerly eaten in this country before numbers declined and the fisheries collapsed. In the middle of the 19th Century, the value of shad rivalled that of salmon, and in the River Severn, shad made up about one-third of all catches. Three of the four confirmed UK spawning populations of twaite shad are in the rivers Severn, Usk and Wye respectively. The major part of the spawning population of Twaite shad consists of fish that have spawned and passed up and down through the estuary more than once. The shad enter estuaries in spring and move up into the rivers to spawn. The estuary serves as a nursery area for juvenile shad where they feed on plankton.

The Severn Estuary supports an important run of migratory salmon and sea trout which pass through the estuary on their way to and from their spawning grounds in the upper reaches of the rivers and the open sea. The Severn Estuary has the largest eel run in Great Britain.

3.7.5 Assemblage of fish species

The assemblage of fish species includes the migratory species (referred to in section 3.8.4 above), as well as the following:

- Estuarine species
    - Species typically occurring and breeding in estuaries (Bird, 2008)
    - Marine species occurring in large numbers in estuaries (Bird, 2008)
- Marine species
    - Predominantly marine species occurring infrequently in the Severn (Bird, 2008)
- Freshwater species
    - Species typically occurring and breeding in freshwater and recorded within the Severn cSAC (Bird, 2008)

Estuarine species

These species of fish rely on the estuary for some aspect of their life-cycle. As a result of this dependence, these species are often the most vulnerable to anthropogenic and environmental factors that could affect the habitat and ecology of the estuary. Marine species occurring in large numbers in estuaries are all marine species who spend the first few years of life in the sheltered waters of the estuary where suitable food is abundant and there are fewer predators. The Severn Estuary ranks as one of the top ten estuaries in the UK for the number of marine estuarine-opportunistic species it supports (Potts & Swaby 1993). Marine estuarine-opportunists can be present in the estuary in very large numbers at particular times of year. These include sprat, herring, whiting, bib, poor cod, bass and common goby (Bird, 2008).

There are a few species that spend their entire life-cycle within the estuary. These include common goby, black goby, sand smolt and 3- spined stickleback (Bird, 2008).

Marine species

These fish normally spend their entire life-cycle in the sea and only occasionally enter estuaries. Therefore, they have only a minor role to play in the estuarine ecosystem. Thus, only four species, the conger eel, Norway pout, red mullet and plaice; are ever caught in numbers exceeding about 10 per year in power station samples. They probably have little impact, either as prey or as predators on other estuarine species. While they add to the biodiversity of the fish assemblage, their main populations occur in the sea. (Bird, 2008)

Freshwater species

These species typically occur and breed in freshwater, but have occasionally been recorded within the Severn Estuary. The specimens recovered at Oldbury and/or Berkeley power stations are presumably fish that have inadvertently been swept downstream and entered brackish water. They include perch, three-spined stickleback, tench, roach and chub. The numbers of freshwater species recovered at Oldbury is always low, and usually related to increases in fresh water discharge in the spring and autumn months after heavy rain. The only exception to this generalisation concerns the three-spined stickleback which occurs in considerable numbers at Oldbury and can be regarded as both a freshwater and an estuarine species (Bird, 2008)

3.8 Birds

3.8.1 Introduction

Many estuaries in the UK are of great importance to migratory and wintering wildfowl and waders. The Severn Estuary forms part of the complex chain of estuary sites along the western coast of the UK that provide habitats for migratory waterfowl. The relatively mild winter weather conditions found here compared to continental Europe at similar latitudes can be of additional importance to the survival of wintering waterfowl during periods of severe weather. It is especially important when there is severe weather affecting other sites further north and on the east coast of Britain.

The Severn Estuary ranks amongst the top ten British estuaries for the size of visiting waterfowl populations that it supports over winter (Musgrove *et. al*., 2001). Outside of this period, it is of particular importance as a staging area in autumn and spring for migratory waterfowl species as it lies on the East Atlantic Flyway route. Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species.

3.8.2 Bird features of the Severn Estuary European Marine Site

The migratory wintering and passage populations of birds in the Severn Estuary are designated features of the SPA (see section 2.2) and Ramsar Site (see section 2.3) which supports in excess of 70,000 birds in winter. These include internationally and nationally important populations of key bird species in winter for which the UK has particular importance in both Europe and the world. The bird assemblage is also part of the Estuaries feature of the SAC.

3.8.3 Low-tide distribution of waterbirds on the Severn Estuary SPA and Ramsar Site

Natural England and the CCW commissioned the British Trust for Ornithology (BTO) to organise , as part of the series of WeBS Low Tide Counts, a complete low tide survey of the Severn Estuary during the winter of 2002/03 (Burton et al., 2003). The mean numbers and distribution of total waterbird species recorded on each count section on the Severn Estuary in the winters 1987/88 to 1991/92 and in 2002/03 from this BTO low-tide count data for various individual species and the bird assemblage are illustrated in Appendix 9. The Figures generally indicate that the waterfowl are distributed extensively across virtually the entire intertidal area with some obviously high concentrations in specific areas.

These maps are indicative only and several constraints on their use should be noted when attempting to interpret them. Firstly, it should be noted that in each winter only a maximum of four counts were made of each count section, one a month from November to February. Observation of the central areas of the estuary is also very difficult with all observations being made from land and it is possible that the numbers of birds using these areas were underestimated. Gulls were only recorded in the 2002/03 survey. However, even in that survey, coverage of these species was patchy. The Severn is a highly dynamic estuary and thus the location and extent of many of the intertidal areas may have changed since the Ordnance Survey maps used for this project were created. The movements of sediments may potentially also cause marked differences in the distributions of invertebrates and thus waterbirds between years. It should also be noted that the numbers of birds recorded on the Severn Estuary may vary annually due to weather conditions. In cold winters, the west coast of Britain may act as a refuge for many waterbirds that in milder winters would occur on the east coast or on the Continent. In cold winters, therefore, waterbirds may be more widely distributed across the estuary than they would in milder winters. Lastly, in assessing the importance of different intertidal mudflats, it is also essential to note that some species may use different areas during the night to those where they are recorded in the day.

3.8.4 Relationship between bird populations and supporting habitats

In recognition of the fact that bird populations on a site may change in response to wider national or international trends or events, this Regulation 33 advice addresses the habitat conditions on the site necessary to support the bird populations, as well as the bird populations themselves. “Supporting habitats” are

identified which describe the key habitats within the European Marine Site necessary to support the interest features i.e. the qualifying bird species (see Table 3 for the SPA and Tables 5 and 7 for the Ramsar Site. The Favourable Condition Tables (section 4.2; Table 15 for the SPA and Section 4.3 Table 20 for the Ramsar Site) contain further details on habitat conditions.

The key supporting habitats are the intertidal mudflats and sandflats, saltmarshes and hard substrate habitats (rocky shores). Reference should also be made to sections of this document that relate to the Severn Estuary SAC interest features which provides advice in respect of these habitats (section 4.1 and Tables 8, 10 and 11).

Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species. Changes in the habitat may therefore affect them differently. The most important factors related to this are:

- current extent and distribution of suitable feeding and roosting habitat (eg saltmarsh, mudflats, shingle and rocky shores);
- sufficient prey availability (eg crustaceans, small fish, molluscs, worms and seeds);
- levels of disturbance maintained at or below levels necessary to provide favourable conditions for birds' feeding and roosting areas;
- water quality necessary to maintain intertidal plant and animal communities; and
- fresh water quantity, tidal flows, salinity gradients and grazing necessary to maintain saltmarsh conditions suitable for bird feeding and roosting.

There are also a number of habitats, such as the wet coastal grazing marsh, improved grassland and open standing waters that support the qualifying bird species and occur within the SPA and Ramsar Site boundary. However, these habitats lie above highest astronomical tide and therefore are not within the European Marine Site. Objectives to maintain these aspects of bird interest in favourable condition are found within Natural England and CCW's conservation objectives for the relevant SSSI within the SPA and Ramsar site boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994.

Some species will also use areas of land and coastal waters outside the boundaries of both the European Marine Site, SPA and Ramsar Site. Relevant authorities need to have regard to such adjacent interests, as they might be affected by activities taking place within, or adjacent to the European Marine Site.

3.8.5 Bird count data and assessing condition of bird features and their habitats

Natural England and CCW's conservation objectives at the site level focus on maintaining both the populations of the qualifying species and the habitats used by them. Site management should therefore aim to avoid both damage to the supporting habitats and disturbance to the birds. In reporting on the conservation status, account will need to be taken of both habitat conditions and the status of the bird populations.

Accordingly, Natural England and CCW will use annual counts, in the context of five year peak means for qualifying species, together with available information on population and distribution trends, to assess whether an SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Union.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions be taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may result in alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table accompanying the conservation objectives for the SPA and Ramsar Site (Tables 16 and 21). In this context, five-year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

Attention is also directed to the inclusion of disturbance in the advice on operations provided in Section 5. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

3.8.6 Description of the Severn Estuary bird features and their supporting habitats

3.8.6.1 Internationally important populations of waterfowl

This comprises:

A. Internationally important populations of regularly occurring Annex 1 species : Bewick's Swan
B. Internationally important populations of regularly occurring migratory species of the SPA
C. Internationally important populations of waterfowl of the Ramsar Site

A. Annex 1 species of the SPA

Description of the Feature

The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable. Annex 1 species that regularly occur at levels over 1% of the national population meet the SPA qualifying criteria. The Severn Estuary SPA supports internationally important populations of one Annex I species

- **Bewick's swan** *Cygnus columbianus bewickii*
  (Note : this species is also part of C. internationally important populations of waterfowl of the Ramsar Site)

Key supporting habitats for Bewick's swan

Intertidal mudflats and sandflats - The focal area for the Bewick's swans is the upper Severn Estuary in the vicinity of the New Grounds, Slimbridge area. The mudflats and sandflats exposed as the tide falls where the estuary widens in the upper reaches of the site at Waveridge Sands, Frampton Sands and The Noose are used as a safe refuge areas when the birds are disturbed.

Saltmarsh communities - The birds feed on the saltmarsh and the transition from saltmarsh to coastal grazing marsh in front of the sea defences in the upper estuary at The Dumbles, where areas of the high marsh are mainly affected only by brackish water during tidal inundation. They favour areas that have unrestricted views for the early detection of predators.

Bewick's swan graze on a range of 'soft' meadow grasses such as *Agrostis stolonifera* and *Alopecurus geniculatus* found in wet meadows which are outwith the European Marine Site boundary.

B. Internationally important populations of regularly occurring migratory species of the SPA and C. Internationally important populations of waterfowl of the Ramsar Site

Description of the features

Migratory species that regularly occur at levels of 1% or more of the total biogeographic population meet the SPA criteria and qualify for designation in their own right.

Wintering species that regularly occur at levels of 1% or more of the total biogeographic population meet the Ramsar criteria (3c) and qualify for designation in their own right.

The following qualifying species of both the SPA and Ramsar are:

- **European white-fronted goose** *Anser albifrons*
- **Dunlin** Calidris alpina alpina
- **Redshank** Tringa totanus totanus
- **Shelduck** Tadorna tadorna
- **Gadwall** Anas strepera

Note : previous Regulation 33 advice issued in respect of the Severn Estuary SPA in February 2005 excluded gadwall as they were considered not to make use of the European Marine Site to any significant degree but further recent evidence (2000/01 Low Tide Bird Counts) has demonstrated that this species does make use of the EMS and has consequently now been included.

Key supporting habitats

Intertidal mudflats and sandflats - The extensive mudflats and sandflats of the Severn Estuary provide undisturbed refuge and a rich resource of intertidal invertebrates as food for many species of migratory birds. The Severn supports massive populations of birds, many of which are highly mobile, feeding and roosting in different areas, depending on food availability and the state of the tide.

The European white-fronted geese roost at night on estuarine sandbanks and usually fly less than 10km to the daytime feeding grounds. Therefore conservation of traditional roosting sites is necessary to enable the population to exploit potential feeding habitats. The sandbanks adjacent to the New Grounds at Slimbridge are a long established, traditional wintering area for the European white-fronted geese (Owen *et al.,* 1986) where they use Waveridge Sand, Frampton Sand and the Noose. Only occasionally will small numbers occur at other localities within the Severn Estuary. Shelduck exploit the rich resources of invertebrates found in the intertidal mudflats where they forage for molluscs and other invertebrates such as the mudsnail *Hydrobia* spp, mussels *Mytilus edulis* and small crustaceans such as the common shore crab *Carcinus maenas.* They feed in groups, and are distributed widely throughout the estuary where there are extensive areas of intertidal flats, but there are major concentrations on Bridgwater Bay, around the mouth of the Rhymney river and, prior to construction of the Cardiff Barrage, in Cardiff Bay (Ferns, 1980a; Fox & Salmon, 1988a; Clarke, 1989; WWT Wetlands Advisory Service, April 2003). Bridgwater Bay is a long established traditional moulting area for shelduck during late summer and autumn (Eltringham & Boyd, 1960, 1963; Morley, 1966; Fox & Salmon, 1988a). It is the largest single moulting area in Europe away from Waddensea.

Redshank and dunlin are distributed widely and feed throughout the estuary on marine polychaete worms, crustaceans and molluscs such as the Baltic tellin *Macoma balthica*. They frequently feed along undisturbed strandlines throughout the estuary. They favour areas that have abundant invertebrate prey species and unrestricted views for the early detection of predators. The location of

feeding birds on the intertidal flats is a reflection of the invertebrate species found there which, in turn, are dependent on the sediment type. Dunlin and redshank mainly feed on invertebrates in the muddier finer sediments. Dunlin are found mostly on the mid shore whereas redshank are more thinly distributed and are often found in smaller groups in the creeks and sub-estuaries. The Severn has the third largest wintering population of Dunlin in Britain. Feeding flocks are widely distributed around the estuary particularly downstream of the first Severn Bridge, with particular concentrations at Rhymney/Peterstone, Uskmouth, Welsh Grounds, Undy, Clevedon and Bridgwater Bay (Ferns, 1977; Mudge, 1979; Ferns, 1980a; Clark, 1989). There are notable concentrations of redshank at the mouths of the Rhymney, Wye, Avon and Parrett rivers (Ferns, 1977, 1980a; Clark, 1989; WWT Wetlands Advisory Service, April 2003).

Gadwall are predominantly a frewshwater species preferring the wetland habitats tht occur within the SPA behind the flood defences and therefore outside the European Marine Site- most notably the freshwater wetlands at Slimbridge and Bridgwater bay. However, they do make use of the estuary but this is largely restricted to areas where freshwater flows come into the estuary, particularly larger pills and rivers- most notably at Avonmouth, between the two Severn Bridges and at Woodspring and Weston Bays.

Saltmarsh - Upper and lower saltmarsh provide important feeding and roosting areas for the internationally important migratory birds throughout the estuary. The saltmarshes provide a rich feeding habitat for redshank and shelduck, which feed on invertebrate species in the sediments, such as the mudsnail *Hydrobia.* The European white-fronted geese graze on a range of saltmarsh grasses and herbs such as common saltmarsh grass *Puccinellia maritima* and sea barley *Hordeum marinum*. The birds feed on the saltmarsh and the transition to coastal grazing marsh in front of the sea defences in the upper estuary and particularly at the The Dumbles.

The saltmarshes also have an important function providing a safe haven from the tides that flood the mudflats twice a day. The low-growing dense vegetation provides a suitable roosting habitat for redshank and dunlin, which prefer to roost on areas of short vegetation ensuring good visibility. The saltmarshes throughout the estuary provide an important communal roosting site for redshank, dunlin and shelduck. Upper saltmarsh in particular makes ideal highwater roost sites and there are main high tide roosts in some areas with little human disturbance where waders congregate from their feeding areas.

Hard substrate habitats (rocky shores) - the shingle and rocks in the estuary provide feeding areas for dunlin and redshank and some limited foraging at high tide. It is also provides important roost sites at high tide particularly for the dunlin and redshank. Many of the rocks are off shore and are therefore generally free from human disturbance. These include Guscar Rocks in the upper reaches, Blackstone Rocks at Clevedon and Stert Island in Bridgwater Bay.

Freshwater coastal grazing marsh, improved grassland and open standing waters – these supporting habitats lie outside the European Marine Site boundary but within the SPA. They provide key areas for feeding and roosting for all the migratory species particularly at high tide, and mainly on the English side of the Estuary.

3.8.6.2 Internationally important assemblage of waterfowl

Description of the feature

In addition to supporting internationally important populations of individual birds, the Severn Estuary also qualifies under Article 4.2 as a wetland of international importance by regularly supporting over 20,000 waterfowl (Cranswick *et al.*, 1999, JNCC website). A peak count of over 100,000 waterfowl was recorded in the winter season of 1992-93 (Waters *et al*., 1993). The wintering waterfowl assemblage (consisting of over 68,000 birds) includes all regularly occurring waterfowl.

Species that qualify as a listed component of the assemblage include all the birds covered by section 3.8.6.1 and species present in nationally important numbers.

These species are:

- **Dunlin** (migratory passage populations)
- **Redshank** (migratory passage populations)
- **Wigeon**
- **Teal**
- **Pintail**
- **Pochard**
- **Tufted duck**
- **Ringed plover**
- **Grey plover**
- **Curlew**
- **Whimbrel**
- **Spotted redshank**

The JNCC website also lists lapwing, *m*allard and shoveler as qualifying for future inclusion as part of this assemblage (Stroud, DA, et al., 2001. *The UK SPA network: its scope and content.* JNCC, Peterborough)

Key supporting habitats for the waterfowl assemblage

Since a number of species comprising the waterfowl assemblage are qualifying species in their own right, their habitat requirements are described in sections 3.4 and 3.5 above. This section therefore mainly deals with the habitat requirements of the other assemblage species which form part of the waterfowl assemblage.

Intertidal mudflats and sandflats - Many of the bird species found within the Severn Estuary are highly mobile, feeding and roosting in different areas, depending on food availability, weather and tides. They favour areas that have abundant prey species and unrestricted views for the early detection of predators. Some species of wader such as ringed plover and turnstone will feed on the rich invertebrate fauna associated with rotting seaweed occurring along undisturbed strandlines.

Pintail and Teal are widely distributed around the estuary with a notable concentration at the New Grounds. Pintail are also found at Peterstone/Rhymney. Pochard and tufted duck have a highly clumped daytime distribution mainly at New Grounds with most others at Peterstone and the mouth of the Rhymney. Large numbers of pochard move onto the estuary in periods of sustained cold weather. There is a large number of wintering ringed plover on the estuary and these numbers swell during the spring and autumn when there is a considerable passage of migrants through the Severn Estuary. There are major concentrations of curlew on the flats above the first Severn Bridge as well as Bridgwater Bay and the Welsh Grounds. The Severn Estuary is a particularly important staging post for whimbrel during autumn and spring passage periods where some birds feed on the mudflats. Spotted redshank are occasionally found on the Axe and Yeo estuaries.

Saltmarsh - Upper and lower saltmarsh provide important feeding and roosting areas for the internationally important assemblage of waterfowl throughout the estuary. The European white-fronted geese graze on a range of saltmarsh grasses and herbs. The birds feed on the saltmarsh and the transition to coastal grazing marsh in front of the sea defences in the upper estuary.

There are areas of well grazed saltmarsh with saltpans at the River Axe and in the upper reaches of the estuary, which are used by wigeon and other wildfowl. Pools in the higher marsh at Bridgwater Bay and in the saltmarsh above the Severn bridges are also attractive to waders and wildfowl, providing invertebrates and shelter. In the winter, ducks such as teal and pintail feed on seeds of saltmarsh plants such as *Salicornia* sp. and *Atriplex* sp. Probing waders such as curlew also feed on the saltmarsh.

The saltmarsh provides a safe haven for the feeding waders and wildfowl from the tides that flood the mudflats twice a day. Upper saltmarsh in particular makes ideal high water roost sites and there are main high tide roosts in some areas with little human disturbance where waders congregate from their feeding areas. Waders in particular, require very short vegetation to afford unrestricted views for the early detection of predators.

Hard substrate habitats (rocky shores) - The shingle and rocks in the estuary provide feeding areas for many wildfowl and waders and important roost sites at high tide. Many of the rocks are off shore and are therefore generally free from human disturbance. These include Guscar Rocks in the upper reaches, Blackstone Rocks at Clevedon and Stert Island in Bridgwater Bay. Whimbrel have major night roosts at Collister Pill and Stert Island and the Stert Island roost is the largest of its kind in Britain. Spotted redshank are also found around Stert Island. Some areas of hard substrate support eelgrass beds which provide a food source for grazing wildfowl species particularly European white-fronted goose and wigeon.

Freshwater coastal grazing marsh, improved grassland and open standing waters – these supporting habitats lie outside the European Marine Site boundary but within the SPA. They provide key areas for breeding, feeding and roosting for all the assemblage species particularly at high tide.

4. Conservation Objectives and Favourable Condition Tables For the European Marine Site

4.1 Conservation objectives for the Severn Estuary / Môr Hafren SAC

The protection and management of the SAC in accordance with Article 6 of the Habitats Directive, including in particular the consideration of plans and projects under Article 6(3) and 6(4), should be carried out in view of the conservation objectives in this section.

4.1.1 SAC interest feature 1: Estuaries

The conservation objective for the "estuaries" feature of the Severn Estuary SAC is to maintain the feature in favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met

i. the total extent of the estuary[2] is maintained;

ii. the characteristic physical form (tidal prism/cross sectional area) and flow (tidal regime) of the estuary is maintained;

iii. the characteristic range and relative proportions of sediment sizes and sediment budget[3] within the site is maintained;

iv. the extent, variety and spatial distribution[4] of estuarine habitat communities[5] within the site is maintained[6];

v. the extent, variety, spatial distribution[4] and community composition of hard substrate habitats and their notable communities[5(v)] is maintained;

vi. the abundance of the notable estuarine species assemblages[7] is maintained or increased;

vii. the physico-chemical characteristics[8] of the water column[9] support the ecological objectives described above;

viii. Toxic contaminants in water column[9] and sediment are below levels which would pose a risk to the ecological objectives described above.

ix. Airborne nutrient and contaminant loads are below levels which would pose a risk to the ecological objectives described above

The meaning of terms [1-9] above is explained in **section 4.1.1.1**

Appendix 2 shows the extent of the "estuaries" feature within the Severn Estuary SAC European Marine Site.

4.1.1.1 Explanatory information for the "estuaries" conservation objective

[1] Natural processes in respect of the SAC

Each feature may be subject to both natural processes and human influence. Human influence on the interest features is acceptable provided that it is proved to be / can be established to be compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions, which is entirely a result of natural process will not constitute unfavourable condition, but may trigger a review of the definition of favourable condition.

Dynamic physical process within estuaries can stem from variable weather conditions including one off storm events, and result in changes in wave exposure, riverine floods or tidal surges. These events can move large quantities of sediments and alter channel morphology, which affect current patterns and sediment transport within the estuary.

Where these processes occur without significant anthropogenic influence they fall under the umbrella of 'natural change'. Because estuaries are dynamic systems we can expect the amount and gross distribution of habitats to change in the future. In general estuarine communities and their supporting habitats are intrinsically more dynamic over short timescales when compared to other marine and terrestrial habitats. Some estuarine communities occur in cycles dependent upon the prevailing physical conditions. Features should not necessarily be considered in unfavourable condition caused by to the short term disappearance of a particular community due to natural processes.

An important example of natural processes occurring over a longer timescale is that estuaries have a natural tendency to accumulate sediment, thereby changing their form from their original glacial morphology to a state where tidal energy is dissipated by sediment banks and other features such as saltmarsh. This, with other forces of natural change, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. Future developments should aim to avoid impact on the future evolution of the system as where this process is constrained by human influence, the capacity of habitats to accommodate readjustment may be affected.

[2] Extent of the estuary

The landward limit of the estuary feature is the limit of highest astronomical tide or the site boundary where it is below highest astronomical tide, except where the landward limit is defined as straight lines across the mouths of rivers entering the estuary. The seaward limit is as shown in the map in Appendix 2. Where other Habitats Directive Annex I habitat types occur within the estuary, they also form part of the estuary feature. In addition, there are areas of the estuary which do not form part of other Annex I habitat types.

[3] Sediment budget

The sediment budget refers to the total amount of sediment within the Severn Estuary taking into account the balance of sediment inputs and outputs.

[4] Spatial distribution

Spatial distribution of estuarine communities refers to the macro spatial pattern in which communities are distributed around the estuary. This statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[5] Estuarine habitat communities

> ***Note:*** *sections i – iv below list the habitat types which are also features of the Severn Estuary SAC in their own right as well as being 'sub-features' of the estuary feature. The detailed definitions of favourable conservation status for these features are provided under their respective conservation objectives.*

i. Subtidal sandbanks *(see section 4.1.2 for the conservation objective for this feature)*
   - Sublittoral Sands and Muddy Sands
   - Sublittoral cohesive mud and sandy mud communities

ii. Intertidal mudflats and sandflats (*see section 4.1.3 for the conservation objective for this feature)*
   - Intertidal gravel and clean sands
   - Intertidal muddy sands
   - Intertidal muds

iii. Atlantic saltmeadows (*see section 4.1.4 for the conservation objective for this feature)*
- Low – mid marsh communities
- Mid – upper marsh communities
- Transitional high marsh communities
- Pioneer marsh communities

iv. Reefs of *Sabellaria alveolata (see section 4.1.5 for the conservation objective for this feature)*
- *Sabellaria alveolata* on variable salinity sublittoral mixed sediment (subtidal)
- *Sabellaria alveolata* reefs on sand-abraded eulittoral rock (contiguous subtidal and intertidal)

v. Hard substrate habitat notable communities
- *Sabellaria alveolata reefs on sand-abraded eulittoral rock* (MLR.Sab.Salv)
- *Hydroids, ephemeral seaweeds and Littorina littorea in shallow eulittoral mixed substrata pools.* **(**LR.RkpH)
- *Balanus crenatus and Tubularia indivisa on extremely tide-swept circalittoral rock.* (ECR.BS.BalTub)
- *Fucus serratus* and piddocks on lower eulittoral soft rock (MLR.Fser.Pid)
- *Mytilus edulis* and piddocks on eulittoral firm clay (MLR.MytPid)
- *Balanus crenatus*, *Halichondria panacea* and *Alcyonidium diaphanum* on extremely tide-swept sheltered circalittoral rock (ECR.BalHpan)
- *Sertularia cupressina* and *Hydrallmania falcate* on tide-swept sublittoral cobbles or pebbles in coarse sand (IGS.ScupHyd).
- *Corrallina officinalis* and coralline crusts in shallow eulittoral rockpools (LR.Rkp.Cor)
- Eel grass (*Zostera*) beds
- Peat and clay exposures
- Any other notable hard substrata communities that may be identified.

[6] Maintained

Since the late 1990s Natural England's condition assessment has identified that parts of the saltmarsh within the Severn Estuary appear to be exhibiting the effects of coastal squeeze. For this reason NE and CCW do not consider it sufficient simply to seek to maintain the existing saltmarsh resource, rather it is our advice that measures will be required which seek to recreate the approximate extent of saltmarsh habitat present within the estuary in 1995 (the year the Severn Estuary was first identified as a proposed SAC); whilst at all times working within the framework of seeking a sustainable estuary form. N.B. This is based upon a site specific consideration of the state of habitats within the Severn Estuary, and should not be extended to other sites on the basis of this advice.

[7] Notable estuarine species assemblages

i. Assemblage of fish species:
- Migratory species
    - River and Sea Lamprey and Twaite shad (Annex 1 species) and Allis shad
    - Sea trout, salmon, eel,
- Estuarine species
    - Species typically occurring and breeding in estuaries (Bird, 2008)
    - Marine species occurring in large numbers in estuaries (Bird, 2008)
- Marine species
    - Predominantly marine species occurring infrequently in the Severn (Bird, 2008)
- Freshwater species
    - Species typically occurring and breeding in freshwater and recorded within the Severn cSAC (Bird, 2008)

ii Assemblage of waterfowl species (refer also sections 4.2 and 4.3 on the SPA and Ramsar Site):
- Regularly occurring Annex 1 species - Bewicks' swan
- Regularly occurring migratory species - European white-fronted goose, dunlin, redshank, shelduck, gadwall
- Nationally important bird populations - wigeon, teal, pintail, pochard, tufted duck, ringed plover, grey plover, curlew, whimbrel and spotted redshank

iii. Assemblage of vascular plant species:
- Salt marsh species (refer to notes 5 and 6 in section 4.1.4.1 - explanatory information on the conservation objective for the Atlantic salt meadows feature)
- Eel grass *(Zostera)* species.

[8] Physico-chemical characteristics

These include nutrients, oxygen, turbidity, pH, temperature and salinity.

[9] Water column

Water column should be read to include contributory water flows into the estuary including surface flows over mudflats and saltmarsh.

4.1.2 SAC interest feature 2: Subtidal sandbanks which are covered by sea water all the time (subtidal sandbanks)

The conservation objective for the "subtidal sandbanks" feature of the Severn Estuary SAC is to maintain the feature in favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of the subtidal sandbanks[2] within the site is maintained;

ii. the extent and distribution[3] of the individual subtidal sandbank communities[4] within the site is maintained;

iii. the community composition[5] of the subtidal sandbank feature within the site is maintained;

iv. the variety and distribution[3] of sediment types across the subtidal sandbank feature is maintained;

v. the gross morphology (depth, distribution and profile) of the subtidal sandbank feature within the site is maintained.

The meaning of terms [1-5] above is explained in **section 4.1.2.1**

Appendix 3 shows the extent of the "subtidal sandbanks" feature within the Severn Estuary SAC European Marine Site.

4.1.2.1 Explanatory information for the "subtidal sandbanks" conservation objective

[1] Natural processes in respect of the SAC

The meaning of 'natural processes' is explained in **section 4.1.1.1**

[2] Extent of subtidal sandbanks

The subtidal sandbanks in the Severn Estuary change their shape over time and many are ephemeral in nature, although some are relatively stable and long established. The extent of the Annex 1 habitat is considered to include both the actual sandbanks and their associated sediments. Areas of associated sediments have been defined by using the sediment environments of the Bristol Channel Marine Aggregates Resources and Constraints project, commissioned by the National Assembly for Wales (Posford Duvivier and ABP, 2000) Associated sediments have been defined as any area of of subtidal sand-sized sediment within the same sediment environment as a subtidal sandbank. Mobile sediments that form temporary sandbanks are considered to be associated sediments that should be retained in the system, but their location may change. Areas of holocence valley infill (relict sediment) are not mobile under present day estuarine conditions. Therefore, where Holocence infill is exposed, it is not considered to form part of the associated sediments. However, any mobile sand deposited over the infill does contribute to the associated sediments.

[3] Distribution

Distribution of sandbank communities and sediments refers to the macro spatial pattern in which these are distributed around the estuary. This statement does not require micro-distribution of communities or sediments e.g. the exact mapped positions of specific communities or sediments to be maintained.

The sand banks of the Middle and Welsh Grounds are relatively permanent sandbank features in the Severn Estuary, along with other long established sandbank features at Cardiff Grounds and in Bridgwater Bay. The tops of these banks are intertidal, and the permanently submerged parts of the banks are considered to contribute to the subtidal sandbanks habitat.

There are other areas of subtidal sandbank habitat within the Estuary, again sometimes the top of the bank may be exposed at low tide, with the submerged sections contributing to the subtidal sandbanks habitat. These banks are more ephemeral in nature, but are still considered part of the feature, and reflect the dynamic nature of the Severn Estuary. The areas where ephemeral subtidal sandbanks are known to occur include areas offshore from Avonmouth and at English Grounds (near Clevedon).

The macro-scale distribution of the subtidal sandbanks should be maintained, and there should be continued presence of ephemeral subtidal sandbanks in the Estuary.

[4] Subtidal sandbank communities

There are two groups of communities comprising the 'sub-features' of the subtidal sandbanks feature:

- Sublittoral Sands and Muddy Sands:

i. Infralittoral mobile sand in variable salinity (estuaries)
ii. Infralittoral mobile clean sand with sparse fauna
iii. *Nephtys cirrosa* and *Macoma balthica* in variable salinity infralittoral mobile sand
iv. *Neomysis integer* and *Gammarus* spp. in fluctuating low salinity infralittoral mobile sand

- Sublittoral cohesive mud and sandy mud communities:

i. *Capitella capitata* in enriched sublittoral muddy sediments
ii. *Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud
iii. *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment*
iv. *Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud*

(* these records have a lower degree of confidence than the other communities listed, i.e. the biotope assessor was uncertain regarding precisely which biotope should be recorded).

[5] Community composition

Species typical of the subtidal sandbank communities:

Aricidea minuta
Capitella capitata
Diastylis rathkei typica
Eurydice pulchra
Gammarus salinus
Harpinia pectinata
Mediomastus fragilis
Nephtys cirrosa
Nephtys hombergii
Oligochaeta
Pygospio elegans
Pontocrates arenarius
Pseudocuma longicornis
Retusa obtusa
Tubificoides amplivasatus

4.1.3 SAC interest feature 3 : Mudflats and sandflats not covered by seawater at low tide (mudflats and sandflats)

The conservation objective for "mudflats and sandflats" feature of the Severn Estuary SAC is to maintain the feature in favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. The total extent of the mudflats and sandflats feature[2] is maintained;

ii. the variety and extent of individual mudflats and sandflats communities[3] within the site is maintained;

iii. the distribution[4] of individual mudflats and sandflats communities[3] within the site is maintained;

iv. the community composition[5] of the mudflats and sandflats feature within the site is maintained;

v. the topography of the intertidal flats and the morphology (dynamic processes of sediment movement and channel migration across the flats) are maintained.

The meaning of terms [1-5] above is explained in **section 4.1.3.1.**

Appendix 4 shows the extent of the "mudflats and sandflats" feature within the Severn Estuary SAC European Marine Site.

4.1.3.1 Explanatory information for the "mudflats and sandflats" conservation objective

[1] Natural processes in respect of the SAC

The meaning of 'natural processes' is explained in **section 4.1.1.1.**

[2]Extent of the intertidal mudflats and sandflats

The extent of the feature is defined using intertidal Phase 1 survey information, which gives the seaward limit of the feature as the low water mark of spring tides (MLWS) because that is in practice the lower limit to which Phase 1 survey is possible. The feature does not include other intertidal habitats which are not mudflats and sandflats, such as intertidal reefs and rocky shores. This is the basis on which the feature is shown in the map in Figure 4, the total extent being 20,271 ha. However in addition there will be some areas of intertidal mudflat and sandflat seaward of MLWS and down to Lowest Astronomical Tide, which is the absolute seaward limit of this habitat type.

[3] Mudflat and sandflat communities

There are three groups of communities comprising the "sub-features" of the "Mudflats and sandflats not covered by seawater at low tide" feature:

• Intertidal gravel and clean sand communities

i. Barren coarse sand shores; **LGS.S.BarSnd**
ii. Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores; **LGS.S.AEur**
iii. Burrowing amphipods and polychaetes in clean sand shores. **LGS.S.AP**
iv. Talitrid amphipods in decomposing seaweed on the strandline **LGS.S.Tal**
v. Dense *Lanice conchilega* in tide-swept lower shore sand **LGS.S.Lan**
vi. Barren shingle or gravel shores **LGS.Sh.BarSh**

• Intertidal muddy sand communities :

i. Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores **LMS.MS.PCer**
ii. *Bathyporeia pilosa* and *Corophium spp.* in upper shore slightly muddy fine sand shores **LMS.MS.BatCor**
iii. *Macoma balthica* and *Arenicola marina* in muddy sand shores. **LMS.MS.MacAre**

• Intertidal mud communities:

i. *Hediste diversicolor* and *Macoma balthica* in sandy mud shores: **LMU.SMu.HedMac**
ii. *Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores **LMU.SMu.HedMacAre**
iii. *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores **LMU.Mu.HedScr**
iv. *Hediste diversicolor* and oligochaetes in low salinity mud shores **LMU.Mu.HedOl**
v. *Hediste diversicolor* and *Streblospio shrubsolii* in sandy mud or soft mud shores **LMU.Mu Hed Str**

Appendix 4a shows the extent of the "mudflats and sandflats" subfeatures within the Severn Estuary SAC European Marine Site.

[4] Distribution

The distribution of mudflats and sandflats communities refers to the macro spatial pattern in which these communities are distributed around the estuary. This statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[5] Community composition

Species typical of the mudflat and sandflat communities:

Aphelochaeta marioni
Arenicola marina
Bathyporeia pelagica
Corophium volutator
Enchytraeidae
Eurydice pulchra
Hediste diversicolor
Hydrobia ulvae
Macoma balthica
Nephtys cirrosa
Nephtys hombergii
Oligochaeta indet.
Pygospio elegans
Scoloplos armiger
Scrobicularia plana
Streblospio shrubsolii
Tubificoides benedii

4.1.4 SAC interest feature 4: Atlantic salt meadow

The conservation objective for the "Atlantic salt meadow" feature of the Severn Estuary SAC is to maintain the feature in favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of Atlantic salt meadow and associated transitional vegetation communities[2] within the site is maintained[3];

ii. the extent and distribution[4] of the individual Atlantic salt meadow and associated transitional vegetation communities[2] within the site is maintained;

iii. the zonation of Atlantic salt meadow vegetation communities and their associated transitions[2] to other estuary habitats is maintained;

iv. the relative abundance of the typical species[5] of the Atlantic salt meadow and associated transitional vegetation communities[2] is maintained;

v. the abundance of the notable species[6]of the Atlantic salt meadow and associated transitional vegetation communities[2] is maintained.

vi. the structural variation of the salt marsh sward (resulting from grazing) is maintained within limits sufficient to satisfy the requirements of conditions iv and v above and the requirements of the Ramsar and SPA features[7]

vii. the characteristic stepped morphology of the salt marshes and associated creeks, pills, drainage ditches and pans, and the estuarine processes that enable their development, is maintained.

viii Any areas of *Spartina anglica* salt marsh (SM6) are capable of developing naturally into other saltmarsh communities.[8]

The meaning of terms [1-8] above is explained in **section 4.1.4.1.**

Appendix 5 shows the extent of Atlantic salt meadow and its associated transitional vegetation communities within the Severn Estuary SAC European Marine Site.

4.1.4.1 Explanatory information for the "Atlantic salt meadow" conservation objective

[1] Natural processes in respect of the SAC

The meaning of 'natural processes' is explained in **section 4.1.1.1**.

[2] Atlantic salt meadow and associated transitional vegetation communities

The vegetation communities comprising the Atlantic Salt Meadow feature can be grouped into four 'sub-features', namely:

(a) low to mid marsh communities
(b) mid to upper marsh communities
(c) transitional high marsh communities
(d) pioneer saltmarsh communities

The communities in each of these sub-features are listed below.

Sub-features (a) and (b) contain the National Vegetation Classification (NVC) communities which fall within the definition of Atlantic Salt Meadow in the EU Interpretation Manual. The extent of these two sub-features within the SAC is currently estimated at 656 ha. The communities in (c) and (d) do not fall within the Atlantic Salt Meadow definition, but are considered to be important components of this feature as they represent its landward and seaward transitions to other habitat types, namely non-saline vegetation and pioneer salt marsh respectively. Atlantic salt meadow is a naturally dynamic habitat and these transitional communities are considered to be an integral part of the Atlantic Salt Meadow feature and essential elements of its structure and function. The total extent of all four of the above sub-features in the SAC is estimated to be 1400 ha, distributed in the SAC as shown in Appendix 5a.

(a) Low to mid marsh communities:

i. Transitional low saltmarsh with *Puccinellia maritima*, annual *Salicornia* sp. and *Suaeda maritima* SM10
ii. *Aster tripolium* (rayed) saltmarsh SM12
iii. *Puccinellia maritima* saltmarsh SM13
    - *Puccinellia maritima* sub-community SM13a
    - *Glaux maritima* sub-community SM13b
    - *Limonium vulgare - Armeria maritima* sub-community SM13c
    - *Plantago maritima - Armeria maritima* sub-community SM13d
    - *Plantago maritima–Triglochin maritima* sub-community SM13x (provisional)
    - *Spartina anglica* sub-community SM13y (provisional)
iv. *Atriplex portulacoides* saltmarsh SM14
    - *Atriplex portulacoides* sub-community SM14a
v. *Juncus maritimus - Triglochin maritima* saltmarsh SM15

(b) Mid to upper marsh communities:

i. *Festuca rubra* salt-marsh SM16
    - *Puccinellia maritima* sub-community SM16a
    - *Juncus gerardii* sub-community SM16b
    - *Glaux maritima* sub-community SM16c
    - *Festuca rubra* sub-community SM16d
    - *Leontondon autumnalis* sub-community SM16e
    - *Aster tripolium* sub-community SM16x (provisional)
ii. *Artemisia maritima* saltmarsh SM17
iii. *Juncus maritimus* salt-marsh SM18
    - *Festuca arundinacea* sub-community SM18c

(c) Transitional high marsh communities:

i. *Spergularia marina - Puccinellia distans* saltmarsh SM23
ii. *Elytrigia atherica* saltmarsh SM24
iii. *Elytrigia repens* saltmarsh SM28
iv. *Festuca rubra - Agrostis stolonifera - Potentilla anserina* inundation grassland MG11
v. *Festuca arundinacea* coarse grassland MG12
vi. *Agrostis stolonifera - Alopecurus geniculatus* inundation grassland MG13
vii. *Phragmites australis* reedbed S4
    - *Phragmites australis* sub-community S4a

xiii. *Bolboshoenus maritimus* swamp S21
    - *B. maritimus* sub-community S21a

Agrostis stolonifera sub-community S21c

(d) Pioneer saltmarsh communities:

i. *Spartina anglica* saltmarsh SM6
ii Annual *Salicornia* saltmarsh SM8
iii. *Suaeda maritima* saltmarsh SM9

[3] Maintained

Since the late 1990s Natural England's condition assessment has identified that parts of the saltmarsh within the Severn Estuary appear to be exhibiting the effects of coastal squeeze. For this reason NE and CCW do not consider it sufficient simply to seek to maintain the existing saltmarsh resource, rather it is our advice that measures will be required which seek to recreate the approximate extent of saltmarsh habitat present within the estuary in 1995 (the year the Severn Estuary was first identified as a proposed SAC); whilst at all times working within the framework of seeking a sustainable estuary form. N.B. This is based upon a site specific consideration of the state of habitats within the Severn Estuary, and should not be extended to other sites on the basis of this advice.

[4]Distribution

The distribution Atlantic salt meadow communities refers to the macro spatial pattern in which these are distributed around the estuary. This statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[5] Typical species of the Atlantic salt meadow

Festuca arundinacea
Festuca rubra
Juncus gerardii
Triglochin maritimum
Carex extensa
Agrostis stolonifera
Juncus maritimus
Oenanthe lachenalii
Puccinellia maritima,
Salicornia spp.
Suaeda maritima
Aster tripolium
Glaux maritima
Plantago maritima
Armeria maritima
Elytrigia atherica
Atriplex prostrata
Phragmites australis
Spartina anglica
Spergularia media
Puccinellia distans
Cochlearia anglica
Cochlearia officinalis
Limonium vulgare
Atriplex portulacoides
Seriphidium maritimum
Plantago coronopus
Beta vulgaris maritima

[6] Notable Atlantic salt meadow vegetation species

Alopecurus bulbosus
Althaea officinalis
Bupleurum tenuissimum
Hordeum marinum
Puccinellia rupestris
Trifolium squamosum
Lepidium latifolium

Allium oleraceum
Petroselinum segetum

[7] Severn Estuary SPA and Severn Estuary Ramsar Site Conservation Objectives
Refer to sections 4.2 and 4.3 of this document

[8] *Spartina anglica* SM6
Spartina in the Severn is considered to be an invasive species and these conservation objectives do not seek the maintenance of the extent or condition of this habitat type. However, SM6 is considered to be a transitional salt marsh community and the conservation objectives seek to protect the ability of areas of *Spartina* to develop into other Atlantic Salt Meadow or transitional communities.

4.1.5 SAC interest feature 5 : Reefs

The conservation objective for the "reefs" feature of the Severn Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent and distribution[2] of *Sabellaria* reef [3] is maintained;

ii. the community composition[4] of the *Sabellaria* reef is maintained;

iii. the full range of different age structures of *Sabellaria* reef are present;

iv. the physical[5]and ecological processes[6] necessary to support *Sabellaria* reef are maintained.

The meaning of terms [1 – 6] above is explained in **section 4.1.5.1** below.

Appendix 6 shows the extent of the "reef" feature within the Severn Estuary SAC European Marine Site.

4.1.5.1 Explanatory information for the "reefs" conservation objective

[1] Natural processes in respect of the SAC

The meaning of 'natural processes' is explained in section **4.1.1.1**

[2] Distribution

The distribution of reefs refers to the macro spatial pattern in which the reefs are distributed around the estuary. This statement does not require micro-distribution of the reefs e.g. the exact mapped positions of specific reefs to be maintained.

[3] *Sabellaria* reef

Little is known about the nature of the *Sabellaria alveolata* reef in the Severn Estuary, especially in the subtidal. However, at other sites *S. alveolata* is known to have a very variable recruitment and the cover in any one area may vary greatly over a number of years. *S. alveolata* reefs also cycle through different phases, from newly settled worms through vigorous fast growing reef to older hummocks. It is likely that subtidal *S. alveolata* reef in the Severn Estuary will exhibit reduced growth forms (lower elevation) in comparison to the intertidal reef habitat. The easiest of these phases to identify is the fast growing reef and for the purposes of these conservation objectives this is defined as a dense aggregation of worms (over 1000 per m^2, as a rough guide), generally forming a thick (2 cm or more) crust of tubes. The area covered by the habitat would generally exceed 25 m^2 although there could be patchiness within this area. The other phases of growth are also important and are encompassed in point iii of the objective.

The *S. alveolata* reef biotopes recorded in the Severn Estuary are SS.SBR.PoR.SalvMx *Sabellaria alveolata on variable salinity sublittoral mixed sediment* and LS.LBR.Sab.Salv *Sabellaria alveolata reefs on sand-abraded eulittoral rock.*

[4] Community composition

Species associated with dense aggregations of *Sabellaria alveolata* in the Severn estuary:

Subtidal

Sabellaria alveolata
Eulalia tripunctata

Mediomastus fragilis
Typosyllis armillaris
Ampharete grubei
Harpinia pectinata
Melinna cristata
Pygospio elegans
Scoloplos armiger
Nemertea
Nucula nitidosa
Nucula nucleus
Tubificoides amplivasatus
Golfingia vulgaris vulgaris
Gammarus salinus
Tubificoides
Arenicola marina
Sphenia binghami
Eumida sanguinea
Nephtys hombergii
Autolytus prolifera
Harmothoe impar
Nematoda
Polycirrus
Dodecaceria concharum
Harmothoe
Syllidae
Enchytraeidae

Intertidal

Sabellaria alveolata,
Actinia equina
Cancer pagurus
Elminius modestus
Littorina saxatilis
L.littorea
L.obtusata
Pholas dactylus
Pomatocerus lamarcki
Porcellana platycheles
Semibalanus balanoides
Halichondrea sp
Corallina officinalis
Enteromorpha sp.
Fucus serratus
Fucus vesiculosus
Pelvetia canaliculata
Porphyra sp
Ulva sp

[5]Physical processes

- abundance of suitable coarse sediments to support reef growth (tube building)
- the availability of suitable substrates where *Sabellaria* has been known to occur in the past

[6]Ecological Processes

- supply of *Sabellaria* larvae (within the water column)
- abundance of food (suspended detritus material) within the water column to support feeding

4.1.6 SAC interest feature 6 : River lamprey *Lampetra fluviatilis*

The conservation objective for the river lamprey *Lampetra fluviatilis* feature of the Severn Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile river lamprey through the Severn Estuary between the Bristol Channel and any of their spawning rivers is not obstructed or impeded by physical barriers, changes in flows, or poor water quality;

ii the size of the river lamprey population in the Severn Estuary and the rivers which drain into it, is at least maintained and is at a level that is sustainable in the long term;

iii. the abundance of prey species[2] forming the river lamprey's food resource within the estuary, is maintained.

iv. Toxic contaminants in the water column[3] and sediment are below levels which would pose a risk to the ecological objectives described above.

The meaning of terms [1-3] above is explained in **section 4.1.6.1**.

Note : The river lamprey population of the Severn depends on habitat in the adjacent River Usk SAC, River Wye SAC and River Severn. The habitats in these rivers, including spawning and nursery areas, are essential for the fulfilment of the species' lifecycle and therefore the Severn Estuary river lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Usk SAC and River Wye SAC river lamprey feature are also met in full and there is a continued recorded presence of this species in the River Severn.

4.1.6.1 Explanatory information for the river lamprey *Lampetra fluviatilis* conservation objective

[1] Natural processes in respect of the SAC fish features

River lamprey population:

The size of the population is subject to non anthropogenic factors relating to natural fluctuations of external factors such as food / host availability in the Bristol Channel and more widely and breeding success in the River Severn and other rivers draining into the Severn Estuary.

Supporting habitats
The general meaning of 'natural processes' with respect to the supporting habitats of river lamprey within the estuary is explained in **section 4.1.1.1**

[2] Prey species

Sea trout *Salmo trutta*, shad *Alosa fallax/Alosa alosa*, herring *Clupea harengu*s, sprat *Sprattus sprattu*s, flounder *Platichthys flesu*s and small gadoids such as whiting *Merlangius merlangu*s and pout *Trisopterus luscu*s are all potential prey species for the river lamprey found within the Severn Estuary (Bird 2008).

[3]Water column

Water column should be read to include contributory water flows into the estuary including surface flows over mudflats and saltmarsh.

4.1.7 SAC interest feature 7: The conservation objective for sea lamprey *Petromyzon marinus*

The conservation objective for the sea lamprey *Petromyzon marinus* feature of the Severn Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile sea lamprey through the Severn Estuary between the Bristol Channel and any of their spawning rivers is not obstructed or impeded by physical barriers, changes in flows, or poor water quality;

ii. the size of the sea lamprey population in the Severn Estuary and the rivers which drain into it, is at least maintained as is at a level that is sustainable in the long term;

iii. the abundance of prey species[2] forming the sea lamprey's food resource within the estuary, is maintained.

vi. Toxic contaminants in the water column[3] and sediment are below levels which would pose a risk to the ecological objectives described above.

The meaning of terms [1-3] above is explained in **section 4.1.7.1**.

Note : The sea lamprey population of the Severn depends on habitat in the adjacent River Usk SAC, River Wye SAC and River Severn. The habitats in these rivers, including spawning and nursery areas, are essential for the fulfilment of the species' lifecycle and therefore the Severn Estuary sea lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Usk SAC and River Wye SAC sea lamprey shad feature are also met in full and there is a continued recorded presence of this species in the River Severn.

4.1.7.1 Explanatory information for the sea lamprey *Petromyzon marinus* conservation objective

[1] Natural processes in respect of the SAC fish features

Sea lamprey population:
The size of the population is subject to non anthropogenic factors relating to natural fluctuations of external factors such as food / host availability in the Bristol Channel and more widely and breeding success in the River Severn and other rivers draining into the Severn Estuary.

Supporting habitats:
The general meaning of 'natural processes' with respect to the supporting habitats of sea lamprey within the estuary is explained in **section 4.1.1.1**.

[2]Prey species

Eel *Anguilla anguilla*, cod *Gadus morhua*, and haddock *Melanogrammus aeglefinus* are all potential prey species for the sea lamprey found within the Severn Estuary (Bird 2008)

[3]Water column

Water column should be read to include contributory water flows into the estuary including surface flows over mudflats and saltmarsh.

4.1.8 SAC interest feature 8: The conservation objective for twaite shad *Alosa fallax*

The conservation objective for the twaite Shad *Alosa fallax* feature of the Severn Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile twaite shad through the Severn Estuary between the Bristol Channel and their spawning rivers is not obstructed or impeded by physical barriers, changes in flows or poor water quality;

ii. the size of the twaite shad population within the Severn Estuary and the rivers draining into it is at least maintained and is at a level that is sustainable in the long term.

iii. the abundance of prey species[2] forming the twaite shad's food resource within the estuary, in particular at the salt wedge[3], is maintained.

iv. Toxic contaminants in the water column[4] and sediment are below levels which would pose a risk to the ecological objectives described above.

The meaning of terms[1-4] above is explained in **section 4.1.8.1**.

Note : The twaite shad population of the Severn depends on habitat in the adjacent River Usk SAC, River Wye SAC and River Severn. The habitats in these rivers, including spawning and nursery areas, are essential for the fulfilment of the species' lifecycle and therefore the Severn Estuary twaite shad feature can only be in favourable condition if the conservation objectives pertaining to the River Usk SAC and River Wye SAC twaite shad feature are also met in full and there is a continued recorded presence of this species in the River Severn.

4.1.8.1 Explanatory information for the Twaite shad *Alosa fallax* conservation objective

[1] Natural processes in respect of the SAC fish features

Twaite shad population:
The size of the population is subject to non anthropogenic factors relating to natural fluctuations of external factors such as food availability in the Bristol Channel and more widely and breeding success in the River Severn and other rivers draining into the Severn Estuary.

Supporting habitats:
The general meaning of 'natural processes' with respect to the supporting habitats of twaite shad within the estuary is explained in **section 4.1.1.1**.

[2] Prey species

Small custaceans, especially mysids and copepods, small fish, especially sprats and anchovies, and fish eggs (Maitland, P.S. & Hatton-Ellis 2003).

[3] Salt wedge

This the area within the estuary where fresh and saline water meet and where the abundance of prey species is particularly important to the twaite shad population. The actual position varies according to the state of the tide and volume of freshwater input to the estuary.

[4] Water column

Water column should be read to include contributory water flows into the estuary including surface flows over mudflats and saltmarsh.

4.1.9 Favourable Condition Tables for the SAC interest features of the Severn Estuary European Marine Site

Background information on the role of favourable condition tables and the information provided in each column is provided in Section 1.8 of this document, and a concise glossary of terms used is provided in Section 7.

The favourable condition table is intended to supplement the conservation objectives, including with respect to the management of established and ongoing activities, future requirements of monitoring and reporting on the condition of the features of the site and, together with the conservation objectives, informs the scope and nature of any appropriate assessment that may be needed. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under the Habitats Regulations. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

These tables set out all the attributes that **may** be used to monitor the condition of the features of the SAC. Where possible we will seek available information from others which can inform our assessment process.

It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline. Where relevant, abbreviations of National Vegetation Classification (NVC) codes are used for simplicity (Rodwell, 2000).

Comprising :

Table 8 – Favourable condition table for the “estuaries” feature of the Severn Estuary SAC and (in part) for the Ramsar Site (refer to section 4.3.1)

Table 9 – Favourable condition table for the “subtidal sandbanks” feature of the Severn Estuary SAC

Table 10 – Favourable condition table for the “intertidal mudflats and sandflats” feature of the Severn Estuary SAC

Table 11 – Favourable condition table for the “Atlantic salt meadows” feature of the Severn Estuary SAC

Table 12 – Favourable condition table for the “reefs” feature of the Severn Estuary SAC

Table 13 – Favourable condition table for the “river lamprey” and “sea lamprey” features of the Severn Estuary SAC

Table 14 – Favourable condition table for the “twaite shad” feature of the Severn Estuary SAC

Table 8 – Favourable condition table for the "estuaries" feature of the Severn Estuary SAC and (in part) for the Ramsar Site (refer to section 4.3.1)

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A1	***SAC interest feature 1:*** **Estuaries**		**Extent** *(Total extent of the estuaries feature - section 4.1.1.i of the conservation objectives)*	Total area (ha) of estuary feature	No decrease in extent due to man induced changes from the established baseline *The baseline is the extent of all areas subject to tidal influence within the boundary of the designation of the pSAC in 2000 - see also map in Appendix 2*	Extent is an attribute on which reporting is required by the Habitats Directive.
A2		All sub-features	**Morphology** *(Characteristic physical form and flow - section 4.1.1.ii of the conservation objectives)*	Intra and inter-estuarine Tidal Prism/Cross Section ratio (TP/CS ratio) measured during the reporting cycle using remote sensing (frequency to be determined).	The intra- and inter- estuarine TP/CS relationship should not deviate significantly from an established baseline subject to natural processes (* includes recognition of fixed hard geology formations) *Baseline to be established :-* *Data to be used is Hydrological Office bathymetry data (intertidal and subtidal) and Environment Agency LIDAR survey*	TP = Tidal Prism = total volume of water crossing a given cross section during the flood tide (m^3). CS = Area of a given cross section at high water springs (m^2). The relationship between TP & CS provides a measure of the way the estuary has adjusted to tidal energy. Substantial departures from this characteristic relationship (determined on a regional basis) may indicate the influence of anthropogenic factors and this would trigger more detailed evaluation of potential problems. The identification of a suitable baseline for TP/CS relationship will need to take account of the highly dynamic nature of the Severn and potential impacts of natural processes (including sea level rise) in altering the profile of the estuary – with a view to maintaining or promoting the movement of the estuary towards "dynamic equilibrium". *The hard geology formations (headlands, cliffs and rock platforms) have a major role in influencing the characteristic physical form and flow of the estuary (many are protected in their own right as geological SSSI).

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A3	***SAC interest feature 1:*** **Estuaries**		**Tidal regime and flows** (saline water and freshwater contributions) *(characteristic physical form and flow - section 4.1.1.ii of the conservation objectives)*	Tidal range, measured from tide gauges at specified locations, and flows measured from current estuary and river meters . Locations and frequency to be determined	No decrease in tidal range subject to natural processes. Tidal currents should not deviate significantly from an established baseline subject to natural processes Riverine flows (Rivers Wye, Usk and Severn) and estuarine flows must be sufficient to ensure Water Framework Directive target of Good Ecological Status (GES) is met. *Baseline to be established :-* *Data to be used is existing tide gauge and current meter data from EA ca 2000, and agreed WFD monitoring measures.*	

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A4			**Sediment budget** *(characteristic range and relative proportions of sediment sizes and sediment budget - section 4.1.1.iii of the conservation objectives)*	Evaluation of the sediment fluxes, sources and sinks, using a variety of measures including bathymetry, suspended sediment concentrations, fluvial and marine influx/efflux, man-made changes (e.g. navigational dredging/marine minerals extraction), cliff erosion etc)	No decrease in sediment budget from the established baseline *Baseline to be established :-* *Data to be used is Severn Estuary Coastal Habitat Management Plan (CHaMP) Part F- Sediment Budget Analysis*	A sediment budget is a balance of the sediment volume entering and exiting a particular section of the coast or an estuary. Sediment budget analysis consists of the evaluation of sediment fluxes, sources and sinks from different processes that give rise to additions and subtractions within a control volume (e.g. a section of coast or an estuary) in order to gain a better understanding of the estuary system. An estuary provides a readily defined control volume, where point sources and sinks exist in the form of rivers, other terrestrial outfalls and the open sea. Line sources and sinks may be defined in terms of erosion from cliffs and transfers to or from saltmarshes, wetlands or other intertidal areas. The subtidal beds also needs consideration as an important source/sink as does material stored in suspension within the volume of water that moves back and forth under tidal action within the estuary. Identification and quantification of all the mechanisms giving rise to sediment transfers can be difficult, and for the most part are approximate estimates of sediment exchange between sources and sinks. Reference ; ABPmer and HR Wallingford (2007).
A5	***SAC interest feature 1:*** **Estuaries**		**Sediment size, range and distribution** *(characteristic range and proportions of sediment sizes and sediment budget - section 4.1.1.iii of the conservation objectives)*	Sediment size distribution characterised and measured by particle size analysis (PSA) at a series of locations across the estuary during the reporting cycle (locations and frequency to be determined)	Sediment size distribution should not deviate from an established baseline. *Baseline to be established :-* *Data to be used is* BGS seabed sediment data and other relevant datasets ?	PSA measures parameters including percentage sand/silt/gravel, mean and median grain size and sorting co-efficient, used to characterise sediment type. Sediment character is key to the structure of the features and reflects the physical processes acting on it – it may vary across the estuary and can be used to indicate the spatial distribution of sediment types reflecting the stability of the features and the processes supporting it..
A6		Subtidal sandbanks	**Extent, variety and spatial distribution of estuarine habitat communities** *(section 4.1.1.iv of the conservation objectives)*	*For information on the attributes of the subtidal sandbank communities sub-feature see the sections of this table which relate to the subtidal sandbanks which are covered by seawater all the time feature, see Table 9*		

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A7		Intertidal mudflat and sandflat communities	**Extent, variety and spatial distribution of estuarine habitat communities** *(section 4.1.1.iv of the conservation objectives)*	*For information on the attributes of the intertidal mudflat & sandflat communities sub-feature see the sections of this table which relate to the intertidal mudflats and sandflats not covered by seawater at low tide feature, see Table 10*		
A8		Atlantic salt meadow (and associated transition habitats)	**Extent, variety and spatial distribution of estuarine habitat communities** *(section 4.1.1.iv of the conservation objectives)*	*For information on the attributes of the Atlantic salt meadow communities sub-feature see the sections of this table which relate to Atlantic salt meadow feature, see Table 11*		
A9		Reefs of *Sabellaria alveolata*	**Extent, variety and spatial distribution of estuarine habitat communities** *(section 4.1.1.iv of the conservation objectives)*	*For information on the attributes of the Reef sub-feature see the sections of this table which relate to the Reef feature, see Table 12*		

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A10	***SAC interest feature 1:*** **Estuaries**	Hard substrate habitats and their notable communities	**Extent & variety** *(extent, variety, spatial distribution and community composition of hard substrate habitats and their notable communities - section 4.1.1.v of the conservation objectives)*	Area (ha) and range of types of hard substrate habitats and their notable communities, measured periodically during the reporting cycle along sampling transects or grids (frequency to be determined).	No decrease in extent or range of types of hard substrate habitats and their notable communities from the established baseline subject to natural processes. *Baseline is the CCW and English Nature Intertidal Biotope Surveys 2006.*	Loss of hard substrate habitats and their notable communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in estuary processes and may indicate long term changes in the physical conditions of the estuaries interest feature. Notable communities of the Severn Estuary comprise the following • *Sabellaria alveolata reefs on sand-abraded eulittoral rock* (MLR.Sab.Salv) • *Hydroids, ephemeral seaweeds and Littorina littorea in shallow eulittoral mixed substrata pools.* **(**LR.RkpH) • *Balanus crenatus and Tubularia indivisa on extremely tide-swept circalittoral rock.*(ECR.BS.BalTub) • *Fucus serratus* and piddocks on lower eulittoral soft rock (MLR.Fser.Pid) • *Mytilus edulis* and piddocks on eulittoral firm clay (MLR.MytPid) • *Balanus crenatus, Halichondrea panicea* and *Alcyonidium diaphanum* on extremely tide-swept sheltered circalittoral rock (ECR.BalHpan) • *Sertularia cupressina and Hydrallmania falcate* on tide-swept sublittoral cobbles or pebbles in coarse sand (IGS.ScupHyd). • *Corralina officinalis* and coralline crusts in shallow eulittoral rockpools (LR.rkp.Cor) • Eel grass (*Zostera*) beds • Any other notable hard substrata communities that may be identified.
A11			**Spatial distribution** *(extent, variety, spatial distribution and community composition of notable communities - section 4.1.1.v of the conservation objectives)*	Spatial distribution of notable communities measured periodically during the reporting cycle using a combination of remote sensing and ground truthing using GPS (frequency to be determined).	Macroscale distribution of notable communities should not deviate significantly from the established baselines, subject to natural processes. *Baseline is the CCW and English Nature Intertidal Biotope Surveys 2006.*	Changes in the variety or distribution of notable estuarine communities may indicate long term changes in the physical conditions of the estuary interest feature or individual subfeatures.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A12	***SAC interest feature 1:*** **Estuaries**	Hard substrate habitats and their notable communities	**Community composition** *(extent, variety, spatial distribution and community composition of notable communities - section 4.1.1.v of the conservation objectives)*	Assessment of community quality through survey of species composition (presence of typical species) within the notable communities measured periodically	No decline in community quality due to changes in species composition or loss of typical species from an established baseline *Baseline to be established :* *Data to be used : CCW and English Nature Intertidal Biotope Surveys 2006 and future surveys*	Different associations of plants, animals and their habitat are an important structural and functional aspect of the feature. Changes in the communities present within an area of a particular type may indicate long-term changes in physical conditions at the site. Typical species of the notable communities to be determined.
A13		Notable estuarine species assemblages : **Assemblage of fish species**	**Abundance** *(abundance of notable estuarine species assemblages - section 4.1.1.vi of the conservation objectives)*	Numbers of species and population estimates	No significant reduction in overall diversity of species or in individual populations against an established baseline *Baseline to be established :* *Data to be used : Environment Agency and relevant Sea Fisheries Committee data*	Loss of notable communities may indicate long term changes in the physical conditions of the estuaries interest feature or individual subfeatures. **Assemblage of fish species:** (Refer to section 4.1.1 note 7) • Migratory species (see also section of this table which relates to the river lamprey, sea lamprey and twaite shad features) • Estuarine species • Marine species • Freshwater species Refer also to section 4.3.2 in relation to the assemblage of migratory fish species of the Ramsar Site.
A14		Notable estuarine species assemblages : **Assemblage of waterfowl species**	**Abundance** *(abundance of notable estuarine species assemblages - section 4.1.1.vi of the conservation objectives)*	Numbers of species and individual population sizes	No significant reduction in overall diversity of species or in individual populations against an established baseline *Baselines are identified in the SPA section of this advice – see section 4.2*	Loss of notable communities may indicate long term changes in the physical conditions of the estuaries interest feature or individual subfeatures. Refer also to section 4.2.7 in relation to the Internationally important **assemblage of waterfowl** of the Severn Estuary SPA and section 4.3.9 in relation to the Internationally important assemblage of waterfowl of the Severn Estuary Ramsar Site
A15		Notable estuarine species assemblages : **Assemblage of vascular plant species**	**Abundance of saltmarsh species** *(abundance of notable estuarine species assemblages - section 4.1.1.vi of the conservation objectives)*	Number of species and population sizes	No significant reduction in overall diversity of species or in individual populations against an established baseline *Baselines to be established:* *Data to be used is 1998 NVC Scarce plant survey, county botanical records and CCW/NE site records*	Loss of notable communities may indicate long term changes in the physical conditions of the estuaries interest feature or individual subfeatures. **Assemblage of vascular plant species includes**: • Salt marsh species Note : maintaining the conditions necessary for these species are covered by the Atlantic salt meadows table attributes Table 11

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A16	***SAC interest feature 1:*** **Estuaries**	Notable estuarine species assemblages : **Assemblage of vascular plant species**	**Abundance of Eel grass**	Extent and density of Eel grass species	No significant reduction in overall extent and density against as established baseline *Baseline is CCW and English Nature Intertidal Biotope Surveys 2006 plus Severn Second Crossing monitoring data 1989-95/6*	**Assemblage of vascular plant species includes**: • Eel grass *(Zostera)* species.
A17		All sub-features	**Water quality – physico-chemical parameters** (Including temperature, salinity, oxygen, nutrients, pH and turbidity etc) *(physico chemical characteristics of the water column - section 4.1.1.vii of the conservation objectives)*	Physico-chemical parameters measured periodically throughout the reporting cycle (frequency to be determined).	Physico-chemical parameters should not pose a risk to the ecology* of the habitats and species of the SAC, SPA or Ramsar Site. Levels should comply with targets established under the EA Review of Consents and the Water Framework Directive.	Changes in any of the physico-chemical parameters in the water column can impact on the quality of the estuary habitat and hence could lead to changes in the presence and distribution of species (along with recruitment processes and spawning behaviour) and those at the edge of their geographic ranges and non-natives. *ie does not compromise the quality, extent, distribution or species composition of habitats or their ability to support species features (eg feeding, breeding, resting) – the outcome sought is the healthy functioning of the estuary.
A18			**Phytoplankton** *(physico chemical characteristics of the water column - section 4.1.1.vii of the conservation objectives)*	Average **phytoplankton biomass and characteristic species** in summer, measured periodically during the reporting cycle.	Growth of phytoplankton does not cause an undesirable disturbance to the estuary habitats and species Levels should comply with targets established under the EA Review of Consents and the Water Framework Directive.	
A19			**Macroalgae**	Average **macroalgal cover and density** in summer, measured periodically during the reporting cycle.	Average macroalgal cover and density should not compromise the ecology * of the estuary habitats and species Levels should comply with targets established under the EA Review of Consents and the Water Framework Directive.	*ie does not compromise the quality, extent, distribution or species composition of habitats or their ability to support species features (eg feeding, breeding, resting) – the outcome sought is the healthy functioning of the estuary.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
A20	***SAC interest feature 1:*** **Estuaries**		**Toxic contaminants** *(toxic contaminants in water column and sediment - section 4.1.1.viii of the conservation objectives)*	Toxic contaminants measured periodically throughout the reporting cycle (frequency to be determined).	Toxic contaminants in water column and sediment should be below levels which would pose a risk to the ecology* of the estuary habitats and species Levels should comply with targets established under the EA Review of Consents and the Water Framework Directive	Elevated concentrations of toxic contaminants in the water column and sediment have the potential to cause lethal or sub-lethal harm to any features and sub-features. *ie does not compromise the quality, extent, distribution or species composition of habitats or their ability to support species features (eg feeding, breeding, resting) – the outcome sought is the healthy functioning of the estuary.
A21			**Airborne nutrient and contaminants** *(airborne contaminants - section 4.1.1.ix of the conservation objectives)*	Airborne contamiants measured periodically throughout the reporting cycle (frequency to be determined)	No exceedence of critical loads for: Sulphur dioxide - 20µg/m³ Nitrous Oxides - 30µg/m³ Ozone - 3000 ppb Ammonia - 3µg/m³ Nutrient Nitrogen - 30-40 kg/ha/yr.	Critical loads have been defined where possible (www.apis.ac.uk) for the conservation features of the European site. Where the critical load is exceeded features are at risk. As more in depth studies are undertaken critical loads will be altered to reflect best available scientific knowledge. The impacts of air pollution on the vegetation need further investigation. If particularly damaging, point sources (or groups of point sources) can be identified, then emissions should be regulated toreduce the impacts. It will also be very important for wider measures to be taken, at Government and international levels, to reduce air pollution. There is currently insufficient knowledge to make a judgment of the impacts on specific species. Decisions should be made at a site specific level."

Table 9 – Favourable condition table for the "subtidal sandbanks" feature of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
B1	***SAC interest feature 2:*** **Subtidal Sandbanks**	All sub-features	**Extent of feature** *(total extent of subtidal sandbanks - section 4.1.2.i of the conservation objectives)*	Total extent assessed periodically against baseline map (using bathymetry data, and other geophysical techniques (e.g. sidescan sonar), and sediment grain-size data)	No decrease in extent of subtidal sandbanks features from an established baseline, subject to natural processes. *Baseline is taken from 1994 admiralty charts, BGS seabed sediment data and sediment environments defined in the Bristol Channel Marine Aggregates Study (Posford Duvivier and ABP Research Consultancy, 2000).* *Refer also to Map in Appendix 3*	Extent is an attribute on which reporting is required by the Habitats Directive. Within the Severn the subtidal sandbanks feature includes both relatively permanent and stable banks (shown in Appendix XX as subtidal sandbanks) and more ephemeral banks which contribute sediment to the sandbanks (shown in Appendix XX as associated sediments) and which are therefore considered to be an integral part of the feature In the long term loss of subtidal sandbank feature communities is likely to be detrimental to the structure of this interest feature and the intertidal mudflats and sandflats features, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature.
B2		All sub-features	**Extent of the subtidal sandbank communities** *(extent of subtidal sandbank communities -section 4.1.2.ii of the conservation objectives)*	Extent of subtidal sandbank communities within the site assessed periodically (method and frequency to be determined).	No decrease in extent of the communities from an established baseline subject to natural processes. *Baseline is data held on Marine Recorder*	The subtidal sandbanks feature comprises two sub-features **Sublittoral sands and muddy sand** : This sub-feature comprises the following four communities: • Infralittoral mobile sand in variable salinity • Infralittoral mobile clean sands with sparse fauna • Nephtys cirrosa and Macoma balthica in variable salinity infralittoral mobile sand • Neomysis integer and Gammarus spp in fluctuating low salinity infralittoral mobile sand **Sublittoral cohesive mud and sandy mud communities** This sub-feature comprises the following four communities: • Capitella capitata in enriched sublittoral muddy sediments • Nephtys hombergii and Tubificiodes spp. In variable salinity infralittoral soft mud • Capitella capitata and Tubificiodes spp. In reduced salinity infralittoral muddy sediment • Nephtys hombergii and Macoma balthica in infralittoral sandy mud

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
B3	***SAC interest feature 2:*** **Subtidal Sandbanks**		**Distribution of subtidal sandbank communities** *(extent of subtidal sandbank communities -section 4.1.2.ii of the conservation objectives)*	Spatial distribution of subtidal sandbank communities measured periodically (frequency to be determined).	No significant change in the macro scale distribution of the communities from an established baseline subject to natural processes *Baseline is data held on Marine Recorder*	Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes
B4			**Community composition** *(community composition of the subtidal sandbank communities -section 4.1.2.iii of the conservation objectives)*	Assessment of community quality through survey of species composition within the subtidal sandbank feature measured periodically	No decline in community quality due to changes in species composition or loss of typical species from an established baseline subject to natural processes *Baseline is data held on Marine Recorder and EA WFD benthic sampling data*	Different associations of plants, animals and their habitat are an important structural and functional aspect of the feature. Changes in the communities present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Typical species of the subtidal sandbanks communities include: *Aricidea minuta, Capitella capitata, Diastylis rathkei typical, Eurydice pulchra, Gammarus salinus, Harpinia pectinata, Mediomastus fragilis, Nephtys cirrosa, Nephtys hombergii, Oligochaeta, Pygospio elegans, Pontocrates arenarius, Pseudocuma longicornis, Retusa obtuse, Tubificoides amplivasatus*
B5		All sub-features	**Sediment character** *(variety & distribution of sediment types - section 4.1.2.iv of the conservation objectives)*	Distribution of sediment types/grain sizes assessed across the site	No major change in composition of sediment type across the feature against an established baseline subject to natural processes *Baseline to be established* *Data to be used is BGS seabed sediment data and other relevant datasets*	

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
B6	***SAC interest feature 2:*** **Subtidal Sandbanks**	All sub-features	**Topography** *(gross morphology – depth distribution and profile of subtidal sandbank feature - section 4.1.2.v of the conservation objectives)*	Depth distribution/profile of the sandbank feature measured across the site	No major alteration of topography of the subtidal sandbank feature against an established baseline *Baseline to be established* *Data to be used is Hydrographic Office bathymetric data and other relevant bathymetric datasets*	

Table 10 – Favourable condition table for the "intertidal mudflats and sandflats" feature of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
C1	***SAC interest feature 3:*** **Mudflats and sandflats**	All sub-features	**Extent of the feature** *(total extent of the mudflats and sandflats feature - section 4.1.3.i of the conservation objectives)*	Total area (ha) of the intertidal mudflat and sandflat feature measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined).	No decrease in extent of intertidal mudflats and sandflats from an established baseline, subject to natural processes. *Baseline is aerial photography dated 1999 and CCW/English Nature Intertidal Biotope Surveys 2006.* *(Note air photo coverage from 1988 gives data for assessing trends in change of this attribute.) Refer also to maps in Appendix 4*	Extent is an attribute on which reporting is required by the Habitats Directive. In the long term loss of intertidal mudflat / sandflat communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature. Some fluctuations in extent may occur which are directly attributable to natural coastal processes. These include reduced extent following storms or due to a change to another feature habitat such as saltmarsh. Such types of change in extent would form under the umbrella of 'natural change'
C2		All sub-features	**Extent and variety of the mudflats and sandflats communities comprising each sub-feature** *(variety and extent of the mudflat and sandflats communities – section 4.1.3.ii of the conservation objectives)*	Extent and range of types of intertidal mudflat and sandflat communities assessed along a sampling transect or grid and rapid phase 1 survey techniques using GPS (frequency to be determined).	No decrease in the extent or range of types of intertidal mudflat and sandflat communities from an established baseline, subject to natural processes *Baseline is CCW/English Nature Intertidal Biotope Surveys 2006.*	Intertidal mudflat and sand flat feature comprises three sub-features: **Intertidal gravel and clean sand communities** • Barren coarse sand shores; • Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores; • Burrowing amphipods and polychaetes in clean sand shores. • Talitrid amphipods in decomposing seaweed on the strandline • Dense *Lanice conchilega* in tide-swept lower shore sand • Barren shingle or gravel shores **Intertidal muddy sand communities** • Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores • *Bathyporeia pilosa* and *Corophium* spp. in upper shore slightly muddy fine sand shores • *Macoma balthica* and *Arenicola marina* in muddy sand shores. • *Arenicola marina*, *Macoma balthica* and *Mya arenaria* in muddy sand shores. • *Echinocardium cordatum* and *Ensis* sp. in lower shore or shallow sublittoral muddy fine sand **Intertidal mud communities** • *Hediste diversicolor* and *Macoma balthica* in sandy mud shores • *Hediste diversicolor*, *Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores • *Hediste diversicolor*, *Macoma balthica* and *Mya arenaria* in sandy mud shores • *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores • *Hediste diversicolor* and oligochaetes in low salinity mud shores

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
C3	***SAC interest feature 3:*** **Mudflats and sandflats**	All subfeatures	**Distribution of mudflats and sandflats communities** *(distribution of communities - section 4.1.3.iii of the conservation objectives)*	Spatial distribution of mudflat and sandflat communities assessed along a sampling transect or grid and rapid phase 1 survey techniques using GPS (frequency to be determined).	Macro scale distribution of communities should not deviate significantly from an established baseline, subject to natural processes. *Baseline is CCW/English Nature Intertidal Biotope Surveys 2006.*	Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes.
C4		All subfeatures	**Community composition** *(community composition of the feature - section 4.1.3.iv of the conservation objectives)*	Assessment of community quality through survey of species composition (presence of typical species) within the intertidal mudflats and sandflats feature measured periodically	No decline in community quality due to changes in species composition or loss of typical species from an established baseline, subject to natural processes. *Baseline is CCW/English Nature Intertidal Biotope Surveys 2006.*	Different associations of plants, animals and their habitat are an important structural and functional aspect of the feature. Changes in the communities present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Typical species of the intertidal mudflats and sandflats communities include: *Aphelochaeta marioni, Arenicola marina, Bathyporeia pelagica, Corophium volutator, Enchytraeidae, Eurydice pulchra, Hediste diversicolor, Hydrobia ulvae, Macoma balthica, Nephtys cirrosa, Nephtys hombergii, Oligochaeta indet, Pygospio elegans, Scoloplos armiger, Scrobicularia plana, Streblospio shrubsolii, Tubificoides benedii*
C5			**Topography** *(Topography and morphology of the intertidal flats -section 4.1.3v of the conservation objectives)*	Tidal elevation and intertidal slope, measured along a series of transects across the estuary periodically during the reporting cycle using remote sensing or traditional surveying techniques (transect locations and survey frequency to be determined).	Intertidal profile should not deviate significantly from an established baseline, subject to natural processes. *Baseline to be established:* *Data to be used is Environment Agency LIDAR survey*	In the intertidal zone topography reflects the energy conditions and stability of the sediment, which is key to the structure of the interest feature. Topography is a major influence on the distribution of communities throughout the intertidal flats. Assessing topography also provides information on the position of channels through the interest feature. .
C6			**Sediment character**	**Particle size analysis** (PSA). measured at a series of locations across the estuary. Locations and frequency to be determined	Average PSA parameters should not deviate significantly from an established baseline. *Baseline to be established* Data to be used *CCW/English Nature Intertidal Biotope Surveys 2006, BGS seabed sediment data and other relevant data sources*	Parameters include percentage sand / silt / gravel, mean and median grain size, and sorting coefficient, used to characterise sediment type Sediment character defined by particle size analysis is key to the structure of the feature, and reflects all of the physical processes acting on it. Particle size composition varies across the feature and can be used to indicate spatial distribution of sediment types thus reflecting the stability of the feature and the processes supporting it.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
C7	***SAC interest feature 3:*** **Mudflats and sandflats**			**Sediment penetrability** (degree of sinking) measured at a series of locations across the estuary (methodology, locations and frequency to be determined).	Average measure should not deviate significantly from an established baseline. *Baseline to be established by future survey*	Penetrability is an indicator of sediment stability and degree of compaction; it indicates the shear strength of the sediment and thus the susceptibility of that sediment type to erosion. Compaction of the sediment influences the biological community within the sediment. Penetrability of the sediment is determined by a combination of grain size and water content, which may provide a surrogate index of the penetrability of the sediments.
C8				**Sediment organic content** (% carbon) measured at a series of locations across the estuary (sampling locations and frequency to be determined).	Average organic carbon content should not deviate significantly from an established baseline. *Baseline to be established by future survey*	Organic content critically influences the infaunal community and can cause deoxygenation of the feature, which can be detrimental to the biota. However, a balance needs to be struck as organic content provides a measure of the material available to detritivores. A reduction in organic content could lead to a reduction in detritivores, with subsequent knock on effects throughout the food chain.
C9				**Oxidation - reduction potential** (depth of black anoxic layer) measured at a series of locations across the estuary (sampling locations and frequency to be determined).	Average black layer depth should not deviate significantly from an established baseline. *Baseline to be established by future survey*	Degree of oxidation / reduction, reflecting oxygen availability within the sediment, critically influences the infaunal community and the mobility of chemical compounds. It is an indicator of the structure of the feature.

Table 11 – Favourable condition table for the "Atlantic salt meadows" feature of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
D1	***SAC interest feature 4:* Atlantic salt meadows**	All sub-features	**Extent of Atlantic salt meadow (and transitional habitats) feature** *(extent of Atlantic salt meadow (and transitional habitats) feature - section 4.1.4.i of the conservation objectives)*	Total area (ha) of the Atlantic salt meadow feature (and associated transitional habitats) within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined).	No decrease in total extent of Atlantic salt meadow and associated transitional habitats from the established baseline. *Baseline is the CCW/English Nature Saltmarsh NVC survey by Dargie 1998* *Refer also to maps in Appendix 5*	Extent is an attribute on which reporting is required by the Habitats Directive. Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in vegetation types. Coastal squeeze may result in the replacement of Atlantic salt meadows with pioneer saltmarsh. A reduction in extent could be further evaluated by a ground survey to assess for signs of erosion such as toppled vegetation blocks, signs of roots in intertidal mud, signs of stress/damage to plants. Extent needs to be measured at low tide.
D2		All sub-features	**Extent of the Atlantic salt meadow communities and associated transitional vegetation communities** *(extent and distribution of atlantic salt meadow and associated transitional vegetation communities - section 4.1.4.ii of the conservation objectives)*	Area (ha) of Atlantic salt meadow and associated transitional vegetation communities within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined).	No decrease in extent of Atlantic salt meadow and associated transitional vegetation communities from the established baseline subject to natural processes *Baseline is the CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	Assessment against this target will take account of the effects of the natural process of cyclical development and breakdown of saltmarshes within the Severn which results in the natural succession of saltmarsh communities over time ie the continued presence of all types in proportions reflecting the natural processes operating. Some individual salt marsh communities occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of transient communities. The outcome sought is the maintenance of the general character of the saltmarshes of the Severn in terms of the continued presence, abundance and variation of communities with local differences reflected – it is not to seek the retention of saltmarsh types in situ but to allow them to shift and evolve in line with natural processes The Atlantic salt meadow feature comprises four sub-features: **Low to mid marsh communities** NVC communities: SM10, SM12, SM13a, SM13b, SM13c,SM13d, SM13x, SM13y,SM14a, SM15. **Mid to upper marsh communities** NVC communities: SM16a, SM16b, SM16c, SM16d, SM16e, SM16x, SM17, SM18c. **Transitional high marsh communities** NVC communities: SM23, SM24, SM28, MG11, MG12, MG13, S4a, S21a, S21c. **Pioneer saltmarsh communities** NVC communities: SM6, SM8, SM9

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
D3	***SAC interest feature 4:*** **Atlantic salt meadows**	All sub-features	**Distribution of the Atlantic salt meadow communities and associated transitional vegetation communities** *(extent and distribution of atlantic salt meadow and associated transitional vegetation communities - section 4.1.4.ii of the conservation objectives)*	Spatial distribution of Atlantic saltmeadow and associated transitional vegetation communities measured along a series of fixed transects (or other suitable method to be agreed) periodically during the reporting cycle using GPS (transect locations and frequency of survey to be determined).	The macro scale distribution of communities should not deviate significantly from an established baseline subject to natural processes. *Baseline is the CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	The distribution of the Atlantic salt meadow communities refers to the macro spatial pattern in which these are distributed around the estuary. This statement does not require micro-distribution of communities (i.e. the exact mapped positions of specific communities to be maintained) but does require the distribution of some saltmarsh types which reflect the differences in estuary structure and function (eg in outer versus inner parts of the estuary, or the influence of freshwater inputs from the rivers) be taken into account. Consideration of this attribute needs to take account of the wider scale and long-term changes and development of saltmarshes in the Severn Estuary which shows a pattern of episodic erosion and accretion evident in a series of saltmarsh terraces. This attribute is also linked with attributes covering zonation and morphology below.
D4		All sub-features	**Extent of *Spartina anglica*** *(areas of Spartina anglica - section 4.1.4.viii of the conservation objectives)*	Total extent of Spartina anglica measured along a series of transects (or other suitable method to be agreed) around the estuary, periodically during the reporting cycle, using a combination of remote sensing and ground survey (transect locations and frequency of survey to be determined).	No increase in total extent of more than 10% over monitoring period; *Baseline is the CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	*Spartina anglica* acts as a pioneer species in the Severn and can undergo succession to other saltmarsh habitats over time. As a consequence, although it may be colonising new areas in one part of the estuary, in others it may be developing into more mixed saltmarsh communities. There will be differences in the density, height and cover of the vegetation depending on where it is in the succession. These changes will need to be monitored to establish a baseline and rates of any gross change. An increase in *Spartina* at the expense of other saltmarsh could indicate changes in the sediment regime and/or tidal levels both in response to natural or anthropogenic processes. Monitoring will only focus on areas of gross expansion of *Spartina* into intertidal mudflat and saltmarsh communities.
D5		All sub-features	**Zonation of vegetation** *(zonation of Atlantic salt meadow communities - section 4.1.4.iii of the conservation objectives)*	Width of pioneer, low-mid marsh, mid-upper marsh, and transitional high marsh saltmarsh zones, measured along a series of transects (or other suitable method to be agreed) around the estuary, periodically during the reporting cycle, using a combination of remote sensing and ground survey (transect locations and frequency of survey to be determined).	The range of variation of zonation of saltmarsh communities around the estuary should not deviate significantly from an established baseline, subject to natural processes. *Baseline is CCW/English Nature Saltmarsh NVC survey by Dargie 1998 (and English Nature condition assessment data collected in 2002 for Gloucestershire section of the estuary.*	Assessment against this target will take account of the effects of the natural process of cyclical development and breakdown of saltmarshes within the Severn which results in the natural succession of saltmarsh communities and changes to the zonation over time . ie the continued presence of all zones in proportions reflecting the natural processes operating. The outcome sought is the maintenance of the general character of the saltmarshes of the Severn in terms of the continued presence and variation of the saltmarsh zones with local differences reflected – it is not to seek the retention of zones in situ but to allow them to shift and evolve in line with natural processes

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
D6	***SAC interest feature 4:*** **Atlantic salt meadows**	Low to mid marsh communities	**Species composition** *(abundance of typical species - section 4.1.4.iv of the conservation objectives)*	Frequency of typical species to be measured using methodology to be agreed (e.g. transects, plots etc) once during reporting cycle	Frequency of typical species of characteristic low to mid marsh communities should not deviate significantly from an established baseline. *Baseline is CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	The typical species for these communities include: *Puccinellia maritima, Salicornia spp., Suaeda maritima, Aster tripolium, Spergularia marginata, Glaux maritima, Plantago maritima, Atriplex glabriuscula, Atriplex prostrata, Triglochin maritima, Limonium vulgare, Armeria maritima and Juncus maritimus* *This target should not however prevent the enhancement of the diversity of swards where possible eg through the encouragement of a wider range of herbs through relaxation of grazing pressure in heavily grazed areas.
D7		Mid to upper marsh communities	**Species composition** *(abundance of typical species - section 4.1.4.iv of the conservation objectives)*	Frequency of typical species to be measured using methodology to be agreed (e.g. transects, plots etc) once during reporting cycle	Frequency of typical species of characteristic mid to upper marsh communities should not deviate significantly from an established baseline. *Baseline is CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	The typical species for these communities include : *Puccinellia maritima, Aster tripolium, Glaux maritima, Plantago maritima, Festuca rubra, Juncus gerardii, Triglochin maritima, , Agrostis stolonifera, Juncus maritimus , Spergularia marginata, Parapholis strigosa, Elymus pycnanthus,, Hordeum secalinum, Trifolium fragiferum and Atriplex glabriuscula,* *(see note above)
D8		Transitional high marsh communities	**Species composition** *(abundance of typical species - section 4.1.4.iv of the conservation objectives)*	Frequency of typical species to be measured using methodology to be agreed (e.g. transects, plots etc) once during reporting cycle	Frequency of typical species of characteristic high marsh communities should not deviate significantly from an established baseline. *Baseline is CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	The typical species for these communities include: *Puccinellia distans, Puccinellia maritima, Puccinellia rupestris, Plantago coronopus, Parapholis strigosa, Atriplex glabriuscula, Spergularia marina, Festuca rubra, Agrostis stolonifera, Aster tripolium, Hordeum secalinum, Elymus pycnanthus, Elymus repens, Potentilla anserina, Lolium perenne, Alopecurus geniculatus, Phragmites australis, Bolboschoenus maritimus, Festuca arundinacea,* *(see note above)
D9		Pioneer saltmarsh communities	**Species composition** *(abundance of typical species - section 4.1.4.iv of the conservation objectives)*	Frequency of typical species to be measured using methodology to be agreed (e.g. transects, plots etc) once during reporting cycle	Frequency of typical species of characteristic pioneer marsh communities should not deviate significantly from an established baseline. *Baseline is CCW/English Nature Saltmarsh NVC survey by Dargie 1998*	The typical species for these communities include : *Spartina anglica, Salicornia sp, Suaeda maritima*

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
D10	***SAC interest feature 4:*** **Atlantic salt meadows**		**Abundance of locally occurring scarce and notable plant species** *(abundance of notable species - section 4.1.4v of the conservation objectives)*	Number of discrete locations within the estuary where scarce and notable species are found and their abundance at each location.	No decrease in abundance of scarce and notable species from an established baseline. *Baseline : CCW/English Nature saltmarsh rare/scarce plant survey survey by Dargie 1998* *Individual county based records from plant recorders/record centres*	Nationally scarce and notable species within the Atlantic salt meadow and associated transitional vegetation communities comprise: **Nationally scarce species:** *Alopecurus bulbosus, Althaea officinalis, Bupleurum tenuissimum, Hordeum marinum, Trifolium squamosum, Puccinellia rupestris, Polygonum raii.* **Other notable species occurring*:*** *Allium oleraceum, Lepidium latifolium, Petroselinum segetum* Note that some of the nationally scarce and notable plants require levels of ground disturbance (resulting in openings in the sward) to establish. Localised tight grazing and /or poaching may provide sward openings for such species as well as the wider range of herbs and unless widespread and persistent should not necessarily regarded as a problem.
D11		All sub-features	**Sward structure** *(structural variation of the salt marsh sward - section 4.1.4 vi of the conservation objectives)*	Sward height of Atlantic salt meadow communities measured periodically during the reporting cycle in late summer using a combination of remote sensing and field visits.	The extent and distribution of vegetation communities exhibiting different sward heights should not deviate significantly from an established set of limits. The limits will be defined to ensure that the requirements of the typical and notable plants species and birds species designated within the Severn Estuary SPA and Ramsar, can be met *Baselines are to be established from Nature Conservancy Council SSSI owner/occupier consent records dating from 1988 Severn Estuary SSSI notification (and subsequent consent reviews)* *CCW and EN/NE site monitoring records*	Vegetation structure is largely affected by the impact of grazing (of wild or domesticated herbivores) interacting with different vegetation communities and ground hydrological conditions. Not all Atlantic salt meadow within the Severn Estuary is grazed, but it is a widespread and long established practice and stocking levels need to be appropriate to the interest of the site. Over grazing can lead to a loss of structural diversity of rare plant species and affect bird use of these habitats while under grazing can lead to a loss of plant diversity by competitive exclusion. Introduction of grazing to previously ungrazed sites can result in deleterious changes to plant community composition and its value for wider conservation interests such as invertebrates. Note that some of the nationally scarce and notable plants require levels of ground disturbance (resulting in openings in the sward) to establish. Localised tight grazing and /or poaching may provide sward openings for such species as well as the wider range of herbs and unless widespread and persistent should not necessarily regarded as a problem. Disturbance is also provided in areas where natural tidal debris accumulates scattered across the salt marsh and in driftlines (often at the base and on the seaward slope of the floodbank). As well as providing seed establishment points for scarce plants the debris also plays a role in creating variation in sward structure particularly in the mid/upper and transition high marsh zones and in supporting important populations of invertebrates (notable deadwood beetles). The continued presence of tidal debris and driftlines in some locations is therefore a desirable aspect of the saltmarsh management which delivers this attribute . They may also be of value for the bird populations which roost and feed on saltmarshes of the SPA and Ramsar Site. (see sections 4.2 and 4.3)

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
D12	***SAC interest feature 4:*** **Atlantic salt meadows**		**Morphology** *(characteristic stepped morphology and associated structural features - section 4.1.4.vii of the conservation objectives)*	Location and extent of established morphological features (saltmarsh terracing, creeks, pills, drainage ditches and pans) measured during the reporting cycle using remote sensing and field survey	No anthropogenic alteration of established morphological features from an established baseline. *Baselines is taken from 1999 air photos , CCW/English Nature Saltmarsh NVC survey by Dargie 1998 and English Nature condition assessment data collected in 2002 for Gloucestershire section of the estuary.*	This target relates to features which have developed naturally as a result of the evolution of the saltmarshes or the presence of freshwater drainage systems entering the estuary and which have established conservation value (eg pill sides of value botanically, pills used for shelter, feeding and roosting by birds). The baseline dataset will establish the location and extent of these features and identify man made features which do not need to meet this target.

Table 12 – Favourable condition table for the "reefs" feature of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
E1	***SAC interest feature 4:*** **Reefs**		**(Total) Extent and distribution** *(total extent and distribution of reef - section 4.1.5.i of the conservation objectives)*	Measurement of the extent and distribution of the purely subtidal part of this feature in the Severn Estuary is challenging. Remote sensing methods (such as side scan sonar) and drop down video are unreliable in these conditions. Therefore limited grab sampling may be required. Measurement of the subtidal component at the subtidal/intertidal interface may be possible by direct observation at very low tides. Extent and distribution of the intertidal *Sabellaria* reef measured using Phase 1 mapping survey techniques	No reduction in the extent and distribution of the reef from an established baseline *Baseline is comprised of grab sampling surveys by Mettam 1988 supplemented by Environment Agency data 1999 and data from Warwick et al.2001 which provide subtidal reef records.* *CCW/English Nature Intertidal Biotope Surveys 2006 identify the distribution of intertidal Sabellaria alveolata and indication of locations for further survey for subtidal Sabellaria contiguous with these intertidal areas.*	Known occurrences of subtidal and subtidal contiguous with intertidal reefs are largely limited to the outer parts of the estuary (area seaward of a line drawn between Portishead and Newport). See appendix 6. Samples show that reef formation is not continuous within this area and is in varying stages of growth. Further work is required to establish the distribution of this feature particularly with respect to the subtidal and the intertidal/subtidal interface. A further upstream zone of intertidal *Sabellaria* populations is recorded up to the old Severn Bridge (Beachley to Aust) . While not part of the reef feature the extent of solely intertidal *Sabellaria* is relevant as these areas will also contribute larvae to the estuary wide populations of this species. The populations of *Sabellaria* within the Severn (subtidal,and intertidal) should be regarded as a metapopulation. New technologies that may allow the measurement of *Sabellaria* reef in a non destructive way should be investigated if they present themselves.
E2			**Community composition** *(community composition - section 4.1.5.ii of the conservation objectives)-*	Measurement of the community composition of this feature in the Severn Estuary is challenging. Remote sensing methods (such as side scan sonar) and drop down video are difficult. Therefore limited grab sampling may be required.	New samples of reef show no significant decline in community composition from baseline records *Baseline is survey by Mettam 1988 supplemented by Environment Agency data 1999 and data from Warwick et al.2001*	The reefs feature comprise two communities : *Sabellaria alveolata* on variable salinity sublittoral mixed sediment SS.SBR.PoR.SalvMx *Sabellaria alveolata* reefs on sand-abraded eulittoral rock. LS.LBR.Sab.Salv The typical species associated with subtidal and intertidal reefs in the Severn Estuary, derived from known samples, are listed in section 4.15.1 note 4

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
E3	***SAC interest feature 4:*** **Reefs**		**Age structure** *(full range of age structures - section 4.1.5.iii of the conservation objectives)*	Measurement of the community composition of this feature in the Severn Estuary is challenging. Remote sensing methods (such as drop down video) are difficult. Therefore limited grab sampling may be required.	Different phases from newly settled worms through vigorous fast growing reef to older hummocks are present *Baseline yet to be established.*	*Sabellaria alveolata* reefs cycle through different phases from newly settled worms through vigorous fast-growing reef to older hummocks. In a stable or increasing population all age phases are likely to be present . The presence of areas of variable stages of growth is important in ensuring larval supply and also enhances the species diversity of the reef
E4			**Physical & ecological processes** *(physical and ecological processes - section 4.1.5.iv of the conservation objectives)*	**Abundance of coarse sediments** Presence of suitable sediment grades in subtidal and intertidal sediments within the defined reefs zone (see comment on extent and distribution above) measured periodically.	No change in the abundance of suitable sediment grades within the defined reefs zone against an established baseline *Baseline yet to be established.*	An abundance of suitable coarse sediments (0.5-1mm sand) are required to support reef growth (tube building)
E5				**Availability of suitable substrates** Extent of available suitable (hard or long-term consolidated) substrates within the defined reef zone measured periodically	No change in overall extent of available suitable substrates within the defined reefs zone against an established baseline *Baseline yet to be established – data from the BGS and the CCW/English Nature intertidal biotope survey 2006 may assist*	Within the Severn reefs have been recorded both on solid geology and on smaller rocks and cobbles.
E6				**Supply of larvae** Abundance of *Sabellaria* larvae within the water column measured through plankton sampling	No decrease in the abundance of *Sabellaria* larvae against an established baseline *Baseline yet to be established – data may be available from existing plankton sampling surveys*	Area of sampling for this attribute should include both the reef zone and areas where intertidal populations are known as all areas supporting *Sabellaria alveolata* formations will be supplying larvae to the water column and hence may seed the reef feature. Recruitment is likely to be variable between years.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
E7				**Abundance of food in water column** Methods to be determined .	No decrease in the abundance of suspended detritus within the water column of the defined reef zone against an established baseline *Baseline yet to be established*	Area of sampling of the water column should include both the reef zone and intertidal populations (the estuary-wide metapopulation of *Sabellaria alveolata*)

Table 13 – Favourable condition table for the "river lamprey" and "sea lamprey" features of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
F1	***SAC interest feature 5:*** **River lamprey** ***Lampetra fluviatilis*** **and** ***SAC interest feature 6:*** **Sea lamprey** ***Petromyzon marinus***		**Migratory access (Barriers to migration)** *(migratory passage not impeded - sections 4.1.6.i and 4.1.7.i of the conservation objectives)*	**Water quality** measured regularly throughout the reporting cycle in the Bristol Channel, Severn Estuary, River Wye SAC, River Usk SAC and River Severn. *(see also Table 8, lines A17-20 relating to general water quality requirements for the estuary feature (and dependant sub features)*	Water quality is sufficient to support migratory passage. Levels (for temperature, salinity, turbidity, pH, and dissolved oxygen) should comply with targets established under the EA Review of Consents and the Water Framework Directive. *Baseline is water quality sampling data collected by the Environment Agency*	Significant variation in these physico-chemical parameters may act as barriers to migration. For example, the timing, duration and consistency of their upstream migration are believed to be closely related to temperature changes as well as pheromone triggers from the juveniles during periods of high water flow. Peak migration usually coincides with river temperatures that remain above 10^{o}C and continues until temperatures reach 18^{o}C. Dissolved oxygen can also be significantly reduced in stretches receiving significant BOD inputs, or through the re-suspension of organic rich sediments. Toxic contaminants may act as a barrier to migration. Environmental Quality Standards (EQSs) are set for dangerous substances as defined under the Dangerous Substances Directive or Government Policy for freshwater and marine environments
F2				**Water flows** measured regularly throughout the reporting cycle (frequency to be determined) in the River Wye SAC, River Usk SAC and River Severn *(see also Table 8 line A3 relating to general tidal and water flow requirements for the estuary feature (and dependant sub features)*	Flows from the river into the estuary must be sufficient to allow migration. *Baseline is water flow sampling data collected by the Environment Agency provides a baseline. Severe low flow conditions that affect these species yet to be defined*	
F3				**Physical barriers** Mapping and quantification of potential obstructions in relation to height, type and water depth below obstruction once during the reporting cycle.	No artificial barriers significantly impairing, adults from reaching existing and historical spawning grounds, or juveniles from moving downstream. *Baseline is the Environment Agency data on structures and flood defences*	Dams, navigation and other weirs may prevent lamprey from reaching their spawning grounds. In particular, sea lamprey is known to be poor at ascending obstacles.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
F4	***SAC interest feature 5:*** **River lamprey** ***Lampetra fluviatilis*** **and** ***SAC interest feature 6:*** **Sea lamprey** ***Petromyzon marinus***		**Population size** (returning adults) *(size of populations - sections 4.1.6.ii and 4.1.7.ii of the conservation objectives)*	Number of returning adults measured using fish counters on the feeding rivers (Wye , Usk and Severn) during the migratory period.	No decline in number of returning adults from established baseline. *Baseline is yet to be established - fish counter data may be able to provide a baseline in future years.*	(Note that this attribute will not be able to be measured until the technological solutions are developed.) Fish counter technology is being developed to monitor adult lampreys but is not yet installed on the feeding rivers of the Severn Estuary. Fish counter technology should be further developed to monitor migrating adult river and sea lamprey.
F5			**Ammocoete population in tributary rivers** *(size of populations - sections 4.1.6.ii and 4.1.7.ii of the conservation objectives)*	Electrofishing surveys in $1m^2$ quadrats at a series of locations in the Rivers Usk, Wye (and Severn)	River population targets for the Usk and Wye must be met *Baseline is the survey of ammocoete abundance and distribution in the Rivers Usk and Wye commissioned by CCW in 2005 (Harvey et al. 2007).*	(Note that this attribute will not be able to be measured until the technological solutions are developed.) During the electrofishing survey all ammocoetes should be identified as *Lampetra* or *Petromyzon* and measured (mm). Surveys should be undertaken at the earliest in July but preferably between August and October. The rivers fauna CSM state three targets which must be met for the population attribute. These are; 1. Ammocoete population age structure For samples of 50 ammocoetes or less, at least 2 distinct size classes should normally be present. If more than 50 ammocoetes are collected, at least 3 size classes should be present. 2. Ammocoete distribution within catchment Lampreys should be present at not less than 2/3 of sites surveyed. 3. Ammocoete density; a. For *lampetra*; Optimal habitat $>10m^{-2}$ Overall catchment mean $>5m^{-2}$ b. For sea lamprey - Ammocoetes should be present in at least sampling sites each not less than 5km apart

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
F6			**Prey species** *(abundance of prey species - sections 4.1.6.iii and 4.1..7.iii of the conservation objectives))*	The abundance of key prey species measured periodically	No significant reduction in abundance of key prey species against an established baseline *Baseline is yet to be established Data to be used is EA monitoring of river and fish populations and future surveys*	River and sea lamprey require a variety of other fish species to act as hosts throughout their lifecycle. Their principal host species are part of the estuarine fish assemblage which has measures and targets included within the "estuaries" feature – Table 8

Table 14 – Favourable condition table for the "twaite shad" feature of the Severn Estuary SAC

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
G1	***SAC interest feature 7:*** **Twaite shad (*Alosa fallax*)**		**Migratory access (Barriers to migration)** *(migratory passage not impeded - section 4.1.8.i of the conservation objectives)*	**Water quality** measured regularly throughout the reporting cycle in the Bristol Channel, Severn Estuary, River Wye SAC, River Usk SAC and River Severn. *(see also Table 8 line A 17-20 relating to general water quality requirements for the estuary feature (and dependant sub features)*	Water quality is sufficient to support migratory passage. Levels (for temperature, salinity, turbidity, pH, and dissolved oxygen) should comply with targets established under the EA Review of Consents and the Water Framework Directive. *Baseline is water quality sampling data collected by the Environment Agency*	Significant variation in these physico-chemical parameters may act as barriers to migration. For example, the timing, duration and consistency of their upstream migration are believed to be closely related to temperature changes . Peak migration usually coincides with river temperatures that remain above 10^{o}C and continues until temperatures reach 18^{o}C. Dissolved oxygen can also be significantly reduced in stretches receiving significant BOD inputs, or through the resuspension of organic rich sediments. Toxic contaminants may act as a barrier to migration. Environmental Quality Standards (EQSs) are set for dangerous substances as defined under the Dangerous Substances Directive or Government Policy for freshwater and marine environments.
G2				**Water flows** measured regularly throughout the reporting cycle (frequency to be determined) in the River Wye SAC, River Usk SAC and River Severn *(see also Table 8 line A3 relating to general tidal and water flow requirements for the estuary feature (and dependant sub features)*	Flows from the river into the estuary must be sufficient to allow migration *Baseline is water flow sampling data collected by the Environment Agency provides a baseline. Severe low flow conditions that affect these species yet to be defined*	
G3				**Physical barriers** Mapping and quantification of potential obstructions in relation to height, type and water depth below obstruction once during the reporting cycle.	No artificial barriers significantly impairing, adults from reaching existing and historical spawning grounds, or juveniles from moving downstream. *Baseline is Environment Agency data on structures and flood defences*	Dams, navigation and other weirs may prevent shad reaching their spawning grounds. In particular, shad are known to be poor at ascending obstacles.

Ref	SAC Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
G4	***SAC interest feature 7:*** **Twaite shad (*Alosa fallax*)**		**Population size (returning adults)** *(size of populations - section 4.1.8.ii of the conservation objectives)*	Number of returning adults measured using fish counters on the Usk and Wye rivers during the migratory period.	No drop in the annual run size greater than would be expected from variations in natural mortality alone. *Baseline is yet to be established - fish counter data may be able to provide a baseline in future years. Noble et al. (2007) provides historical information on returning adults for the River Wye.*	(Note that this attribute will not be able to be measured until the technological solutions are developed.) Fish counter technology is being developed to monitor adult shad but is not yet installed on the feeding rivers of the Severn Estuary. Fish counter technology should be further developed to monitor migrating adult shad.
G5			**River population** *(size of populations - section 4.1.8.ii of the conservation objectives)*	Seine netting for juveniles in the lower rivers and upper estuaries and monitoring of shad eggs by kick sampling	River population targets for the Usk and Wye must be met *Baseline yet to be established. Noble et al. (2007) provides some information on juvenile densities.*	(Note that this attribute will not be able to be measured until the technological solutions are developed.) Seine netting should occur in lower rivers and upper estuaries. Netting should be carried out in late summer early autumn (July-October). For each river, juvenile densities should exceed a specified minimum target at least two years in six. The extent of spawning should be monitored by kick sampling for eggs at a proportion of known spawning sites. A reduction in the spawning distribution of more than 50 % compared with the baseline will indicate an adverse change. Kick sampling should occur during May and June.
G6			**Prey species** *(abundance of prey species – section 4.1.8.iii of the conservation objectives))*	The abundance of key prey species measured by EA in their routine monitoring of the rivers and estuary	No significant reduction in abundance of key prey species against an established baseline *Baseline is yet to be established through fish surveys in estuary and rivers*	Twaite shad require a variety of invertebrates including crustacean, mysids and copepods, small fish and fish eggs particularly in that section of the estuary where saline and freshwaters meet.

4.2 Conservation objectives for SPA European Marine Site interest features

The protection and management of the SPA in accordance with Article 6 of the Habitats Directive, including in particular the consideration of plans and projects under Article 6(3) and 6(4), should be carried out in view of the conservation objectives in this section.

Note : The conservation objectives for areas of the SPA which lie outside the European Marine Site boundary are provided in separate documents by CCW and Natural England which are currently in preparation and will soon be available on request.

4.2.1 SPA Interest feature 1: Internationally important population of regularly occurring Annex 1 species : Bewick's swan

The conservation objective is to maintain the Bewick's swan population and its supporting habitats[1]in **favourable condition**, as defined below

The interest feature Bewick's swan will be considered to be in favourable condition when, subject to natural processes[2], each of the following conditions are met:

(i) the 5 year peak mean population size for the Bewick's swan population is no less than 289 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of saltmarsh at the Dumbles (Appendix 8: Map 1) is maintained;

(iii) the extent of intertidal mudflats and sandflats at Frampton Sands, Waveridge Sands and the Noose (Appendix 8: Map 1) is maintained;

(iv) the extent of vegetation with an effective field size of >6 ha and with unrestricted bird sightlines > 500m at feeding, roosting and refuge sites (Appendix III) are maintained;

(v) greater than 25% cover of suitable soft leaved herbs and grasses[3] in winter season throughout the transitional saltmarsh at the Dumbles (Appendix 8: Map 1) is maintained;

(vi) aggregations of Bewick's swan at feeding, roosting and refuge sites are not subject to significant disturbance.

4.2.1.1 Explanatory information for the Bewick's swan conservation objective

[1] Key supporting habitats for the Annex I species

- **Intertidal mudflats and sandflats**
- **Saltmarsh**

[2]Natural processes in respect of the SPA

Each interest feature is subject to both natural processes and human influences. Human influence on the interest features is acceptable provided that it is compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions which is entirely a result of natural processes will not constitute unfavourable condition, but will trigger a review of the definition of favourable condition. This qualification is necessary because:

(a) the bird populations themselves are subject to natural factors, many of which arise outside the SPA, such as breeding success and winter temperatures;

(b) the supporting habitats of the birds are influenced by the evolution of the estuary. Natural adjustments within estuaries can take many forms. One important example is the tendency of estuaries to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by subtidal and intertidal sediment banks or features. This, with other natural processes, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. However, where this process is constrained, the capacity of habitats to accommodate readjustment may be affected.

[3]Key food plants of Bewick's swan

eg *Agrostis stolonifera, Alopecurus geniculatus, Glyceria geniculatus.* (This list contains examples and is not exhaustive)

4.2.2 SPA interest feature 2: Internationally important population of regularly occurring migratory species: wintering European white-fronted goose

The conservation objective is to maintain the European white-fronted goose population and its supporting habitats[1] in **favourable condition**, as defined below.

The interest feature European white-fronted goose will be considered to be in favourable condition[2] when, subject to natural processes[2], each of the following conditions are met:

(i) the 5 year peak mean population size for the wintering European white fronted goose population is no less than 3,002 individuals (ie the 5 year peak mean between 1988/9-1992/3);

(ii) the extent of saltmarsh at the Dumbles (Appendix 8: Map 1) is maintained;

(iii) the extent of intertidal mudflats and sandflats at Frampton Sands, Waveridge Sands and the Noose (Appendix 8: Map 1) is maintained;

(iv) greater than 25% cover of suitable soft-leaved herbs and grasses[3] is maintained during the winter on saltmarsh areas (Appendix 8: Map 1);

(v) unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;

(vi) aggregations of European white-fronted goose at feeding or roosting sites are not subject to significant disturbance.

4.2.2.1 Explanatory information for the wintering European white-fronted goose objective

[1]Key supporting habitats for the migratory bird species

- **Intertidal mudflats and sandflats**
- **Saltmarsh**

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.2.1.1**.

[3]Key food plants of European white-fronted goose

eg *Alopecurus bulbosus, Festuca rubra, Hordeum marinum, Lolium perenne; Puccinellia maritima*. (This list contains examples and is not exhaustive)

4.2.3 SPA interest feature 3: Internationally important population of regularly occurring migratory species: wintering dunlin

The conservation objective is to maintain the dunlin population and its supporting habitats[1] in **favourable condition**, as defined below:

The interest feature dunlin will be considered to be in favourable condition when, subject to natural processes[2], each of the following conditions are met:

(i) the 5 year peak mean population size for the wintering dunlin population is no less than 41,683 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of saltmarsh (Appendix 8)and associated strandlines is maintained;

(iii) the extent of intertidal mudflats and sandflats (Appendix 8) is maintained;

(iv) the extent of hard substrate habitats (Appendix 8) is maintained;

(v) the extent of vegetation with a sward height of <10cm is maintained throughout the saltmarsh (Appendix 8);

(vi) the abundance and macro-distribution of suitable invertebrates[3] in intertidal mudflats and sandflats (Appendix 8) is maintained;

(vii) the abundance and macro-distribution of suitable invertebrates[3] in hard substrate habitats (Appendix 8) is maintained;

(viii) unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;

(ix) aggregations of dunlin at feeding or roosting sites are not subject to significant disturbance.

4.2.3.1 Explanatory information for the wintering dunlin objective

[1]Key supporting habitats for the migratory bird species

- **Intertidal mudflats and sandflats**
- **Saltmarsh**
- **Hard substrate habitats (rocky shores)**

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.2.1.1**.

[3]Key intertidal invertebrate prey species of dunlin

eg *Carcinus, Crangon, Hydrobia, Macoma, Hediste,* and *Talitrus* spp.
(This list contains examples and is not exhaustive)

4.2.4 SPA interest feature 4: Internationally important population of regularly occurring migratory species: wintering redshank

The conservation objective is to maintain the redshank population and its supporting habitats[1] in **favourable condition**, as defined below

The interest feature redshank will be considered to be in favourable condition when, subject to natural processes[2] each of the following conditions are met:

(i) the 5 year peak mean population size for the wintering redshank population is no less than 2,013 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of saltmarsh (Appendix 8) and associated strandlines is maintained;

(iii) the extent of intertidal mudflats and sandflats (Appendix 8) is maintained;

(iv) the extent of hard substrate habitats (Appendix IV) is maintained;

(v) the extent of vegetation with a sward height of <10cm throughout the saltmarsh (Appendix 8) is maintained;

(vi) the abundance and macro-distribution of suitable invertebrates[3] in intertidal mudflats and sandflats (Appendix 8) is maintained;

(vii) the abundance and macro-distribution of suitable invertebrates[3] in hard substrate habitats (Appendix 8) is maintained;

(viii) unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;

(ix) aggregations of redshank at feeding or roosting sites are not subject to significant disturbance.

4.2.4.1 Explanatory information for the wintering redshank objective

[1]Key supporting habitats for the migratory bird species

- **Intertidal mudflats and sandflats**
- **Saltmarsh**
- **Hard substrate habitats (rocky shores)**

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.2.1.1**.

[3]Key intertidal invertebrate prey species of redshank

eg *Carcinus, Crangon, Hydrobia, Macoma, Hediste,* and *Talitrus* spp.
(This list contains examples and is not exhaustive)

4.2.5 SPA interest feature 5: Internationally important population of regularly occurring migratory species: wintering shelduck

The conservation objective is to maintain the shelduck population and its supporting habitats[1] in **favourable condition**, as defined below:

The interest feature shelduck will be considered to be in favourable condition when, subject to natural processes[2], each of the following conditions are met:

(i) the 5 year peak mean population size for the wintering shelduck population is no less than 2,892 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of saltmarsh (Appendix 8) is maintained;

(iii) the extent of intertidal mudflats and sandflats (Appendix 8) is maintained;

(iv) the extent of hard substrate habitats (Appendix 8) is maintained;

(v) the abundance and macro-distribution of suitable invertebrates[3] in intertidal mudflats and sandflats (Appendix 8) is maintained;

(vi) unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;

(vii) aggregations of shelduck at feeding or roosting sites are not subject to significant disturbance.

4.2.5.1 Explanatory information for the wintering shelduck objective

[1]Key supporting habitats for the migratory bird species

- **Intertidal mudflats and sandflats**
- **Saltmarsh**
- **Hard substrate habitats (rocky shores)**

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.2.1.1**.

[3]Key intertidal invertebrate prey species of shelduck

eg *Carcinus, Corophium* , *Hydrobia, Macoma, Mytilus,* and *Hediste* spp
(This list contains examples and is not exhaustive)

4.2.6 SPA interest feature 6: Internationally important population of regularly occurring migratory species: wintering gadwall

The conservation objective is to maintain the gadwall population and its supporting habitats[1] in **favourable condition**, as defined below:

The interest feature gadwall will be considered to be in favourable condition when, subject to natural processes[2], each of the following conditions are met:

(i) the 5 year peak mean population size for the wintering gadwall population is no less than 330 (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of intertidal mudflats and sandflats (Appendix 8) is maintained;

(iii) unrestricted bird sightlines of >200m at feeding and roosting sites are maintained;

(iv) aggregations of gadwall at feeding or roosting sites are not subject to significant disturbance.

4.2.6.1 Explanatory information for the wintering gadwall objective

[1]Key supporting habitats for the migratory bird species

- **Intertidal mudflats and sandflats**

  Note : It is currently unclear what use this species is making of the estuary – they are clearly present in intertidal areas particularly around areas freshwater streams and pills enter the estuary. Although primarily freshwater plant feeders they do also take animal material including insects, molluscs, annelids and even small fish and small amphibians – it is possible that they are feeding on such matter in the freshwater influenced mud and sands. Recent evidence indicates this species is changing it general habits as it extends its range westwards. As a result the conservation objective for this species does not include a condition in respect of the key food sources as for other species at this time.

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.2.1.1**.

4.2.7 SPA interest feature 7: Internationally important assemblage of waterfowl

The conservation objective is to maintain the waterfowl assemblage and its supporting habitats[1] in **favourable condition**, as defined below:

The interest feature waterfowl assemblage will be considered to be in favourable condition when, subject to natural processes[2] , each of the following conditions are met:

(i) the 5 year peak mean population size for the waterfowl assemblage is no less than 68,026 individuals (ie the 5 year peak mean between 1988/9 - 1992/3);

(ii) the extent of saltmarsh (Appendix 8) and their associated strandlines is maintained;

(iii) the extent of intertidal mudflats and sandflats (Appendix 8) is maintained;

(iv) the extent of hard substrate habitats (Appendix 8) is maintained;

(v) extent of vegetation of <10cm throughout the saltmarsh (Appendix 8) is maintained;

(vi) the abundance and macroscale distribution of suitable invertebrates[3] in intertidal mudflats and sandflats (Appendix 8) is maintained;

(vii) the abundance and macroscale distribution of suitable invertebrates[3] in hard substrate habitats (Appendix IV) is maintained;

(viii) greater than 25% cover of suitable soft leaved herbs and grasses[4] during the winter on saltmarsh areas (Appendix 8) is maintained;

(ix) unrestricted bird sightlines of >500m at feeding and roosting sites are maintained;

(x) waterfowl aggregations at feeding or roosting sites are not subject to significant disturbance.

4.2.7.1 Explanatory information for the internationally important assemblage of waterfowl

[1]Key supporting habitats for the waterfowl assemblage[1]

- **Intertidal mudflats and sandflats**
- **Saltmarsh**
- **Hard substrate habitats (rocky shores)**

[2]Natural processes in respect of the SPA

The meaning of 'natural processes' is explained in **section 4.1.1**.

[3]Key intertidal invertebrate prey species of the waterfowl assemblage

eg *Arenicola, Carcinus, Corophium, Crangon, Gammarus, Hydrobia, Macoma, Hediste, Notomastus and Talitrus* spp. - these lists are examples and are not exhaustive

[4]Key saltmarsh food plants

eg *Puccinellia maritima, Salicornia* spp., *Agrostis stolonifera, Atriplex* spp., *Hordeum marinum, Festuca rubra, Alopecurus bulbosus, Lolium perenne* - these lists are examples and are not exhaustive

4.2.8 Favourable Condition Tables for SPA interest features of the Severn Estuary European Marine Site

Background information on the role of favourable condition tables and the information provided in each column is provided in section 1.8 of this document, and a concise glossary of terms used is provided in Section 7.

The favourable condition table is intended to supplement the conservation objectives, including with respect to the management of established and ongoing activities, future requirements of monitoring and reporting on the condition of the features of the site and, together with the conservation objectives, informs the scope and nature of any appropriate assessment that may be needed. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under the Habitats Regulations. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

These tables set out all the attributes that **may** be used to monitor the condition of the features of the SPA. Where possible we will seek available information from others which can inform our assessment process.

It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the initial monitoring events in order to characterise the site and establish the baselines. Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Severn Estuary and may well be missed by routine monitoring.

Comprising :

Table 15 – Favourable condition table for the supporting habitats of the bird interest features in the Severn Estuary SPA

Table 16 – Favourable condition table for the qualifying bird features of the Severn Estuary SPA

Reference should also be made to Tables 8,10 and 11 - Favourable Condition Tables for the SAC habitat features relevant to the supporting habitats (intertidal mudflats and sandflats, saltmarsh and hard substrate habitats (rocky shores)) .

Table 15 Favourable Condition Table for the supporting habitats of the bird interest features in the Severn Estuary SPA European Marine Site (information on the populations of bird species using these habitats are given in Table 4)

SPA interest feature	Supporting Habitat	Attribute	Measure	Target	Comments
SPA interest feature 1: **Internationally important Annex 1 species: Bewick's swan**	Saltmarsh	Habitat extent	Area (ha) measured once per reporting cycle.	At The Dumbles, no decrease in extent from 76 ha.	Saltmarsh provides an important feeding and roosting habitat for Bewick's swans on The Dumbles - saltmarsh/transition wet grassland in front of sea defences.
		Vegetation characteristics	Abundance of suitable soft leaved herbs and grasses - % cover (frequency to be determined)	Greater than 25% cover during the winter season.	Bewick's swans graze on soft wet meadow grasses such as *Agrostis stolonifera, Glyceria fluitans* and *Alopecurus geniculatus* which are found in the transition of saltmarsh to grassland.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines. Areas of vegetation with an effective field size of >6ha	Bewick's swan require unrestricted views >500m to allow early detection of predators when feeding and roosting.
	Intertidal mudflats and sandflats	Habitat extent	Area (ha), measured once per reporting cycle.	At Frampton Sands, Waveridge Sands and the Noose, no decrease in extent from 980 ha.	The intertidal mudflats and sandflats at The Noose, Frampton Sand and Waveridge Sand are used as disturbance refuge for Bewick's swan. The extent and distribution of this sub-feature are important to maintain the population in favourable condition.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Bewick's swan require unrestricted views >500m to allow early detection of predators when feeding and roosting.

Table 15 - continued

SPA interest feature	Supporting Habitat	Attribute	Measure	Target	Comments
SPA interest features 2 - 6: **Internationally important populations of regularly occurring migratory species** and *SPA interest feature 7:* **Internationally important assemblage of waterfowl**	Saltmarsh	Habitat extent	Area (ha), measured once per reporting cycle.	No decrease in extent from 1,400 ha. At The Dumbles, no decrease in extent from 76 ha.	Saltmarsh and their communities are important habitats as they provide both roosting and feeding areas.
		Food availability	Presence and abundance of suitable saltmarsh food plants measured periodically (frequency to be determined).	Presence and abundance of suitable saltmarsh food plants should not deviate significantly from an established baseline[1]	European white-fronted geese graze on a range of saltmarsh grasses and herbs. Wigeon feed on well-grazed saltmarsh with *Puccinella maritiae*, *Salicornia* and *Agrostis*. Teal and pintail feed on seeds from *Salicornia* and *Atriplex*.
		Vegetation characteristics	Range of vegetation heights measured periodically (frequency to be determined).	Sward height and density throughout areas used for roosting should not deviate significantly from an established baseline[1].	Vegetation of <10 cm is required throughout areas used by roosting waders. This is managed by grazing.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.

Table 15 - continued

SPA interest feature	Supporting Habitat	Attribute	Measure	Target	Comments
SPA interest features 2 - 6: **Internationally important populations of regularly occurring migratory species** and *SPA interest feature 7:* **Internationally important assemblage of waterfowl**	Intertidal mudflats and sandflats	Habitat extent	Area (ha), measured once per reporting cycle.	No decrease in extent from 15,000 ha. At Frampton Sands, Waveridge Sands and The Noose no decrease in extent from 980 ha.	Intertidal mudflats and sandflats and their communities are important habitats as they provide both roosting and feeding areas.
		Food availability	Presence and abundance of suitable prey species measured periodically (frequency to be determined).	Presence and abundance of suitable prey species should not deviate significantly from an established baseline. [1]	Most of the waders and waterfowl within the assemblage including the internationally important regularly occurring migratory birds feed on invertebrates within and on the sediments. Diet includes *Arenicola, Crangon, Hydrobia,Hediste, Corophium, Macoma, Gammarus,* small molluscs and strandline plankton and seeds.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.
	Shingle and rocky shores	Habitat extent	Area (ha), measured once per reporting cycle.	No decrease in extent from 1,500 ha.	This habitat is used for feeding and roosting, particularly by waders.
		Food availability	Presence and abundance of suitable intertidal invertebrates, measured periodically (frequency to be determined).	Presence and abundance of suitable food species should not deviate significantly from an established baseline[1]	Waders feed on worms, crustaceans and molluscs.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.

[1] Baselines to be established

Table 16 Favourable Condition Table for the qualifying bird features in the Severn Estuary European Marine Site

SPA interest feature	Supporting Habitat	Attribute	Measure	Target	Comments
SPA interest feature 1: **Internationally important Annex 1 species: Bewick's swan**		Population size	5 year peak mean number of individuals	No less than 289 individuals [ie the 5 year peak mean between 1988/9 - 1992/3]	Mainly found in the Upper Severn Estuary at Slimbridge
		Proportion of biogeographic population	% of NW European population	1 % of NW European population	WeBS counts provide this information
		Distribution	Number and location of sectors occupied at low tide	No decrease in use of the number of sectors and their distribution established as baseline[1]	WeBS low tide counts display distribution information by sector (not annual counts) Birds use certain sectors to a greater or lesser degree from year to year
		Disturbance in feeding and roosting areas	Reduction or displacement of wintering birds	No significant reduction in numbers or displacement of wintering birds attributable to disturbance from an established baseline[1]	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.
SPA interest features 2 - 6: **Internationally important populations of regularly occurring migratory species** and *SPA interest feature 7:* **Internationally important assemblage of waterfowl**		Population size	5 year peak mean number of individuals	No less than 68,026 individuals in the assemblage [ie the 5 year peak mean between 1988/9 - 1992/3] For individual species - no less than the 5 year peak mean between 1988/9 - 1992/3 detailed in Table 4	Figures derived from WeBS counts. The 5 year peak means for this period for each of the internationally important populations and species with nationally important populations which make up the internationally important assemblage are detailed in Table 4
		Distribution	Number and location of sectors occupied at low tide	No decrease in use of the number of sectors and their distribution established as baseline[1]	In some years birds use certain sectors to a greater or lesser degree. WeBS low tide counts display distribution information by sector (not annual counts).

SPA interest feature	Supporting Habitat	Attribute	Measure	Target	Comments
		Disturbance in feeding and roosting areas.	Reduction or displacement of wintering birds	No significant reduction in numbers or displacement of wintering birds attributable to disturbance from an established baseline[1].	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

[1] Baselines to be established

4.3 Conservation objectives for the Severn Estuary / Môr Hafren Ramsar Site

The protection and management of the Ramsar in accordance with Article 6 of the Habitats Directive, including in particular the consideration of plans and projects under Article 6(3) and 6(4), should be carried out in view of the conservation objectives in this section.

4.3.1 Ramsar interest feature 1: Estuaries

The conservation objective for the "estuaries" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SAC "estuaries" feature" (refer to section 4.1.1 and Table 8 of this document), in so far as these objectives are applicable to the area designated as Ramsar Site and as defined below.

4.3.1.1 Explanatory information for the Ramsar Site "estuaries" conservation objective

The area of the estuarine ecosystem designated as Ramsar Site is smaller than that of the SAC as it is restricted to the terrestrial and intertidal areas and excludes all subtidal areas. There are therefore aspects of the SAC "estuaries" conservation objective that are not applicable to the Ramsar Site "estuaries" feature. The following Table 17 identifies the limits and restrictions, if any, that apply in respect of the Ramsar Site. The table layout follows the numbering of the SAC "estuaries" objective conditions given in section 4.1.1.

Table 17 - Limits of the Ramsar "estuaries" feature

SAC "estuaries" objective conditions to be met		Limits, if any, of the Ramsar
i.	the total extent of the estuary is maintained;	Limited to the lesser area of the Ramsar Site – excludes all subtidal areas - refer also to Appendix 2
ii.	the characteristic physical form (tidal prism/cross sectional area) and flow (tidal regime) of the estuary is maintained;	These requirements are related to the estuary regime, structure and function at a whole ecosystem level
iii.	the characteristic range and relative proportions of sediment sizes and sediment budget[3] within the site is maintained;	
iv.	the extent, variety and spatial distribution of estuarine habitat communities within the site is maintained;	Within the Ramsar Site this is limited to the habitats listed as Ramsar "estuarine habitats communities"[1] below
v.	the extent, variety, spatial distribution and community composition of hard substrate habitats and their notable communities is maintained;	Within the Ramsar Site this is limited to the habitats listed as Ramsar "hard substrate communities "[2] below
vi.	the abundance of the notable estuarine species assemblages is maintained or increased;	Within the Ramsar Site this is limited to the species listed as Ramsar "notable estuarine species assemblages"[3] below
vii.	the physico-chemical characteristics of the water column support the ecological objectives described above;	These requirements apply estuary wide at a whole ecosystem level
viii.	Toxic contaminants in water column and sediment are below levels which would pose a risk to the ecological objectives described above.	

[1]Ramsar "estuarine habitat communities"

a. Intertidal mudflats and sandflats (refer also to maps in Appendices 4 and 4a)
   - Intertidal gravel and clean sands
   - Intertidal muddy sands
   - Intertidal muds

b. Saltmarshes (equivalent to the Atlantic saltmeadows feature of the SAC) (refer also to maps in Appendices 5 and 5a)
   - Low – mid marsh communities
   - Mid – upper marsh communities
   - Transitional high marsh communities
   - Pioneer marsh communities

[2]Ramsar "hard substrate communities"

These include all hard substrate (rocky shore) communities within the Ramsar Site boundary shown in the map in Appendix 7 which includes the following notable communities:

- *Sabellaria alveolata reefs on sand-abraded eulittoral rock* (MLR.Sab Salv) *****
- *Hydroids, ephemeral seaweeds and Littorina littorea in shallow eulittoral mixed substrata pools.* **(**LR.RkpH)
- *Balanus crenatus and Tubularia indivisa on extremely tide-swept circalittoral rock* ECR.BS.BalTub)
- *Fucus serratus* and piddocks on lower eulittoral soft rock (MLR.Fser.Pid)
- *Mytilus edulis* and piddocks on eulittoral firm clay (MLR.MytPid)
- *Balanus crenatus, Halichondrea panicea* and *Alcyonidium diaphanum* on extremely tide-swept sheltered circalittoral rock (ECR.BalHpan) .
- *Sertularia cupressina and Hydrallmania falcate* on tide-swept sublittoral cobbles or pebbles in coarse sand (IGS.ScupHyd).
- *Corralina officinalis* and coralline crusts in shallow eulittoral rockpools (LR.Rkp.Cor)
- Eel grass (*Zostera*) beds
- Any other notable hard substrata communities that may be identified.

*****Note : where this community is contiguous with the occurrence of subtidal *Sabellaria alveolata* reefs it forms part of the SAC reefs feature. Within the Ramsar it is regarded as a component of the hard substrates subfeature of the Ramsar estuaries feature .

[3]Ramsar "notable estuarine species assemblages"

i. Assemblage of fish species:
   - Migratory species
     - River and Sea Lamprey and Twaite shad and Allis shad
     - Sea trout, salmon, eel,
   - Estuarine species
     - Species typically occurring and breeding in estuaries (Bird, 2008)
     - Marine species occurring in large numbers in estuaries (Bird, 2008)
   - Marine species
     - Predominantly marine species occurring infrequently in the Severn (Bird, 2008)
   - Freshwater species
     - Species typically occurring and breeding in freshwater and recorded within the Severn (Bird, 2008)

ii Assemblage of waterfowl species (refer also to section 4.3.9)

Internationally important populations of waterfowl comprising :
- Regularly occurring Annex 1 species - Bewicks' swan
- Regularly occurring migratory species - European white-fronted goose, dunlin, redshank, shelduck, and gadwall

Internationally important assemblage of waterfowl comprising above species plus the following :
- Nationally important bird populations - wigeon, teal, pintail, pochard, tufted duck, ringed plover, grey plover, curlew, whimbrel and spotted redshank, lesser black-backed gull

iii. Assemblage of vascular plant species:

- Salt marsh species (refer to notes 5 and 6 in section 4.1.4.1 - explanatory information on the conservation objective for the Atlantic salt meadows feature)
- Eel grass *(Zostera)* species.

4.3.2 Ramsar interest feature 2: Assemblage of migratory fish species[1]

The conservation objective for the "assemblage of migratory fish species" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined below:

The feature will be considered to be in favourable condition when, subject to natural processes[2], each of the following conditions are met:

i. the migratory passage of both adults and juveniles of the assemblage of migratory fish species through the Severn Estuary between the Bristol Channel and any of their spawning rivers is not obstructed or impeded by physical barriers, changes in flows, or poor water quality;

ii the size of the populations of the assemblage species in the Severn Estuary and the rivers which drain into it, is at least maintained and is at a level that is sustainable in the long term;

iii. the abundance of prey species[3] forming the principle food resources for the assemblage species within the estuary, is maintained.

iv. Toxic contaminants in the water column[4] and sediment are below levels which would pose a risk to the ecological objectives described above.

The meaning of terms [1-4] above is explained in **section 4.3.2.1**

Note : The populations of three of the assemblage species (river lamprey, sea lamprey and twaite shad) are designated as features of the SAC for which separate specific objectives have been written (refer to sections 4.1.6 to 4.1.8 of this document). The populations of these species depend on habitat in the adjacent River Usk SAC, River Wye SAC and River Severn. The habitats in these rivers, including spawning and nursery areas, are essential for the fulfilment of the species' lifecycle and therefore these features can only be in favourable condition if the conservation objectives pertaining to the River Usk SAC and River Wye SAC are also met in full and there is a continued recorded presence of these species in the River Severn.

4.3.2.1 Explanatory information for the assemblage of migratory fish species conservation objective

[1] Assemblage of migratory fish species

Species which are designated features of the SAC and for which individual conservation objectives have been written (refer to sections 4.1.6, 4.1.7 and 4.1.8)

Sea lamprey *Petromyzon marinus*
River lamprey *Lampetra fluviatilis*
Twaite shad *Alosa. fallax*

Other migratory species in the assemblage

Allis shad *Alosa alosa*
Salmon *Salmo salar*
Sea trout *S. trutta*
Eel *Anguilla anguilla*.

[2]Natural processes in respect of the Ramsar fish features

Assemblage populations :
The size of the populations is subject to non anthropogenic factors relating to natural fluctuations of external factors such as food / host availability in the Bristol Channel and more widely and breeding success in the River Severn and other rivers draining into the Severn Estuary.

Supporting habitats
The general meaning of 'natural processes' with respect to the supporting habitats of the migratory fish assemblage within the estuary is explained in **section 4.1.1.1**.

[3]Prey species

Assemblage Species	Key prey species
Sea lamprey	Eel *Anguilla anguilla*, cod *Gadus morhua*, and haddock *Melanogrammus aeglefinus* are all potential prey species for the sea lamprey found within the Severn Estuary (Bird 2008)
River lamprey	Sea trout *Salmo trutta*, shad *Alosa fallax/Alosa alosa*, herring *Clupea harengu*s, sprat *Sprattus sprattu*s, flounder *Platichthys flesu*s and small gadoids such as whiting *Merlangius merlangu*s and pout *Trisopterus luscu*s are all potential prey species for the river lamprey found within the Severn Estuary (Bird 2008).
Twaite shad	Small custaceans, especially mysids and copepods, small fish, especially sprats and anchovies, and fish eggs (Maitland, P.S. & Hatton-Ellis 2003).
Allis shad	Small custaceans, especially mysids and copepods, small fish, especially sprats and anchovies, and fish eggs (Maitland, P.S. & Hatton-Ellis 2003).
Salmon	While at sea, salmon feed on a variety of fish (e.g. herring, sprat, sand eel, mackerel, and various gadoids) and crustaceans (e.g. euphausiid shrimps, prawns, gammarid amphipods and various crabs). (Bird, 2008)
Sea trout	The diet of this species at sea has not been much studied but is believed to include a range of fish species including sprat, young herring and sand eels as well as crustaceans such amphipods (e.g. Corophium), gammarids, decapods such as Crangon and mysid shrimps. Many of these prey items also occur in estuaries where sea trout are known to feed extensively. (Bird, 2008)
Eel	A range of benthic organisms that include crustaceans and small fish. (Bird, 2008)

[4]Water column

Water column should be read to include contributory water flows into the estuary including surface flows over mudflats and saltmarsh.

4.3.3 Ramsar interest feature 3: Internationally important populations of waterfowl : Bewick's swan

The conservation objective for the "Bewick's swan" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "Bewick's swan " feature (refer to section 4.2.1)

4.3.4 Ramsar interest feature 4 : Internationally important populations of waterfowl : European white-fronted goose

The conservation objective for the "European white-fronted goose" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "wintering European white-fronted goose" feature (refer to section 4.2.2)

4.3.5 Ramsar interest feature 5: Internationally important populations of waterfowl : dunlin

The conservation objective for the "dunlin" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "wintering dunlin " feature (refer to section 4.2.3)

4.3.6 Ramsar interest feature 6: Internationally important populations of waterfowl : redshank

The conservation objective for the "redshank" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "wintering redshank" feature (refer to section sections 4.2.4)

4.3.7 Ramsar interest feature 7: Internationally important populations of waterfowl :shelduck

The conservation objective for the "shelduck" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "wintering shelduck" feature (refer to section 4.2.5)

4.3.8 Ramsar interest feature 8: Internationally important populations of waterfowl : gadwall

The conservation objective for the "gadwall" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "wintering gadwall" feature (refer to section sections 4.2.6)

4.3.9 Ramsar interest feature 9: Internationally important assemblage of waterfowl

The conservation objective for the "internationally important assemblage of waterfowl" feature of the Severn Estuary Ramsar Site is to maintain the feature in favourable condition, as defined by the conservation objective for the SPA "internationally important assemblage of waterfowl" feature (refer to section sections 4.2.7) – with special reference to the individual species listed and their population figures given in Table 6

Note : This Ramsar Site feature incorporates both wintering and passage populations of some birds and hence some species are included more than once in lists given in Table 6

4.3.10 Favourable Condition Tables for the Ramsar Site interest features of the Severn Estuary European Marine Site

Background information on the role of favourable condition tables and the information provided in each column is provided in section 1.8 of this document, and a concise glossary of terms used is provided in Section 7.

The favourable condition table is intended to supplement the conservation objectives, including with respect to the management of established and ongoing activities, future requirements of monitoring and reporting on the condition of the features of the site and, together with the conservation objectives, informs the scope and nature of any appropriate assessment that may be needed. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under the Habitats Regulations. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

These tables set out all the attributes that **may** be used to monitor the condition of the features of the Ramsar Site. Where possible we will seek available information from others which can inform our assessment process.

It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the initial monitoring events in order to characterise the site and establish the baselines. Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Severn Estuary and may well be missed by routine monitoring.

Comprising :

Table 18 – Favourable condition table for the “estuaries” feature of the Severn Estuary Ramsar Site

Table 19 – Favourable condition table for the migratory fish assemblage of the Severn Estuary Ramsar Site

Table 20 – Favourable condition table for the supporting habitats of the bird interest features (Ramsar features 3 to 9) in the Severn Estuary Ramsar Site

Table 21 – Favourable condition table for the qualifying bird interest features in the Severn Estuary Ramsar Site
Favourable condition table for the “estuaries” feature of the Severn Estuary Ramsar Site

Reference should also be made to Tables 8,10 and 11 - Favourable Condition Tables for the SAC habitat features relevant to the supporting habitats (intertidal mudflats and sandflats, saltmarsh and hard substrate habitats (rocky shores)) .

Table 18 Favourable Condition Table for the "estuaries" feature of the Severn Estuary Ramsar Site

Ramsar interest feature	**Comments**
Ramsar Interest feature 1: **Estuaries**	**The Favourable Condition Table for the "estuaries" feature of the Severn Estuary Ramsar Site is largely the same as that for the Severn Estuary SAC "estuaries" feature (see section 4.1 : Table 8).** However the area of the estuarine ecosystem designated as Ramsar Site is smaller than that of the SAC as it is restricted to the terrestrial and intertidal areas and excludes all subtidal areas. Table 17 identifies the limits and restrictions that apply in respect of the Ramsar Site Conservation Objective. **There are therefore aspects of the SAC "estuaries" Favourable Condition Table that are not applicable to the Ramsar Site "estuaries" feature as follows :** • All attributes other than those referred to below - apply only in respect of the area within the Ramsar Boundary (as shown in Appendix 2) • Line A6 - which relates to the subtidal sandbanks subfeature of the estuaries feature - this does not apply as these habitats lie outside the boundary of the Ramsar Site • Line A9 - which relates to the reefs subfeature of the estuaries feature - this only applies in respect of areas where intertidal *Sabellaria alveolota* occurs contiguously with the subtidal reefs (yet to be fully defined).

Table 19 Favourable Condition Table for the Migratory fish assemblage feature of the Severn Estuary Ramsar Site

Ramsar interest feature	Sub-feature	Attribute	Measure	Target	Comments
Ramsar Interest feature 2 : **Migratory fish assemblage**		**Migratory access (Barriers to migration)** *(migratory passage not impeded - sections 4.6.i and 4.7.i of the conservation objectives)*	**Water quality** measured regularly throughout the reporting cycle in the Bristol Channel, Severn Estuary, River Wye SAC, River Usk SAC and River Severn. *(see also lines A17- A20 of Table 8 relating to general water quality requirements for the estuary feature (and dependant sub features)*	Water quality is sufficient to support migratory passage. Levels (for temperature, salinity, turbidity and pH, and dissolved oxygen) should comply with targets established under the EA Review of Consents and the Water Framework Directive. *Baseline is water quality sampling data collected by the Environment Agency*	Significant variation in these physio-chemical parameters may act as barriers to migration. For example, the timing, duration and consistency of their upstream migration are believed to be closely related to temperature changes as well as pheromone triggers from the juveniles during periods of high water flow. Peak migration usually coincides with river temperatures that remain above 10^{o}C and continues until temperatures reach 18^{o}C. Dissolved oxygen can also be significantly reduced in stretches receiving significant BOD inputs, or through the re-suspension of organic rich sediments. Toxic contaminants may act as a barrier to migration.
			Water flows measured regularly throughout the reporting cycle (frequency to be determined) in the River Wye SAC, River Usk SAC and River Severn *(see also line A3 of Table 8 relating to general tidal and water flow requirements for the estuary feature (and dependant sub features)*	Flows from the rivers into the estuary must be sufficient to allow migration *Baseline is water flow sampling data collected by the Environment Agency provides a baseline. Severe low flow conditions that affect these species yet to be defined*	
			Physical barriers Mapping and quantification of potential obstructions in relation to height, type and water depth below obstruction once during the reporting cycle.	No artificial barriers significantly impairing, adults from reaching existing and historical spawning grounds, or juveniles from moving downstream. *Baseline is the Environment Agency data on structures and flood defences*	Dams, navigation and other weirs may prevent fish from reaching their spawning grounds. In particular, sea lamprey is known to be poor at ascending obstacles.

Ramsar interest feature	Sub-feature	Attribute	Measure	Target	Comments
		Population sizes (returning adults) *(size of populations - sections 4.6.ii and 4.7.ii of the conservation objectives)*	Number of returning adults measured using fish counters on the feeding rivers (Wye , Usk and Severn) during the migratory period.	No decline in number of returning adults from established baseline. *Baseline is yet to be established - fish counter data may be able to provide a baseline in future years.*	(Note that this attribute will not be able to be measured until the technological solutions for monitoring some species (notably lampreys and shad) are developed.)
		River populations *(size of populations - sections 4.6.ii and 4.7.ii of the conservation objectives)*	Survey through various methods (Electrofishing, seine netting , line fishing records, licencing returns) at a series of locations in the Rivers Wye, Usk and Severn	No decline in populations of the Rivers Wye and Usk *Baseline is yet to be established - fish counter data may be able to provide a baseline in future years.*	Details of methods for river and sea lamprey are outlined in section 4.1.9, Table 13 and for Twaite shad in Table 14 - the individual FCT for these species within the SAC section of this document
		Prey species *(abundance of prey species - sections 4.6.iii and 4.7.iii of the conservation objectives))*	The abundance of key prey species measured by EA in their routine monitoring of the rivers and estuary	No significant reduction in abundance of key prey species against an established baseline *Baseline is yet to be established through fish surveys in estuary and rivers*	River and sea lamprey require a variety of other fish species to act as hosts throughout their lifecycle. Their principal host species are part of the estuarine fish assemblage which has measures and targets included within Table 8. Twaite shad require a variety of invertebrates including crustacean, mysids and copepods, small fish and fish eggs particularly in that section of the estuary where saline and freshwaters meet. While at sea, salmon feed on a variety of fish (e.g. herring, sprat, sand eel, mackerel, and various gadoids) and crustaceans (e.g. euphausiid shrimps, prawns, gammarid amphipods and various crabs). (Bird, 2008) The diet of sea trout at sea is believed to include a range of fish species including sprat, young herring and sand eels as well as crustaceans such amphipods (e.g. Corophium), gammarids, decapods such as Crangon and mysid shrimps. Eeels feed on a range of benthic organisms that include crustaceans and small fish. (Bird, 2008)

Table 20 Favourable Condition Table for the supporting habitats of the bird interest features (Ramsar interest features 3 to 9) in the Severn Estuary Ramsar Site (Numbers of bird species using these habitats are given in Table 6)

Ramsar interest features	Supporting Habitat	Attribute	Measure	Target	Comments
Ramsar Interest features 3-8 : **Internationally important populations of waterfowl** and *Ramsar Interest feature 9 :* **Internationally important assemblage of waterfowl**	Saltmarsh	Habitat extent	Area (ha) measured once per reporting cycle.	No decrease in extent from 1,400 ha. At The Dumbles, no decrease in extent from 76 ha.	Saltmarsh and their communities are important habitats as they provide both roosting and feeding areas.
		Food availability	Presence and abundance of suitable saltmarsh food plants measured periodically (frequency to be determined).	Presence and abundance of suitable saltmarsh food plants should not deviate significantly from an established baseline[1].	European white-fronted geese graze on a range of saltmarsh grasses and herbs. Wigeon feed on well-grazed saltmarsh with *Puccinella maritiae*, *Salicornia* and *Agrostis*. Teal and pintail feed on seeds from *Salicornia* and *Atriplex*.
		Vegetation characteristics	Abundance of suitable soft leaved herbs and grasses - % cover (frequency to be determined)	Greater than 25% cover during the winter season.	Bewick's swans graze on soft wet meadow grasses such as *Agrostis stolonifera*, *Glyceria fluitans* and *Alopecurus geniculatus* which are found in the transition of saltmarsh to grassland.
		Vegetation characteristics	Range of vegetation heights measured periodically (frequency to be determined).	Sward height and density throughout areas used for roosting should not deviate significantly from an established baseline[1].	Vegetation of <10 cm is required throughout areas used by roosting waders. This is managed by grazing.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines. Areas of vegetation with an effective field size of >6ha at the Dumbles (Bewicks swan)	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.

Table 20 continued

Ramsar interest features	Supporting Habitat	Attribute	Measure	Target	Comments
Ramsar Interest features 3-8 : **Internationally important populations of waterfowl** and *Ramsar Interest feature 9 :* **Internationally important assemblage of waterfowl**	Intertidal mudflats and sandflats	Habitat extent	Area (ha), measured once per reporting cycle.	No decrease in extent from 15,000 ha. At Frampton Sands, Waveridge Sands and The Noose no decrease in extent from 980 ha.	Intertidal mudflats and sandflats and their communities are important habitats as they provide both roosting and feeding areas. The intertidal mudflats and sandflats at The Noose, Frampton Sand and Waveridge Sand are used as disturbance refuge for Bewick's swan. The extent and distribution of this sub-feature are important to maintain the population in favourable condition.
		Food availability	Presence and abundance of suitable prey species measured periodically (frequency to be determined).	Presence and abundance of suitable prey species should not deviate significantly from an established baseline[1]..	Most of the waders and waterfowl within the assemblage including the internationally important population of waterfowl feed on invertebrates within and on the sediments. Diet includes *Arenicola, Crangon, Hydrobia,Hediste, Corophium, Macoma, Gammarus,* small molluscs and strandline plankton and seeds.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.
	Shingle and rocky shores	Habitat extent	Area (ha), measured once per reporting cycle.	No decrease in extent from 1,500 ha.	This habitat is used for feeding and roosting, particularly by waders.
		Food availability	Presence and abundance of suitable intertidal invertebrates, measured periodically (frequency to be determined).	Presence and abundance of suitable food species should not deviate significantly from an established baseline[1].	Waders feed on worms, crustaceans and molluscs.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines.	Waterfowl require unrestricted views >500m to allow early detection of predators when feeding and roosting.

[1] Baselines to be established

Table 21 Favourable Condition Table for the qualifying bird features in the Severn Estuary Ramsar Site

Ramsar interest features	Supporting Habitat	Attribute	Measure	Target	Comments
Ramsar Interest features 3-8 : **Internationally important populations of waterfowl** and *Ramsar Interest feature 9 :* **Internationally important assemblage of waterfowl**		Population size	5 year peak mean number of individuals	No less than 68,026 individuals in the assemblage [ie the 5 year peak mean between 1988/9 - 1992/3] For individual species - no less than the 5 year peak mean between 1988/9 - 1992/3 detailed in Table 6	Figures derived from WeBS counts. The 5 year peak means for this period for each of the internationally important populations and species with nationally important populations which make up the internationally important assemblage are detailed in Table 6
		Distribution	Number and location of sectors occupied at low tide	No decrease in use of the number of sectors and their distribution established as baseline[1].	WeBS low tide counts display distribution information by sector (not annual counts) Birds use certain sectors to a greater or lesser degree from year to year
		Disturbance in feeding and roosting areas.	Reduction or displacement of wintering birds	No significant reduction in numbers or displacement of wintering birds attributable to disturbance from an established baseline[1].	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

[1] Baselines to be established

5. Advice on Operations

CCW and Natural England have a duty under Regulation 33(2)(b) of The Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to 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. Information on how CCW and Natural England have developed this advice is given in section 5.2, and on how it may be reviewed and updated in the future in section 5.3.

The Advice on Operations concerning the SAC are provided in detail in Table 22 and section 5.6. The Advice on Operations concerning the SPA is provided in Table 23 and section 5.7. These include recommendations regarding specific interest features and their supporting habitats. The Advice on Operations concerning the Ramsar Site is provided by cross reference to the subsections of the advice for the SAC and SPA which are relevant to the Ramsar Site interest features.

5.1. Purpose of advice

The aim of this advice is to provide CCW and Natural England's Advice on Operations as required by Regulation 33 (2)(b)for the Severn Estuary European Marine Site and thereby enable all relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threat to the favourable condition of interest features on the Severn Estuary European Marine Site. The advice should be read in conjunction with the Conservation Objectives for the SAC, SPA and Ramsar Sites interest features given in sections 4.1, 4.2 and 4.3 respectively and it is intended to provide the basis for detailed discussions to formulate and agree a management scheme for the European Marine Sites.

General advice on sensitivity, exposure (and therefore vulnerability) contained within this document is presented against broad categories of operation which may cause the deterioration of natural habitats or the habitats of species, or the disturbance of species (refer to section 5.2). It reflects activities and plans and projects. Generic examples of some of the types of operation that are covered under the broad category headings are given for illustration.

The advice is based on best available information at the time of preparation of the Regulation 33 advice for the Severn Estuary in 2008/09. For a current assessment of levels of disturbance of specific types of activity across the Severn Estuary (relevant solely to the SPA interest features), reference should be made to the SPA Scheme of Management, available at the ASERA website (http://www.severnestuary.net/asera/). It should be noted, however, that the frequency, intensity, effects and level of risk to the SPA features that certain activities may have are still being investigated under the existing Severn Estuary Scheme of Management.

5.2 Methods for assessment

The advice provided here is within six broad categories of operation which may cause the deterioration of natural habitats or the habitats of species, or the disturbance of species. These categories are:

- Physical loss
- Physical damage
- Non-physical disturbance
- Toxic contamination
- Non-toxic contamination
- Biological disturbance

Within these categories are environmental impacts that may result from operations. Example sources of activities are provided in the MarLIN *Maritime and coastal activities to environmental factors matrix* (see Appendix 10), although these are by no means inclusive of all potentially damaging activities.

Given current knowledge of the nature and extent of activities taking place within the Severn Estuary European Marine Site, this approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;
- provides a consistent framework to enable relevant authorities in England and Wales to assess the effects of activities and identify priorities for management within their areas of responsibility; and
- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by the CCW and Natural England.

These broad categories provide a clear framework against which relevant authorities can assess activities or operations under their responsibility. The more detailed information in Tables 22 and 23 (covering both the SAC and SPA) provides competent authorities with a context against which to consider an assessment of 'significant effect' of any plans or projects which may affect the site and a basis to inform on the scope and nature of appropriate assessments required in relation to plans and projects. It is important to note that this advice is only a starting point for assessing impacts. It does not remove the need for the relevant or competent authorities to consult CCW or Natural England formally over individual plans and projects where required to do so under the Regulations.

This Advice on Operations for the site is based on a three-step process involving:

- an assessment of the **sensitivity** of the interest features or their component supporting habitats to operations;
- an assessment of the **current exposure** of each interest feature or their component supporting habitats to operations; and
- a final assessment of **current vulnerability** of interest features or their component supporting habitats to operations.

Note that in respect of the SPA, sensitivity, exposure and vulnerability have been assessed largely in relation to the use of habitats by birds, but may also take into account direct effects on the bird species themselves (such as 'shooting' or 'disturbance').

This three-step process builds up a level of information necessary to manage activities in and around the European Marine Site in an effective manner and to identify to competent and relevant authorities those operations which pose the most immediate threats to the favourable condition of the interest features of the European Marine Site.

The assessment of relative sensitivity, exposure and vulnerability is derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of knowledge and understanding of the marine environment. Where possible, the sensitivity, exposure and vulnerability are assessed on a three-point scale of 'Low', 'Moderate' or 'High'. To assist with interpretation, these levels have been colour-coded in Tables 22 & 23.

5.2.1 Sensitivity assessment

The sensitivity assessment used is an assessment of the relative sensitivity of the interest features or the component supporting habitats of the Severn Estuary European Marine Site to the effects of six broad categories of human activities. In relation to this assessment, **sensitivity** has been defined as **'the intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor and the time taken for its subsequent recovery'** (MarLIN, 2003). For

example, a very sensitive species or habitat is one that is very adversely affected by an external factor arising from human activities or natural events (killed/destroyed, 'high' intolerance) and is expected to recover over a very long period of time, i.e. >10 or up to 25 years ('low' recoverability).

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. The sensitivity of interest features (and scientific understanding of sensitivity) may change over time; hence an operation which is not currently considered to have a negative effect, may do so in the future.

English Nature (now Natural England) and Scottish Natural Heritage commissioned the Marine Biological Association of the UK, through its Marine Life Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice. Detailed sensitivity information at a biotope or species level is available via MarLIN's website (www.marlin.ac.uk). The sensitivity assessments are indicative qualitative judgements based on the best available scientific information. They represent the most likely (probable) result of a given change in a factor. The sensitivity assessments of the interest features or their component supporting habitats of the Severn Estuary SAC, SPA and Ramsar Site are based upon MarLIN sensitivity assessments for biotopes (components of the Annex I habitats) and species supplemented by local knowledge and professional judgement to provide a site specific assessment that reflect the unusual and extreme character of the Severn Estuary.

The sensitivities of each of the SAC Annex I habitat features have been assessed on the component biotopes represented within each of the habitats (where information is available). Where information has not been available, such as for subtidal *Sabellaria alveolata* reefs or for Atlantic saltmeadow communities, a number of scientific review documents have been consulted, including reports produced for the UK Marine SAC LIFE project (see Bibliography section for a full list of these).

Assessments for the Annex II migratory fish have been based on current knowledge (best available scientific knowledge), which is limited for the life phase that shad and lamprey spend in estuarine waters. Given the paucity of information, it has not been possible to assess the level of sensitivity on a three-point scale; they have been assessed to be either 'sensitive' or 'not sensitive'.

For the SPA, the sensitivities have been assessed in relation to the use of habitats by birds and the sensitivities of the individual species themselves to certain activities. For example, wintering birds are highly sensitive to the loss of their roosting or feeding grounds; and they are highly sensitive to the noise of shooting. The sensitivity assessments of the interest features or their component supporting habitats of the Severn Estuary SPA are based on a number of scientific review documents. These include reports produced for the UK Marine SAC LIFE project (Davison & Hughes 1998; Elliott *et al.*, 1998), the Countryside Council for Wales Science Report (Holt *et al.*, 1995) and the Marine Habitats Review (Jones *et al.*, 2000.).

The magnitude or scale of the effect of an activity and the resultant change in environmental factors are site specific. For the purpose of this advice, the assessments of sensitivity have been adjusted for *changes in suspended sediments* and *turbidity* to reflect the particular conditions affecting the site. As a result of the high tidal energy of the site, the concentration of suspended sediment and turbidity are naturally very high. The marine fauna, including the migratory fish, are adapted to such high concentrations of suspended sediment and thus they are unlikely to have any significant effect. Consequently the sensitivities relating to *changes in suspended sediments* and *turbidity* have been downgraded.

Table 22 shows the sensitivity assessments for the SAC features and sensitivity assessments for the SPA can be seen in Table 23.

5.2.2 Exposure assessment

Exposure assessment has been undertaken for the Severn Estuary European Marine Site by assessing the relative exposure of the interest features or their component supporting habitats to the effects of broad categories of operations, resulting from human activities currently occurring on the site. Exposure has been assessed against a matrix which relates activities to operation pressures (see Appendix 10). The

matrix has been used as a guide and interpreted to assess the exposure to current activities known to be present within the site.

In assigning a three-point score (High, Moderate or Low) to the exposure, each activity is considered for:

- Spatial extent of the pressure
- Frequency of the pressure and
- Intensity of the pressure

For the SPA, the exposure has been assessed in relation to the use of habitats by birds and on the bird species themselves. As an example, the feeding and roosting grounds of wintering birds may be considered highly exposed to toxic contamination from synthetic compounds due to the locations and intensity of discharges into an area.

5.2.3 Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component supporting habitats to operations. This category results from an integration of sensitivity and exposure. Only if a feature is both sensitive and exposed to a human activity will it be considered vulnerable. In this context therefore, 'vulnerability' has been defined as **'the exposure of a habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive'** (Hiscock, 1996).

Tables 22 and 23 show the vulnerability assessments for the SAC features and the SPA features respectively.

5.3 Update and review of advice

Information as to the categories of operations which may cause the deterioration of natural habitats or the habitats or disturbance of species for which the site has been designated, is provided in light of what CCW and Natural England know about current activities and patterns of usage within the Severn Estuary European Marine Site. The general information on current activities and patterns of usage (which was used in part to derive Table 23) has been refined at the local level in producing the management scheme for the SPA and through further discussion with the relevant authorities. This management scheme is available at the ASERA website (http://www.severnestuary.net/asera/) although this will require review following this more detailed analysis of impacts on the estuarine habitats that are supporting habitats for the birds of the SPA.

The information provided in this advice on the sensitivity of interest features or their supporting habitats (Table 23) will change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. It is suggested that advice for sites be kept under review and is periodically updated through discussion with relevant authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

5.4 Plans and Projects

Under Regulation 48(1), an appropriate assessment must be undertaken by competent authorities in respect of any plan or project which:

a. either alone or in combination with other plans or projects is likely to have a ***significant effect*** on a European site; and
b. is not directly connected with or necessary to the management of the site for nature conservation.

This legal requirement applies to all European sites (SACs and SPAs). Regulation 48 is also applied, as a matter of Government policy, to proposed SPAs and listed Ramsar sites.

Tables 22 and 23 provides competent authorities with a guide against which to initiate an assessment of the 'significance' of any plans or projects (and on-going operations or activities) proposed for the site, although this will only be a starting point for assessing impacts and does not remove the need for competent authorities to consult CCW or Natural England formally over individual plans and projects where required under the Regulations.

5.5 Review of consents

Regulation 50 of the Conservation (Natural Habitats, &c.) Regulations 1994 requires a competent authority to undertake a review of any existing consent or permission to which Regulation 48(1) would apply if it were to be reconsidered as of the date on which the site became a European site. Where a review is required under these provisions it must be carried out as soon as reasonably practicable after classification of the European Marine Site. Consents will need to be reviewed in the light of these objectives.

5.6 Specific Advice on Operations for the Severn Estuary SAC

This section provides information to help relate general advice to each of the specific interest features of the Severn Estuary SAC. Where specific examples are given they are provided to aid understanding of possible impacts and are not intended to be a comprehensive list of all relevant operations.

This advice relates to the vulnerability of the interest features and supporting habitats of the Severn Estuary SAC as set out in more detail in Table 22. A brief explanation of the sensitivity of the interest features or supporting habitats follows, with an explanation of their exposure and consequently their vulnerability to damage or disturbance from the listed categories of operations is also given. This enables links between the categories of operation and the ecological requirements of the European Marine Site and Ramsar Site interest features to be made.

The precise impact of any category of operation occurring on the site will be dependent upon the nature, scale, location and timing of events. In accordance with Government policy guidance, the Advice on Operations provided here, is feature and site specific, and provided in the light of current activities and patterns of usage at the site.

As such, it is important that future consideration of this advice by relevant authorities, and others, takes account of changes in usage patterns that have occurred at the site over the intervening period. Advice for sites should be kept under review: it is suggested that periodic discussions with relevant authorities and others be undertaken to reflect significant changes in the understanding of sensitivities, as well as the potential effects of future plans or projects on the marine environment.

5.6.1 Estuaries feature

(Note : this advice is also relevant to the "estuaries" feature of the Ramsar Site – refer also to section 5.8)

5.6.1.1 Sensitivity

The **estuary** and its associated biological communities are **moderately to highly sensitive** to:

- **physical loss**
- **physical damage**
- **toxic contamination**
- **non-toxic contamination** and
- **biological disturbance**

These result from a range of activities known to occur in the estuary. Further details are provided in points i) to xiv) below, with details of the level of sensitivity set out in Table 22.

5.6.1.2 Exposure

The **estuary** and its associated biological communities are **moderately to highly exposed** to:

- **substratum loss**
- **smothering**
- **changes in suspended sediment**
- **changes in water flow rate**
- **changes in wave exposure**
- **abrasion and physical disturbance**
- **noise and visual disturbance**
- **toxic contamination (introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in thermal regime**
- **changes in turbidity**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**
- **introduction of non-native species**
- **selective extraction of species**

5.6.1.3 Vulnerability

The **estuary** and its associated biological communities are **moderately to highly vulnerable** to:

i. Substratum loss

The estuary feature is considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to substratum loss.

The physical loss of areas of intertidal habitats may be caused directly through a change in land use, or indirectly as a consequence of changes to sedimentation processes (e.g. resulting from the construction of groynes or of seawalls). Subtidal sedimentary habitats will be directly affected by the removal of material during maintenance dredging and aggregate extraction in particular. These activities, coupled with strong current flows, result in material being suspended in the water column and removed away from their point of origin. Removal of the substratum will lead to partial loss of faunal diversity, exposure of the underlying sediment and changes in the topography of the area. Intertidal seagrass beds will be adversely affected by substratum loss, with recoverability depending upon recruitment from other populations.

ii. Smothering

The estuary feature is considered to have **high sensitivity** and **moderate exposure** and therefore **high vulnerability** to smothering

Smothering of organisms is likely to occur as a result of the direct deposition of material on top of them and/or on their habitat. Examples of activities causing smothering in intertidal areas include beach replenishment, port developments, archaeological activities, coastal farming, industrial effluent discharge, oil spills, land runoff including highways discharge and sewage discharge. In subtidal areas, dumping of spoil from dredging operations is responsible for most smothering events. Both intertidal and subtidal seagrass beds are considered to be highly sensitive to smothering. A seagrass bed close to the second Severn crossing is known to have been adversely affected by smothering as a result of changes to sediment movements due to temporary works associated with the bridge construction in the early 1990's.

iii. Changes in suspended sediment

The estuary feature is considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediment

As a result of the high tidal energy of the site, the concentration of suspended sediment and turbidity are naturally very high. This high tidal energy is one of the reasons for site selection as part of the Natura 2000 series. The marine fauna, including the migratory fish, are adapted to high concentrations of suspended sediment. Increase in sediment in suspension is unlikely to cause problems unless it leads to smothering (see smothering). Of greater concern in the Severn estuary would be the decrease in suspended sediments leading to increased light penetration and changes in the habitats and their plant and animal communities.

Activities likely to result in changes in suspended sediment would include those which would affect sediment availability or the water flow rate (coastal defences, development, construction and dredging).

iv. Changes in water flow rate

The estuary feature is currently considered to have be **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate.

The estuary is considered to have high exposure due to its highly constrained nature (by man made hard defences). Increases or decreases to the water flow rate are likely to lead to, respectively, increased sediment erosion or accretion in certain areas. Seagrass beds in particular are intolerant to any activity that changes the sediment regime. Activities/structures responsible for changing the water flow rate could include in-estuary construction; groynes, beach replenishment, sea walls/breakwaters, port developments and aggregate extraction.

v. Changes in wave exposure

The estuary feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in wave exposure.

The estuary is considered to have high exposure due to its highly constrained nature (coastal defence structures; groynes, seawalls, breakwaters and beach replenishment) and presence of significant aggregate extraction which can cause changes in wave exposure. Storms and intense wave action may move or remove substrata from shallow subtidal sandbanks. Increased wave action will disrupt feeding and burrowing, and reduce species abundance, richness and biomass. Decreased wave exposure will result in increased food availability, but suspension feeders are intolerant of sediment increases in silt/clay content and therefore the proportion of suspension feeders may decrease in favour of deposit feeders. Both intertidal and subtidal seagrass beds are highly sensitive to changes in wave exposure, with an increase leading to loss of substrata and exposure of rhizomes, and a decrease causing deposition of fine particles on leaves which may result in smothering.

vi. Abrasion and physical disturbance

The estuary feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to physical disturbance and abrasion.

This factor includes mechanical interference, crushing, trampling, rubbing or erosion of the organism or habitat of interest. The activities most likely to cause abrasion include beach replenishment, development of port facilities, maintenance dredging, aggregate extraction, fixed netting, benthic trawls, sea-based recreation (including anchoring, power boat and jet ski wash), archaeology, coastal farming, educational visits, shipping, litter and debris. Habitats/communities that are moderately sensitive to abrasion include saltmarsh - see section 4.4 (at risk from overgrazing, erosion from moored boats or from trampling or vehicles), intertidal mudflats and sandflats (see section 4.3), and seagrass beds in particular.

vii. Toxic contamination

The estuary feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to toxic contamination. (Note that there is currently insufficient scientific information on the sensitivities of the estuarine habitats to radionuclides to determine any vulnerability).

This category includes contamination from synthetic compounds (including pesticides and herbicides), non-synthetic compounds (including heavy metals) and hydrocarbons (oil related products). As a result of the predominance of physical conditions within the Estuary, for the majority of biological communities there is little unequivocal evidence of additional impact due to contaminants across the Estuary as a whole. Individual populations may have been impacted close to major discharges however.

A number of synthetic compounds may be present locally in elevated concentrations. Riverine inputs are probably responsible for the majority of these compounds entering the Estuary. The concentration of metals in sediments (cadmium, arsenic, chromium, silver, copper, zinc and nickel in particular) are commonly above interim sediment quality guidelines over much of the Estuary, but only occasionally exceed probable effects levels (Langston et al., 2003). Bioaccumulation of metals occurs widely in invertebrates, though the ecological significance is still uncertain. Hydrocarbon compounds may also be present locally in elevated concentrations. Sources include a combination of fossil fuel combustion, shipping, urban run-off, sewage treatment works and various point-source and diffuse discharges from industrialised areas. Moderately high levels of poly-aromatic hydrocarbons (PAHs) are present in sediments across much of the Estuary. Overall vulnerability to all toxic contamination is considered 'high' (due to the exposure from sewage inputs being classed as 'high' and also with 'moderate' levels from industrial inputs etc.).

Note that there is currently insufficient scientific information on the sensitivities of the estuarine habitats to radionuclides to determine any vulnerability. However despite the presence of several potential sources of radionuclides (Berkeley, Oldbury and Hinkley Nuclear Power Plants, a manufacturer of radiopharmaceuticals in Cardiff and a number of other smaller sources) the accumulation of radionuclides in the Severn Estuary is generally low compared with samples from the Irish Sea. The exceptions to this are Tritium and Carbon 14, which have been found locally at significant levels. This is thought to be related to discharges from the radiopharmaceutical company in Cardiff, for which remedial action is being taken. (Langston et al, 2003).

viii. Changes in nutrient loading

The estuary feature is considered to have **high sensitivity** and **high exposure** to changes in nutrient loading but **is *not* considered vulnerable to changes in nutrient loading due to the high natural turbidity.**

Whilst nutrient levels and loadings within the Estuary are considered significant in UK terms (and thus have been scored as high for sensitivity and high for exposure), the high natural turbidity of the system negates these high levels, with algal productivity being generally low except in localised hotspots. Where these do occur, nutrient enrichment may lead to significant shifts in community composition on/in subtidal sandbanks (see section 5.2) and on/in intertidal mudflats and sandflats (see section 5.3), but recoverability is likely to be high. Should there be a decrease in natural turbidity levels, then the overall associated 'masking effect' would be lessened and there would be a higher risk of nutrient enrichment.

At the present time, despite the high sensitivity and high exposure scores discussed above, the high natural turbidity levels across most of the estuary lead to a conclusion that the estuary is not considered vulnerable to changes in nutrient loading.

ix. Changes in thermal regime

The estuary feature is considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in thermal regime

Temperature can affect many biological, physical and chemical geochemical processes within the water column including stratification, mixing and turbidity, nutrients, oxygenation, salinity and pH. For example, activities which can cause short or longterm changes in temperature can include thermal discharges (eg from power station cooling waters and other discharges). Thermal discharges are likely to be between 2 and 10 degrees above ambient temperature and a long term duration of changes may impact on the larval forms and breeding cycles of marine organisms.

x. Changes in salinity

The estuary feature is considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in salinity.

Decreases in salinity within the Estuary are likely to result from heavy rain events and associated land/waterfront run-off and riverine inputs. The vast floodplain and catchment area of the Severn Estuary results in annual extreme flooding events and prolonged periods of freshwater input the estuary so the exposure is considered to be high. Localised salinity changes may also result around discharges. Certain biotopes associated with subtidal sandbanks occur in conditions of reduced salinity and these biotopes are considered to be moderately vulnerable to any long-term increases in salinity levels.

xi. Changes in oxygenation

The estuary feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in oxygenation.

A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary. These probably originate from high densities of suspended solids and associated particulate organic matter, perhaps enhanced by discharge outfalls. Other causes include maintenance dredging, aggregate extraction, spoil dumping, coastal farming and shipping.

Oxygen-deficient marine areas are characterized by a decline in the number and diversity of species. Certain communities occurring within the Estuary's intertidal mudflats and sandflats are moderately sensitive to decreases in dissolved oxygen levels . However, recoverability of these areas should be rapid upon return to normal conditions. The fish assemblage is also likely to be sensitive to decreases in dissolved oxygen levels, although it is unclear what the level of sensitivity is at the present time.

xii. Introduction of microbial pathogens

The estuary feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in microbial pathogens.

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges, be these from port facilities, recreational boating, shipping or the outfalls from sewage treatment works. For the majority of biological communities there is insufficient information available to be able to make an assessment of their sensitivity to microbial pathogens. Of the few known impacts, subtidal seagrass beds of *Zostera marina* are known to be highly sensitive to the marine fungus *Labyrinthula macrocystis* which causes 'wasting disease'. The disease causes the death of leaves and, after 2-3 seasons, can lead to the death of regenerative shoots, rhizomes and the loss of up to 90% of the population and its associated

biotope. However, no information has been found which confirms the presence of the wasting disease in the Estuary.

While no infomation has been found which confirms the presence of the wasting disease in the estuary, the potential significant consequences for one of this notable estuarine community in particular has lead to the conclusion that estuary is highly sensitive to microbial pathogens. The exposure is considered to be high due to the high number of sewage discharges.

xiii. Introduction of non-native species

The estuary feature is currently considered to have **high sensitivity** and **moderate exposure** and therefore **high vulnerability** to the introduction of non-native species.

The saltmarsh cordgrass *Spartina anglica* is an invasive pioneer species whose rapid growth consolidates sediment, raises mudflats and reduces sediment availability elsewhere. It is regarded as being a potential threat to intertidal beds of *Zostera noltei* in particular. However, whilst recognising *S. anglica* as an invasive species, it also has a role in saltmarsh formation and the community SM6 in which it features should be allowed to develop into other Atlantic Salt Meadow or transitional communities. The Japanese seaweed *Sargassum muticum* is another non-native species which is thought to compete for space with the subtidal seagrass *Zostera marina*, though evidence for actual competition is conflicting. The presence of another non-native, the slipper limpet *Crepidula fornicata*, in large numbers may alter the species composition within certain soft mud habitats leading to a decline in overall species richness. However, *C. fornicata* has yet to penetrate the Estuary, possibly due to the strong water flows. The exposure to introduction of non-natives to the estuary is considered to be moderate because of the considerable volume of ship traffic, including transport to and from the major ports at Cardiff, Newport and Bristol.

xiv. Selective extraction of species

The estuary feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to the selective extraction of species.

This category refers to the removal of key species within a biotope or of a prey species. Activities which occur within the Estuary which are likely to be implicated bait digging, fixed netting, commercial fishing, recreational angling, wildfowling and educational visits. Whilst the majority of biotopes have a low sensitivity to such activities, intertidal *Zostera noltei* beds are highly sensitive to grazing by species of wildfowl. Significant amounts of dwarf eelgrass can be consumed by wildfowl, particularly during the autumn and winter months. However as these grazers are also part of the natural estuarine ecosystem and designated features in their own right their impact is not judged to be detrimental.

5.6.2 Subtidal sandbanks feature

5.6.2.1 Sensitivity

The **sandbanks** and their associated biological communities are **moderately to highly sensitive** to:

- **physical loss**
- **physical damage**
- **toxic contamination**
- **non-toxic contamination**
- **biological disturbance**

These result from a range of activities known to occur in the vicinity of the sandbanks. Further details are provided in points i) to vii) below, with details of the level of sensitivity set out in Table 22.

5.6.2.2 Exposure

The **sandbanks** and their associated biological communities are **moderately to highly exposed** to:

- **substratum loss**
- **smothering**
- **changes in suspended sediment**
- **abrasion and physical disturbance**
- **noise** and **visual disturbance**
- **toxic contamination (introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in turbidity**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**

5.6.2.3 Vulnerability

The **s**ubtidal sandbanks communities are **moderately to highly vulnerable** to:

i. Substratum loss

The subtidal sandbanks feature is currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to substratum loss.

The physical loss of subtidal sandbanks will occur through the removal of material during maintenance dredging and aggregate extraction in particular. These activities, coupled with strong current flows, result in material being suspended in the water column and removed away from their point of origin. Removal of the substratum will lead to partial loss of faunal diversity, exposure of the underlying sediment and changes in the topography of the area. Recolonisation of the biotope might occur within a few months, but the biotope would be unlikely to be recognized until after six months. Cohesive mud and sandy mud communities are considered to be moderately sensitive to substratum loss.

ii. Changes in suspended sediment

The subtidal sandbanks feature is currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediment.

Increase in sediment in suspension are unlikely to cause problems unless it leads to smothering (see smothering). A decrease in suspended sediments may lead to increased light penetration and changes in the sandbank communities.

Activities likely to result in changes in suspended sediment would include those which would affect sediment availability or the water flow rate (coastal defences, development, construction and dredging).

iii. Toxic contamination

The subtidal sandbanks feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to toxic contamination. (Note that there is currently insufficient scientific information on the sensitivities of subtidal sandbank communities to radionuclides to determine their vulnerability).

This category includes contamination from synthetic compounds (including pesticides and herbicides), non-synthetic compounds (including heavy metals) and hydrocarbons (oil related products). As a result of the domination of physical conditions within the Estuary, for the majority of biological communities there is little unequivocal evidence of additional impact due to contaminants across the Estuary as a whole. Individual populations may have been impacted close to major discharges however.

Moderately high levels of poly-aromatic hydrocarbons (PAHs) are present in sediments across much of the Estuary (Langston et al., 2003). Generally speaking however, subtidal sediments are less likely to be at risk from oil spills than intertidal sediments unless oil dispersants are used or if wave action causes dispersion of oil into the water column and sediment mobility drives oil into the sediment. Certain species such as amphipods which occur within the Estuary's infralittoral mobile clean sand community have been found to be moderately sensitive to oil pollution. (See also section 5.1).
Despite the presence of several potential sources of radionuclides (Berkeley, Oldbury and Hinkley Nuclear Power Plants, a manufacturer of radiopharmaceuticals in Cardiff and a number of other smaller sources) the accumulation of radionuclides in the Severn Estuary is generally low compared with samples from the Irish Sea. The exceptions to this are Tritium and Carbon 14, which have been found at locally at significant levels. This is thought to be related to discharges from the radiopharmaceutical company in Cardiff, for which remedial action is being taken. The exposure for subtidal sandbanks is therfore thought to be low.

iv. Changes in nutrient loading

The subtidal sandbanks feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in nutrient loading

Whilst nutrient levels and loadings within the Estuary are considered significant in UK terms the high natural turbidity of the system negates these high levels, with algal productivity being generally low except in localised hotspots. Where these do occur, nutrient enrichment may lead to significant shifts in community composition on/in subtidal sandbanks but recoverability is likely to be high.

v. Changes in salinity

The subtidal sandbanks feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in salinity.

Aphelochaeta marioni, a polychaete worm which characterizes the shallow sandbanks' biotope of variable salinity infralittoral mobile sand, is very tolerant of low salinity conditions but would be moderately vulnerable to any long-term increases in salinity levels. This species has a wide distribution throughout the Estuary, being present on subtidal and intertidal sand habitats on both sides of the Estuary.

vi. Changes in oxygenation

The subtidal sandbanks feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation.

A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary.

Decreases in oxygenation levels can result from maintenance dredging, aggregate extraction, industrial effluent discharge, land/waterfront runoff and sewage discharge (Langston et al., 2003). Oxygen-deficient

marine areas are characterized by a decline in the number and diversity of species. Certain communities occurring within the Estuary's subtidal sandbanks are moderately sensitive to decreases in dissolved oxygen levels. However, recoverability of these areas should be rapid upon return to normal conditions.

vii. Introduction of microbial pathogens

The subtidal sandbanks feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to the introduction of microbial pathogens.

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges. For the majority of biological communities there is insufficient information available to be able to make an assessment of their sensitivity to microbial pathogens. However, some research has been undertaken on marine bivalves, several species of which occur within the Estuary's sandbanks. Mass mortalities of bivalves can result from diseases caused by bacteria, viruses (over 20 have been described for marine bivalves) or protozoans. There is a greater likelihood of such events occurring in areas adjacent to outfalls than elsewhere. Recovery of populations is probable.

5.6.3 Mudflats and sandflats feature

(Note : this advice is also relevant to the Ramsar Site as the mudflats and sandflats are both a subfeature of the estuaries feature and a supporting habitat of the birds species, for which the Ramsar Site has been designated – refer also to section 5.8)

5.6.3.1 Sensitivity

The **mudflats and sandflats** and their associated biological communities are **moderately to highly sensitive** to:

- **physical loss**
- **physical damage**
- **toxic contamination**
- **non-toxic contamination**
- **biological disturbance**

These result from a range of activities known to occur in the vicinity of the mudflats and sandflats. Further details are provided in points i) to xiii) below, with details of the level of sensitivity set out in Table 22.

5.6.3.2 Exposure

The **mudflats and sandflats** and their associated biological communities are **moderately to highly exposed** to:

- **substratum loss**
- **smothering**
- **changes in suspended sediment**
- **changes in water flow rate**
- **changes in wave exposure**
- **abrasion and physical disturbance**
- **toxic contamination(introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in thermal regime**
- **changes in turbidity**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**

5.6.3.3 Vulnerability

The **intertidal mudflats and sandflats** communities are **moderately to highly vulnerable** to:

i. Substratum loss

The intertidal mudflats and sandflats feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to substratum loss.

Areas of intertidal habitats will be lost as a direct result of land claim or developments, or indirectly as a consequence of changes to sedimentation processes (e.g. resulting from the construction of groynes or of seawalls). Consequently, there is moderate to high exposure of mudflats and sandflats to substratum loss. The sediment infauna reside in the uppermost layers of the substratum and the removal of this layer would cause a major decline in species richness as they would have been removed with it. Thus the sensitivity of the biotopes in question is high. Fortunately, recovery of the community is also regarded as being high as recolonisation is likely following deposition of suitable substrata.

ii. Smothering

The intertidal mudflats and sandflats feature is considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to smothering

Smothering of organisms is likely to occur as a result of the direct deposition of material on top of them and/or on their habitat. Examples of activities causing smothering in intertidal areas include beach replenishment, port developments, archaeological activities, coastal farming, industrial effluent discharge, oil spills, land runoff including highways discharge and sewage discharge.

iii. Changes in suspended sediment

The intertidal mudflats and sandflats feature feature is considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediment

Changes in suspended sediments could change the extent and nature of intertidal habitats including affecting estuary-wide erosion and accretion patterns. Increase in sediment in suspension are unlikely to cause problems unless it leads to smothering (see smothering) and in some cases the invertebrate communities associated with the sediment may provide additional food resources for feeding birds. A decrease in suspended sediments may lead to increased light penetration and changes in the intertidal mud and sandflat communities.

Activities likely to result in changes in suspended sediment would include those which would affect sediment availability or the water flow rate (coastal defences, development, construction and dredging).

iv. Changes in water flow rate

The intertidal mudflats and sandflats feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate.

Increases or decreases to the water flow rate are likely to lead to, respectively, increased sediment erosion or accretion in certain areas. Activities/structures responsible for changing the water flow rate include construction activities, groynes, beach replenishment, sea walls/breakwaters, port developments and aggregate extraction.

v. Changes in wave exposure

The intertidal mudflats and sandflats feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in wave exposure.

Changes in wave exposure result from coastal defence structures (groynes, seawalls, breakwaters and beach replenishment), shipping and possibly aggregate extraction. Increased wave action will disrupt feeding and burrowing, and reduce species abundance, richness and biomass. The strength of wave action determines the topography, steepness and shore width of the intertidal zone.

vi. Abrasion and physical disturbance

The intertidal mudflats and sandflats feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to physical disturbance and abrasion.

The activities most likely to cause abrasion to mudflats and sandflats include beach replenishment, bait digging, maintenance dredging, aggregate extraction, land-based recreation and archaeology. Boating, anchoring, trampling or the use of vehicles are also likely to cause physical disturbance, with compaction of the substratum being of particular concern. For example, the use of vehicles on mudflats or sandflats appears to have a potentially severe impact on gaper clams *Mya arenaria*. Large clams live in permanent burrows and are therefore susceptible to burrow collapse and sediment compaction through trampling and especially vehicle use. Another two key species found in muddy sand, the heart urchin *Echinocardium cordatum* and the razor shell *Ensis ensis*, are probably highly sensitive to physical disturbance. Recovery is likely to be moderate because, although the individual key species may recolonize an area within five years, several of the species are very long-lived and so the biotope may take longer to return to its original age structure and species diversity.

vii. Toxic contamination

The intertidal mudflats and sandflats feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to toxic contamination by synthetic and non-synthetic compounds. (Note that there is currently insufficient scientific information on the sensitivities of communities present on/in intertidal mudflats and sandflats to radionuclides to determine their vulnerability).

This category includes contamination from synthetic compounds (including pesticides and herbicides), non-synthetic compounds (including heavy metals) and hydrocarbons (oil related products). Infaunal populations present within intertidal sediments are likely to have been impacted close to major discharges, with a number of synthetic compounds known to have elevated concentrations locally (Langston et al.,2003). However, because of the energetic hydrodynamic regime in the Severn, and the resultant high turbidity, there is considerable mixing and redistribution of fines and their associated contamination burden, resulting in a fairly homogenous distribution.

Whilst the concentration of metals within the Estuary's sediments (cadmium, arsenic, chromium, silver, copper, zinc and nickel in particular) are commonly above interim sediment quality guidelines, these only occasionally exceed probable effects levels (Langston et al.,2003).. Contamination loadings of metals will be highest where fine particulates predominate (for example between Avonmouth and Severn Beach, Caldicot Flats, the River Parrett and outer Bridgewater Bay, and between the mouths of the Usk and Taff), and lowest on sands (for example the Middle to Welsh Grounds, and Culver Sands). Bioaccumulation of metals is known to occur widely in invertebrates, though the ecological significance is still uncertain. Note also that the toxicity of metals to many invertebrates increases with decreased salinity and elevated temperature (Langston et al.,2003). Thus many benthic invertebrates living within their normal salinity range may be less susceptible to heavy metal pollution than those living in salinities near the lower limit of their salinity tolerance.

Hydrocarbon compounds are present locally in elevated concentrations (Langston et al.,2003).. Sources include a combination of fossil fuel combustion, shipping, urban run-off, sewage treatment works and various point-source and diffuse discharges from industrialised areas. Moderately high levels of poly-aromatic hydrocarbons (PAHs) are present in sediments across much of the Estuary (Langston et al.,2003).

Overall vulnerability to all toxic contamination is considered 'high' (due to the exposure from sewage inputs being classed as 'high' and also with 'moderate' levels from industrial inputs etc.).
Despite the presence of several potential sources of radionuclides (Berkeley, Oldbury and Hinkley Nuclear Power Plants, a manufacturer of radiopharmaceuticals in Cardiff and a number of other smaller sources) the accumulation of radionuclides in the Severn Estuary is generally low compared with samples from the Irish Sea. The exceptions to this are Tritium and Carbon 14, which have been found at locally at significant levels. This is thought to be related to discharges from the radiopharmaceutical company in Cardiff, for which remedial action is being taken. The intertidal mudlfats and sandflats are therefore thought to be moderately exposed to radionuclides (Langston et al, 2003).

viii. Changes in nutrient loading

The intertidal mudflats and sandflats feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in nutrient loading.

The most obvious sign of an increase in nutrient loading (or organic enrichment) on mudflats is the lush growth of green seaweeds on the surface. Such increases coupled with reduced oxygenation typically lead to anaerobic conditions predominating within the sediment. Moderate organic enrichment does provide food which can enhance species diversity but with greater enrichment, the diversity declines and the community becomes increasingly dominated by a few, pollution tolerant, opportunistic species such as the polychaete *Capitella capitata*. In sandier sediments where particle size is greater, the effects of an increase in organic enrichment are less dramatic. However, the structure of the community is still likely to change from one dominated by suspension feeders to one favouring deposit feeders, accompanied by an increase in the abundance of opportunistic species and a decrease in species richness. Note, however,

that the high natural turbidity of the system negates many of these effects, and algal productivity is generally low except in localised hotspots.

ix. Changes in thermal regime

The intertidal mudflats and sandflats feature is currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in thermal regime

Temperature can affect many biological, physical and chemical geochemical processes within the water column including stratification, mixing and turbidity, nutrients, oxygenation, salinity and pH. For example, activities which can cause short or longterm changes in temperature can include thermal discharges (eg from power station cooling waters and other discharges). Thermal discharges are likely to be between 2 and 10 degrees above ambient temperature and a long term duration of changes may impact on the larval forms and breeding cycles of marine organisms.

x. Changes in salinity

The intertidal mudflats and sandflats feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in salinity

Decreases in salinity are likely to result from heavy rain events and associated land/waterfront run-off and riverine inputs. Localised salinity changes may also result around discharges. The vast floodplain and catchment area of the Severn Estuary results in annual extreme flooding events and prolonged periods of freshwater input to the intertidal areas so the exposure is considered to be high. However the metabolism of intertidal communities cope with vast extremes of conditions which result from the dynamic nature of the estuary's tidal regime and so are considered to have low sensitivity.

xi. Changes in oxygenation

The intertidal mudflats and sandflats feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation.

A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary.

Decreases in oxygenation levels will result from maintenance dredging, aggregate extraction, industrial effluent discharge, land/waterfront runoff and sewage discharge. Oxygen-deficient marine areas are characterized by a decline in the number and diversity of species. Certain communities occurring within the Estuary's intertidal mudflats and sandflats are moderately sensitive to decreases in dissolved oxygen levels. However, recoverability of these areas should be rapid upon return to normal conditions.

xii. Introduction of microbial pathogens

The intertidal mudflats and sandflats feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to the introduction of microbial pathogens.

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges. For the majority of biological communities there is insufficient information available to be able to make an assessment of their sensitivity to microbial pathogens. However, some research has been undertaken on marine bivalves, several species of which occur within the Estuary's intertidal sandbanks. Mass mortalities of bivalves can result from diseases caused by bacteria, viruses (over 20 have been described for marine bivalves) or protozoans. There is a greater likelihood of such events occurring in areas adjacent to outfalls than elsewhere. Recovery of populations is probable.

xiii. Introduction of non-native species

The intertidal mudflats and sandflats feature is currently considered to have **high sensitivity** and **low exposure** and therefore **moderate vulnerability** to the introduction of non-native species.

The saltmarsh cordgrass *Spartina anglica* is an invasive pioneer species whose rapid growth consolidates sediment, raises mudflats and reduces sediment availability elsewhere. It is regarded as being a potential threat to intertidal beds of *Zostera noltei* in particular. However, whilst recognising *S. anglica* as an invasive species, it also has a role in saltmarsh formation and the community SM6 in which it features should be allowed to develop into other Atlantic Salt Meadow or transitional communities. The presence of another non-native, the slipper limpet *Crepidula fornicata*, in large numbers may alter the species composition within certain soft mud habitats leading to a decline in overall species richness. However, *C. fornicata* has yet to penetrate the Estuary, possibly due to the strong water flows.

*Note, in relation to '**noise and visual disturbance'**, that while mudflats and sandflats communities have **moderate exposure** to both noise and visual disturbance, these habitats are **not sensitive** to these factors but they do provide a vitally important role as supporting habitats for waterfowl that use these areas for roosting and feeding and these are considered **highly sensitive to** both noise and visual disturbance – see sections 5.7.1 & 5.7.2). So while the habitats themselves have **low vulnerability** their dependant bird species have high vulnerability.*

5.6.4 Atlantic salt meadow feature

(Note : this advice is also relevant to the Ramsar Site as the Atlantic saltmeadows are both a subfeature of the estuaries feature and a supporting habitat of the birds species, for which the Ramsar Site has been designated – refer also to section 5.8)

5.6.4.1 Sensitivity

The **Atlantic salt meadow** and its associated biological communities are **moderately or highly sensitive** to:

- **physical loss**
- **physical damage**
- **toxic contamination**
- **non-toxic contamination**

These result from a range of activities known to occur on or in the vicinity of the salt meadows. Further details are provided in points i) to xiii) below, with details of the level of sensitivity set out in Table 22.

5.6.4.2 Exposure

The **Atlantic salt meadow** and its associated biological communities are **moderately to highly exposed** to:

- **substratum loss**
- **smothering**
- **changes in suspended sediment**
- **changes in water flow rate**
- **changes in wave exposure**
- **abrasion and physical disturbance**
- **changes in grazing management**
- **noise and visual disturbance**
- **toxic contamination(introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**

5.6.4.3 Vulnerability

The **saltmarsh** communities are **moderately to highly vulnerable** to:

i. Substratum loss

The Atlantic salt meadows and their associated communities feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to substratum loss

Saltmarshes, cordgrass and *Salicornia* are highly sensitive to physical loss. This can occur mostly through one-off developments such as infrastructure construction and modification involving land claim and changes in land management and coastal farming, and also as a result of coastal squeeze. This is a process by which coastal features such as saltmarshes and *Salicornia* are eroded as they become trapped between man-made structures such as sea walls and rising sea levels. Where this occurs on saltmarshes, it may result in the replacement of mid-marsh communities by pioneer saltmarsh communities or through erosion changing saltmarsh to intertidal mud and sand. Changes to coastal processes may also affect the sediment budget of estuaries and reduce the supply of sediment to saltmarsh, *Salicornia* and cordgrass areas. Whilst some areas of the Estuary are subject to these pressures, others are not, yet it remains a real

threat as is reflected in the moderate to high exposure score. When combined with high sensitivity this leads to a high vulnerability.

ii. Smothering

The Atlantic salt meadows feature is considered to have **high sensitivity** and **moderate exposure** and therefore **high vulnerability** to smothering.

Smothering of saltmarsh is likely to occur as a result of the direct deposition of material on the surface. This can happen by either direct deposition of materials on land or through silt-laden tides. The saltmarshes of the Severn are subject to spring tides each year which can in some locations deposit a thick layer of sediment on the surface which can persist for some months. Normally the level of this natural deposition is compatible with the speed of vertical accretion and growth of the saltmarsh. Higher levels of sediment deposition which may be associated with development activities (increasing sediment suspension) can cause smothering to occur resulting in loss of vegetation or shifts in community composition and zonation. Examples of activities likely to cause smothering from tidal deposition include coastal defence works, dredging, construction and archaeological works. Examples of direct deposition are fly tipping and accumulation of tidal debris.

iii. Changes in suspended sediment

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediment

Changes in suspended sediments could change the extent and nature of saltmarsh communities and other intertidal habitats including affecting estuary-wide erosion and accretion patterns. Increases in suspended sediment are unlikely to cause problems unless it leads to smothering (see smothering).

Activities likely to result in changes in suspended sediment would include those which would affect sediment availability or the water flow rate (coastal defences, development, construction and dredging).

iv. Desiccation and changes in emergence regime

The Atlantic salt meadows and their associated communities feature is currently considered to have **high sensitivity** and **low exposure** and therefore **moderate vulnerability** to desiccation and changes in emergence regime

Changes in the emergence regime will result in changes in the time habitats or species spend either covered in water or exposed to the air, one consequence of which is the desiccation (drying) of habitats and species. Examples of activities which may induce these changes are the construction of coastal and flood defences and other developments which change the tidal regime and water flow characteristics of the estuary.

The morphology, zonation and composition of saltmarshes are determined by their position within the tidal frame. They therefore considered highly sensitive to changes in the emergence regime and desiccation in particular.

These changes occurring in saltmarshes may result in either the stranding and exposure of communities or lengthened periods of inundation and lack of drying out with consequent impacts on species composition of swards (through dieback and shifts in community types) and affecting their suitability for species dependant on them. These changes may also cause the expansion of *Spartina* into both saltmarsh habitats and across adjacent mudflats.

The size of the estuary means that most small scale activities will have limited impacts with only large scale or estuary-wide activities likely to be of concern and exposure to this operation is therefore currently considered as low.

v. Changes in water flow rate

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate.

A reduction in the rate of water flow over the saltmarsh will result in an increase in the deposition of sediment. The rate at which this occurs will depend on the sediment supply, the duration of the tidal cover and the extent to which the tidal flow is impeded by the vegetation itself to facilitate deposition. Saltmarsh communities actually require a degree of sediment deposition in order to survive and flourish and they have been assessed as having a low to moderate sensitivity. Exposure to changes in water flow rate on saltmarsh communities will vary throughout the Estuary.

vi. Changes in wave exposure

The Atlantic salt meadows and their associated communities feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in wave exposure.

Changes in wave exposure result from the presence of coastal defence structures (groynes, seawalls, breakwaters), beach replenishment and possibly aggregate extraction. Increased wave action can have two opposing effects. On the one hand it is likely to lead to a greater amount of suspended sediment being carried to the saltmarsh, while on the other hand the greater energy regime is likely to prevent the settlement of this material and may even remove material from the saltmarsh through erosion at the saltmarsh edge. A decrease in wave action will lead to greater sediment deposition with the possibility of smothering.

vii. Abrasion and physical disturbance

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to physical disturbance and abrasion.

Physical disturbance or abrasion to saltmarsh communities may result from a wide range of activities including recreational usage (both land-based and water-based), any of which may damage individual saltmarsh plants or areas of saltmarsh. Trampling by foot, and particularly by off-road vehicles, causes localised damage which may impact upon the ecological structure and function of larger areas, and requiring long-term recovery. Saltmarshes are also sensitive to erosion as a result of trampling or overgrazing, with communities that support succulents such as *Limonium* spp. being very susceptible to any form of grazing. In addition, it is widely recognised that shipping and boating can increase saltmarsh erosion from their wash.

viii. Changes in grazing management

The Atlantic salt meadows and their associated communities feature is currently considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in grazing management.

The presence, duration and intensity of grazing management can alter the vegetation composition and structure of saltmarsh habitats. Abandonment or introduction of grazing can result in changes in the saltmarsh plant and animal communities which are important in their own right and which also provide food resources for passage and wintering birds. Grazing changes may also affect the suitability of saltmarsh areas as resting and roosting sites for birds where open terrain with low vegetation is an important factor. Changes may also affect the presence of specific niches for scarce and notable plants.

ix. Toxic contamination

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate to high sensitivity** and **high exposure** and therefore **high vulnerability** to toxic contamination from both synthetic and non-synthetic compounds.

Atlantic salt meadows, cordgrass swards and *Salicornia* within the Estuary are considered to have a moderate sensitivity to toxic contamination by synthetic compounds (which includes domestic/industrial effluent, pesticides, anti-foulant paints and PCBs) and a high sensitivity to non-synthetic compounds

(which includes domestic/industrial effluent, heavy metals and hydrocarbons). Although saltmarsh plants may be reasonably tolerant of certain synthetic substances, they can bioaccumulate toxic compounds and act as sinks for them. This could have implications for wildfowl which feed on saltmarsh plants.
Saltmarsh communities are also highly sensitive to oil and oil products, even at relatively low levels. This is mainly by virtue of their ability to trap sediments. Acute events, such as oil spills, can be particularly damaging to saltmarsh plants. Dispersants used to treat oil spills can also have a toxic effect on saltmarsh plants, sometimes to a greater degree that the spilled oil itself. Saltmarshes have been reported to recover from chronic oil pollution, where denuded of vegetation, within ten years, although recovery depends largely on the degree to which oil is retained in the sediment and the clean up procedures used.

x. Changes in nutrient loading

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in nutrient loading.

The Estuary's saltmarshes and associated communities are thought to be more susceptible to nutrient enrichment than was previously realised (Deegan, L. A. et al. 2007), so they have been assessed as being of high sensitivity to increases in nutrient loading and/or organic enrichment. However, increased growth of certain seaweed species may result from elevated levels of nitrates and phosphates and cause local smothering which is known to have a detrimental effect on glasswort (*Salicornia* spp.) in low marsh communities. In addition, the species composition of the plants on the saltmarsh may be altered by changes in nutrient loading leading to a change in the structure of the sward.

xi. Changes in salinity

The Atlantic salt meadows and their associated communities feature is currently considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in salinity.

Changes to the salinity of water flowing across the saltmarshes as a result of the tides are likely to occur following heavy rain events and associated land/waterfront run-off and riverine inputs. The vast floodplain and catchment area of the Severn Estuary results in annual extreme flooding events and prolonged periods of freshwater input to the intertidal areas so the exposure is considered to be high. The botanical composition of the saltmarshes reflects salinity. The saltmarshes, while capable of tolerating a wide range of salinities, are considered moderately sensitive to changes in salinity particularly prolonged periods of change which can cause shifts in composition and zonation.

xii. Changes in oxygenation

The Atlantic salt meadows and their associated communities feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation.

A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary.

xiii. Introduction of microbial pathogens

The Atlantic salt meadows and their associated communities feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to the introduction of microbial pathogens

For the majority of saltmarsh communities there is insufficient information available to be able to make an assessment of their sensitivity to microbial pathogens.

*Note, in relation to '**noise and visual disturbance'**, that while Atlantic salt meadows and their associated plant communities have **high exposure** to both noise and visual disturbance, these habitats are **not sensitive** to these factors but they do provide a vitally important role as supporting habitats for waterfowl that use these areas for roosting and feeding and these are considered **highly sensitive** to both noise and*

visual disturbance – see sections 5.7.1 & 5.7.2). So while the habitats themselves have ***low vulnerability*** *their dependant bird species have high vulnerability.*

5.6.5 Reefs feature

5.6.5.1 Sensitivity

The **reefs** and their associated biological communities are **moderately to highly sensitive** to:

- **physical loss**
- **physical damage**

These result from a range of activities. Note that there is currently insufficient scientific information to assess the degree of sensitivity of reefs to **toxic** & **non-toxic contamination** and also to **biological disturbance**. In these cases, the precautionary principle has been applied with a **moderate level of sensitivity** being assumed until proven otherwise**.** Further details are provided in points i) to vii) below, with details of the level of sensitivity set out in Table 22.

5.6.5.2 Exposure

The **reefs** and associated biological communities are **moderately to highly exposed** to:

- **changes in suspended sediment**
- **toxic contamination(introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in turbidity**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**

The reefs of the Severn Estuary are biogenic in origin, that is, they are built by a concretion-forming organism creating elevated structures. The organism in this case is the honeycomb worm *Sabellaria alveolata.* These reefs occur both in the intertidal (where one might expect to find them) and, most unusually, in the subtidal. Indeed, the Severn Estuary has the only extensive subtidal *Sabellaria alveolata* reef in Britain. There has been little research undertaken on these subtidal *Sabellaria alveolata* reefs, so the scientific information on their sensitivities is extremely limited. In the advice given here, much has been drawn on the information known about subtidal reefs of the closely related *Sabellaria spinulosa*.

5.6.5.3 Vulnerability

The **reef** communities are **moderately to highly vulnerable** to:

i. Changes in suspended sediment

The reefs feature is currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediment

The reduced availability of sand, essential for *S. alveolata* tube building, may lead to the reduced development of *S. alveolata* reefs and the decline of colonies. Increase in suspended sediment is unlikely to cause problems unless it leads to smothering of the reef. Activities likely to result in changes in suspended sediment would include those which would affect sediment availability or the water flow rate (coastal defences, development, construction and dredging).

ii. Toxic contamination

The **sensitivity** of *Sabellaria alveolata* to toxic contaminants (domestic effluent, industrial effluent, heavy metals, hydrocarbons) entering the water is **not known**. The precautionary principle should therefore be applied.

The reefs are considered to have **high exposure** to both synthetic compounds and non-synthetic compounds (industrial effluents, heavy metals, hydrocarbons etc.),

The reefs are therefore **moderately vulnerable** to the introduction of synthetic compounds and non-synthetic compounds .

iii. Changes in nutrient loading

The reefs feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in nutrients.

iv. Changes in salinity

The reefs feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in salinity.

Decreases in salinity within the Estuary are likely to result from heavy rain events and associated land/waterfront run-off and riverine inputs. The vast floodplain and catchment area of the Severn Estuary results in annual extreme flooding events and prolonged periods of freshwater input the estuary so the exposure is considered to be high.

v. Changes in oxygenation

The reefs feature is currently considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation.

A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary.

vi. Introduction of microbial pathogens

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges. There is considered to be **high exposure** to microbial pathogens due to the high number of sewage discharges within the estuary.

For the majority of biological communities there is insufficient information available to be able to make an assessment of their sensitivity to microbial pathogens and there is currently no information on the sensitivity of *Sabellaria* reefs to the introduction of microbial pathogens. The vulnerability of the *Sabellaria* reefs therefore remains unknown and the precautionary principle should be applied.

vii. Introduction of non-native species

There is insufficient information on the sensitivity of reefs to introduction of non native species therefore the vulnerability is unknown.

5.6.6 Shad and lamprey features

(Note : this advice is also relevant to the Ramsar Site as these features are also part of the "assemblage of migratory fish species" for which the Ramsar Site has been designated – refer also to section 5.8)

Note that in the explanatory text that follows, the term 'shad and lamprey' refer to three species of migratory fish: twaite shad *Alosa fallax*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*.

As the populations of these migratory fish depend upon the freshwater habitats of the Rivers Usk, Wye and Severn as well as the estuarine habitats of the Severn Estuary during their lifetime, the advice presented here should be read in conjunction with the advice given for the River Usk SAC and the River Wye SAC (Management Plans and Conservation Objectives) available from CCW and Natural England on request.

5.6.6.1 Sensitivity

The **shad and lamprey** are considered **sensitive** to:

- **physical damage** of their supporting habitats
- **non-physical disturbance**
- **toxic contamination**
- **non-toxic contamination**
- **biological disturbance**

These result from a range of activities known to occur within the Estuary on which further details are provided in points i) to xi) below.

5.6.6.2 Exposure

The **shad and lamprey** and their supporting habitats (whilst within the Estuary) are **moderately to highly exposed** to:

- **noise** (part of 'noise and visual presence' but latter not applicable)
- **toxic contamination(introduction of synthetic & non synthetic compounds)**
- **changes in nutrient loading**
- **changes in thermal regime**
- **changes in turbidity**
- **changes in salinity**
- **changes in oxygenation**
- **introduction of microbial pathogens**

The Estuary provides an important migration route for these three rare species, to and from their spawning and nursery grounds. Shad and lamprey are known to be present in coastal and estuarine waters throughout the year, though there remains a lack of information on these migratory species during the time they actually spend in the Estuary. More information exists for the rivers where they migrate to spawn and for the subsequent development of juveniles. Little is known of their biology and distribution during the marine part of their life cycle.
In the assessments given below, it is assumed that these species would be capable of avoiding unsuitable areas, that is, given the size of the Estuary, localized activities are unlikely to adversely affect the population.

5.6.6.3 Vulnerability

Assessment of vulnerability of these features is particularly difficult given that there is little or no information to enable the level of sensitivity to be established. In line with the "precautionary principle" **where there is moderate to high exposure the feature is considered vulnerable.**

Therefore the **shad and lamprey** are considered **vulnerable** to:

i. Noise (part of 'noise and visual presence' but latter not applicable)
Research has shown that shad are sensitive to vibration which can arise from noisy activities. High frequency vibration (70 – 300Khtz) can be barrier to migration affecting movement both up and downstream and preventing fish reaching spawning areas. In some circumstances high frequency vibrations can be fatal. Vibration sources need to be assessed at the planning and consent stage and their potential impacts mitigated for, particularly during the key upstream migration phase.

ii. Toxic contamination
A decrease in water quality within the Estuary may impede the migration of these fish to their spawning grounds in the rivers. Poor water quality may also affect their supply of food. Shad require a good supply of small crustacean prey species, especially mysids and small fish (particularly clupeids). At sea, river lamprey feed on a variety of small fish such as clupeids, whilst sea lamprey feed on larger fish including salmon. Pollution tolerance levels of shad and lamprey are unknown, but EA water quality policy is that levels should comply with targets established under the EA Review of Consents and the Water Framework Directive.

iii. Changes in nutrient loading
It is possible that changes in nutrient levels may affect the food supply of the shad and lamprey. However, due to the natural high turbidity of the system and the volumes of water involved, it is thought that any effects would be minimal.
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iv. Changes in thermal regime
Water temperature is believed to act as a trigger for the shad to migrate upstream to spawn in the rivers. There could be changes in water temperature in the vicinity of the power stations (eg Hinkley Point and Oldbury) and from other discharges

v. Changes in turbidity
It is not known whether the migratory fish are sensitive to changes in turbidity within the Estuary. Given the extremely high background levels of turbidity, it is unlikely that any changes in turbidity will have any significant impact on the shad and lamprey whilst in the estuarine waters.

vi. Changes in salinity
Decreases in salinity within the Estuary are likely to result from heavy rain events and associated land/waterfront run-off and riverine inputs. The vast floodplain and catchment area of the Severn Estuary results in annual extreme flooding events and prolonged periods of freshwater input the estuary so the exposure is considered to be high. Within the Estuary, juvenile twaite shad prey on mysids feeding at the salt wedge near the head of the tide. It must be assumed that any activities affecting the salinity regime of the estuary would in turn affect the distribution of these prey species, which may have consequences for the shad.

vii. Changes in oxygenation
A cycle of changes in oxygenation occurs within the Severn as a result of both seasonal and tidal cycles and is linked to fluctuating sediment regimes. In addition occasional, intermittent oxygen sags occur in low salinity regions of the Severn and in some of the principal rivers feeding the Estuary. Shad and lamprey may therefore be vulnerable to changes in oxygenation given the high exposure to changes resulting from operations within the Estuary.

viii. Introduction of microbial pathogens

There is insufficient information available to make any meaningful assessment on the introduction of microbial pathogens to these species of fish, but there is potential for high exposure.

Note regarding 'changes in water flow rate'

It is thought unlikely that changes in water flow rate within the Estuary will affect these fish but they are likely to be affected (and therefore vulnerable) once in the rivers where water abstraction and freshwater flows may have more of a bearing.

Note regarding 'selective estraction of species'

After hatching in the rivers, young shad gradually move downstream into the upper estuary where they feed and mature until the end of their second summer before moving into coastal waters. Young shad feed on estuarine invertebrates while adult shad feed on mysids and other fish (particularly other clupeids such as sprat and herring). Both river and sea lamprey spend several years of development in riverine mud and then, after a relatively rapid metamorphosis, migrate downstream to the estuary. River lamprey feed on a variety of estuarine fish, particularly herring, sprat and flounder. At sea, sea lamprey feed on larger fish including large salmon.

Extraction of target species - it is reported that twaite shad are vulnerable to capture on cooling water intakes, particularly those associated with power stations, where the numbers killed can be considerable.

Extraction on non target species - the shad and lamprey may be vulnerable to the extraction of their prey species (levels unknown) affecting their feeding behavior and patterns and long-term survival.

Table 22 Sensitivity, exposure and vulnerability of the Severn Estuary SAC to physical, chemical and biological pressures

Sensitivity		Exposure		Vulnerability	
High sensitivity	OOO O	High Exposure	××××	High vulnerability	⊗⊗⊗⊗ ⊗⊗⊗O ⊗⊗⊗×
Moderate sensitivity	OOO	Medium Exposure	×××	Moderate vulnerability	⊗⊗OO ⊗⊗×× ⊗⊗⊗
Low sensitivity	OO	Low Exposure	××	Low vulnerability	⊗⊗O ⊗⊗× ⊗⊗ ⊗××× ⊗×× ⊗×
No detectable sensitivity	O	No exposure	×	No vulnerability	⊗O
?S =Insufficient information on sensitivity; ✓ = migratory fish considered to be sensitive, but insufficient information to assess level of sensitivity				Unknown vulnerability	

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Categories of operations which may cause deterioration or disturbance[25]	**Annex I features**					**Annex II species**
	Estuaries	**Subtidal Sandbanks**	**Mudflats & sandflats**	**Atlantic saltmeadow**	**Reefs**	**Fish**[26]
Physical loss						
Removal / substratum loss	⊗⊗⊗⊗	⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗O	⊗×
Smothering	⊗⊗⊗O	⊗⊗×	⊗⊗⊗	⊗⊗⊗O	⊗⊗	⊗×
Physical damage						
Changes in suspended sediment	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗×
Desiccation & changes in emergence regime	⊗⊗O	⊗O	⊗⊗O	⊗⊗OO	⊗O	✓××
Changes in water flow rate	⊗⊗⊗×	⊗⊗O	⊗⊗⊗×	⊗⊗⊗×	⊗⊗O	✓××
Changes in wave exposure	⊗⊗⊗⊗	⊗⊗O	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗O	⊗×
Abrasion / physical disturbance (of habitats)	⊗⊗⊗×	⊗⊗×	⊗⊗⊗×	⊗⊗⊗×	⊗⊗O	✓××
Changes in grazing management	⊗⊗	Not relevant	Not relevant	⊗⊗⊗⊗	Not relevant	Not relevant
Non-physical disturbance						
Noise & visual presence	⊗××	⊗××	⊗⊗×	⊗×××	⊗×	✓×××
Toxic contamination						
Introduction of synthetic compounds	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗⊗	⊗⊗⊗×	⊗⊗××	✓××××
Introduction of non-synthetic compounds	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗⊗	⊗⊗⊗⊗	?S××××	✓××××
Introduction of radionuclides	?S××	?S××	?S××	?S××	?S××	✓××
Non-toxic contamination[27]						
Changes in nutrient loading	⊗⊗⊗⊗[28]	⊗⊗××	⊗⊗⊗×	⊗⊗⊗×	⊗⊗××	✓××××
Changes in thermal regime	⊗⊗⊗	⊗⊗	⊗⊗⊗	⊗⊗	⊗⊗	✓××××
Changes in turbidity[29] (light penetration)	⊗⊗×	⊗⊗×	⊗⊗×	⊗×	⊗××	✓×××
Changes in salinity	⊗⊗⊗×	⊗⊗⊗×	⊗⊗××	⊗⊗⊗×	⊗⊗××	✓××××
Changes in oxygenation	⊗⊗⊗×	⊗⊗××	⊗⊗××	⊗⊗××	⊗⊗××	✓××××
Biological disturbance						
Introduction of microbial pathogens	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗××	?S××××	✓××××
Introduction of non-native species	⊗⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗	?S××	✓××
Selective extraction of species	⊗⊗⊗×	⊗⊗	⊗⊗	⊗⊗	⊗⊗	✓××

[25] For a further explanation of each category see http://www.marlin.ac.uk/sah/baskitemplate.php?benchmarks
[26] River lamprey, sea lamprey & twaite shad
[27] All elements of non toxic contamination are interrelated and also link closely with changes in suspended sediment (physical damage)
[28] The high natural turbidity of the estuary negates these high levels with algal productivity being generally low – the estuary feature is therefore not considered vulnerable – see section 5.6.1.3.(viii)
[29] Turbidity here incorporates light penetration; suspended sediment under 'changes in suspended sediment' and its deposition under 'smothering'

5.7 Specific Advice on Operations for the Severn Estuary SPA

This section provides information to help relate general advice to each of the specific interest features of the Severn Estuary SPA. Where specific examples are given they are provided to aid understanding of possible impacts and are not intended to be a comprehensive list of all relevant operations.

This advice relates to the vulnerability of the interest features and supporting habitats of the Severn Estuary SPA as set out in Table 23. An explanation of the sensitivity of the interest features or supporting habitats follows with an explanation of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links between the categories of operation and the ecological requirements of the SPA's interest features (as set out in Section 2.2) to be made. It should be noted that sensitivity scorings are a combination of whether the habitat itself is likely to be affected by a particular operation (which is drawn from the SAC scores in Table 22), in combination with an assessment as to whether the outcome is likely to affect the bird's use of that habitat.

Note that this advice for the SPA supercedes that issued to ASERA in February 2005 following reassessment of exposure, sensitivity and vulnerability to take account of availability of new information in the Severn Estuary CHaMP and MarLIN sensitivities and following the more detailed analysis of impacts on the SAC estuarine habitats that are supporting habitats for the birds of the SPA.

5.7.1 Internationally important populations of regularly occurring Annex 1 species (Bewick's swan)

(Note : this advice is also relevant to the Ramsar Site's internationally important population of waterfowl "Bewick's swan" feature and as part of the "internationally important assemblage of waterfowl" feature for which the Ramsar Site has been designated – refer also to section 5.8)

5.7.1.1 Sensitivity

The Annex 1 species is **moderately to highly sensitive** to :

- **Physical loss**
- **Physical damage**
- **Non-physical disturbance**
- **Toxic contamination**
- **Non- toxic contamination**
- **Biological disturbance**

These result from a range of activities known to occur within the Estuary. Further details are provided in points i) to xii) below, with details of the level of sensitivity set out in Table 23.

5.7.1.2 Exposure

The Annex 1 species is **moderately to highly exposed** to:

- **Substratum loss and smothering**
- **Changes in suspended sediment**
- **Desiccation and changes in emergence regime**
- **Changes in water flow**
- **Changes in wave exposure**
- **Changes in grazing regime**
- **Noise and visual disturbance**
- **Toxic contamination**
- **Changes in nutrient loading**
- **Changes in salinity**
- **Changes in oxygenation**
- **Introduction of microbial pathogens**

5.7.1.3 Vulnerability

The Annex 1 species is **moderately to highly vulnerable** to:

i. Substratum loss and smothering

The intertidal habitats and therefore the Bewick's Swan feature which these habitats support are considered to have **moderate to high sensitivity** and **moderate to high exposure** and therefore **moderate to high vulnerability** to physical loss (removal and smothering).

The physical loss of areas of intertidal habitats may be caused directly through change of land use or indirectly as a consequence of changes to sedimentation processes (e.g. coastal defences) as well as via the effects of smothering by artificial structures (e.g. jetties) or the disposal of spoils. Activities or developments resulting in physical loss of the intertidal supporting habitats are likely to reduce the availability of food and roosting habitat and thus be detrimental to the favourable condition of the SPA interest features including the Annex 1 species, Bewick's swan. The intertidal mudflats and sandflats and the saltmarsh are highly sensitive to removal by land reclamation and major construction activities.

ii. Changes in suspended sediment

It is thought unlikely that changes in the suspended sediment within the Estuary will affect the Bewick's Swan directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding. The saltmarshes and intertidal mudflats and sandflats are currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in suspended sediments . (Refer also to sections 5.6.3 and 5.6.4). Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

iii. Desiccation and changes in emergence regime

It is thought unlikely that changes in the emergence regime within the Estuary will affect the Bewick's Swan directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding. The saltmarshes are currently considered to have **high sensitivity** and **low exposure** and therefore **moderate vulnerability** to desiccation and changes in emergence regime. (Refer also to section 5.6.4.) Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

iv. Changes in water flow rate

It is thought unlikely that changes in water flow rate within the Estuary will affect the Bewick's Swan directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding. The saltmarshes and intertidal mudflats and sandflats of the estuary are considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate . (Refer also to sections 5.6.3 and 5.6.4). Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

v. Changes in wave exposure

It is thought unlikely that changes in wave exposure within the Estuary will affect the Bewick's Swan directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding. The saltmarshes and intertidal mudflats and sandflats of the estuary are considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate . (Refer also to sections 5.6.3 and 5.6.4). . Impacts on the extent and suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

vi. Changes in grazing management

The Bewicks Swan feature, which is dependent on the saltmarsh habitats, is considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in grazing management.

The vegetation composition of saltmarsh habitats can be altered by changes in grazing management. This can affect the palatability of the sward for grazing Bewick's swans and therefore affect the availability of adequate preferred feeding areas within the SPA. There are critical areas for this species located at the Dumbles in the uppermost part of the estuary all of which are grazed.

vii. Noise and visual presence

Overwintering birds are disturbed by sudden movements and sudden noises. This can displace the birds from their feeding grounds. Disturbance can prevent the birds from feeding and in response they either a) decrease their energy intake at their present (disturbed) feeding site through displacement activity, or b) move to an alternative less favoured feeding site. Such a response affects energy budgets and thus survival. There is intermittent disturbance from both the landward and seaward side of the site. Bewick's swans are mainly affected by disturbance from the landward side and any increase in disturbance should be avoided. At present the Annex 1 species are **moderately vulnerable** to noise and visual disturbance on the intertidal mudflats and sandflats and have a **high vulnerability** to this category of operation on the saltmarsh.

viii. Toxic contamination through the introduction of synthetic and/or non-synthetic compounds

Waterfowl are subject to the accumulation of toxins through the food chain or through direct contact with toxic substances when roosting or feeding. Their ability to feed can also be affected by the abundance or change in palatability of their prey caused by toxic contamination. At the moment there is no evidence to show that this is the case, but the estuary is vulnerable to oil spills and there is a continuous discharge of toxins into the estuary,

some of which bind to the sediments. This is an area which requires further assessment and is likely to be addressed by work arising from both the Water Framework Directive and ongoing Review of Consents by the Environment Agency. The Bewick's swans has a **moderate vulnerability** to toxic contamination.

ix. **Changes in nutrient loading**

Changes in organic or nutrient loading can change the species composition of the plants on the saltmarsh and thus the structure of the sward. This could affect the palatability of the sward for grazing Bewick's swans and therefore affect the availability of adequate preferred feeding areas within the SPA. There are critical areas for this species located at the Dumbles in the uppermost part of the estuary all of which are grazed.

x. Changes in salinity

It is thought unlikely that changes in salinity within the Estuary will affect the Bewicks Swan feature directly but such changes may have marked effects on the supporting saltmarsh habitats on which this species are dependant for feeding. The saltmarshes of the estuary are considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in salinity. Impacts on these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

xi. Changes in oxygenation

It is thought unlikely that changes in oxygenation within the Estuary will affect the Bewicks Swan feature directly but such changes may have an effect on the community composition of supporting saltmarsh habitats on which this species are dependant for feeding. The saltmarshes of the estuary are considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation. Impacts on these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

xii. Introduction of microbial pathogens

Bewicks swan is considered to have **low sensitivity** and **high exposure** (due to the high number of sewage discharges) and therefore **moderate vulnerability** to the introduction of microbial pathogens.

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges. Bewicks swans on their feeding or roosting grounds may be affected by direct infection by pathogens (bacteria or viruses) present in the water or river sediments and through the release of endo or exotoxins bacterial toxins. Infection may cause mortality, loss of condition and behavioural changes in individuals and within the population using the site through onward contamination.

5.7.2 Internationally important waterfowl assemblage including populations of regularly occurring migratory species

(Note : this advice is also relevant to the Ramsar Site's "internationally important populations of waterfowl" features and the "internationally important assemblage of waterfowl" feature for which the Ramsar Site has been designated – refer also to section 5.8)

5.7.2.1 Sensitivity

The Internationally important waterfowl assemblage including populations of regularly occurring migratory species is **moderately to highly sensitive** to:

- **Physical loss**
- **Physical damage**
- **Non-physical disturbance**
- **Toxic contamination**
- **Non-Toxic contamination**
- **Biological disturbance**

These result from a range of activities known to occur within the Estuary. Further details are provided in points i) to xvi) below, with details of the level of sensitivity set out in Table 23.

5.7.2.2 Exposure

The Internationally important waterfowl assemblage including populations of regularly occurring migratory species is **moderately to highly exposed** to:

- **Substratum loss and smothering**
- **Changes in suspended sediment**
- **Desiccation and changes in emergence regime**
- **Changes in water flow**
- **Changes in wave exposure**
- **Abrasion and physical disturbance**
- **Grazing management**
- **Noise and visual disturbance**
- **Toxic contamination**
- **Changes in nutrient loading**
- **Changes in thermal regime**
- **Changes in salinity**
- **Changes in oxygenation**
- **Introduction of microbial pathogens**
- **Introduction of non-native species**
- **Selective extraction of species**

5.7.2.3 Vulnerability

The Internationally important waterfowl assemblage including populations of regularly occurring migratory species has **moderate to high vulnerability** to:

i. Substratum loss and smothering

The intertidal habitats and therefore the waterfowl assemblage feature which these habitats support are considered to have **moderate to high sensitivity** and **moderate to high exposure** and therefore **moderate to high vulnerability** to physical loss (substratum loss and smothering).

The physical loss of areas of intertidal habitats may be caused directly through change of land use or indirectly as a consequence of changes to sedimentation processes (e.g. coastal defences) as well as via the effects of smothering by artificial structures (e.g. jetties) or the disposal of spoils. Activities or developments resulting in

physical loss of the intertidal supporting habitats are likely to reduce the availability of food and roosting habitat and thus be detrimental to the favourable condition of the SPA interest features including all the migratory species and waterfowl assemblage. The intertidal mudflats and sandflats and the saltmarsh are highly sensitive to removal by land reclamation and major construction activities.

Eelgrass beds (which are a food source for some species of the assemblage) are being affected by siltation due to changes in sediment movement after construction of the Second Severn Crossing which has resulted in smothering.

ii. Changes in suspended sediment

It is thought unlikely that changes in the suspended sediment within the Estuary will affect the waterfowl assemblage directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding.. (Refer also to sections 5.6.1, 5.6.3 and 5.6.4). The supporting habitats are all are currently considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to desiccation and changes in emergence regime. Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

iii. Desiccation and changes in emergence regime

It is thought unlikely that changes in the emergence regime within the Estuary will affect the waterfowl assemblage directly but such changes may have marked effects on the supporting habitats on which they are dependant for roosting and feeding.. (Refer also to sections 5.6.1, 5.6.3 and 5.6.4). The saltmarshes are currently considered to have **high sensitivity** and **low exposure** and therefore **moderate vulnerability** to desiccation and changes in emergence regime. Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

iv. Changes in water flow rate

It is thought unlikely that changes in water flow rate within the Estuary will affect the designated bird species of the assemblage directly but such changes may have marked effects on the supporting habitats on which these species are dependant for roosting and feeding. All the supporting habitats are considered to have **moderate sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate . (Refer also to sections 5.6.1, 5.6.3 and 5.6.4). Impacts on the suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

v. Changes in wave exposure

It is thought unlikely that changes in wave exposure within the Estuary will affect the designated bird species of the assemblage directly but such changes may have marked effects on the supporting habitats on which these species are dependant for roosting and feeding. All the supporting habitats are considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in water flow rate . (Refer also to sections 5.6.1, 5.6.3 and 5.6.4). Impacts on the extent and suitability of these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

vi. Abrasion and physical disturbance

Saltmarsh may be physically damaged from overgrazing or eroded when boats are moored on it and when paths are worn through it to reach moored boats on foot or via vehicles. Currently all supporting habitats are considered to be moderately vulnerable to abrasion. Intertidal habitats are **highly sensitive** to damage by direct and indirect effects of aggregate dredging. The intertidal mudflats and sandflats and the shingle and rocky shore are therefore considered **highly vulnerable** to selective extraction.

vii. Changes in grazing management

The waterfowl assemblage which is in part dependant on the saltmarsh habitats is considered to have **high sensitivity** and **high exposure** and therefore **high vulnerability** to changes in grazing management.

The vegetation composition of saltmarsh habitats can be altered by changes in grazing management. This can affect the palatability of the sward for grazing wildfowl and availability of invertebrate food sources and therefore affect the availability of adequate preferred feeding areas within the SPA. Grazing changes may also

affect the suitability saltmarsh areas as resting and roosting sites for birds where open terrain with low vegetation is an important factor.

viii. Noise or visual disturbance

Overwintering birds are disturbed by sudden movements and sudden noises. This can have the effect of displacing the birds from their feeding grounds. Disturbance can prevent the birds from feeding and in response they either a) decrease their energy intake at their present (disturbed) feeding site through displacement activity, or b) move to an alternative less favoured feeding site. Such a response affects energy budgets and thus survival. There is intermittent disturbance to the internationally important migratory species and the waterfowl assemblage from both the landward and seaward side of the site which has increased in recent years, due to the estuary becoming more populated and the development of all weather recreational pursuits. All supporting habitats are currently **highly vulnerable** to noise and visual disturbance.

ix. Toxic contamination through the introduction of synthetic and/or non-synthetic compounds

Waterfowl are subject to the accumulation of toxins through the food chain or through direct contact with toxic substances when roosting or feeding. Their ability to feed can also be affected by the abundance or change in palatability of their prey caused by toxic contamination. At the moment there is no evidence to show that this is the case on the Severn Estuary, but the estuary is vulnerable to oil spills and there is a continuous discharge of toxins into the estuary, some of which bind to the sediments. This is an area that requires further assessment. The intertidal mudflats and sandflats and the saltmarsh are currently **highly vulnerable** to the introduction of synthetic and non-synthetic compounds.

x. Changes in nutrient loading

Changes in organic or nutrient loading can change the species composition of the plants on the saltmarsh and thus the structure of the sward. Increases in nutrients can cause excessive algal growth on the mudflats, denying the birds access to their invertebrate prey and changing the invertebrate species composition in the sediment. However, high nutrient loads can also be beneficial to some species of birds by increasing the density and size of prey items. Though the water quality has been improved in recent years there are still local areas of concern. On balance, any increase in nutrient loading should be avoided. At present the intertidal mudflats and sandflats are **moderately vulnerable** to this category of operation.

xi. Changes in thermal regime

It is thought unlikely that changes in the thermal regime within the Estuary will affect the designated bird species of the assemblage directly but such changes may have marked effects on the community composition of supporting habitats on which these species are dependant for feeding. The intertidal mudflats and sandflats of the estuary are considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to changes in thermal regime. Impacts on these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

xii. Changes in salinity

It is thought unlikely that changes in salinity within the Estuary will affect the waterfowl assemblage feature directly but such changes may have marked effects on the supporting habitats on which these species are dependant for feeding. The saltmarshes, intertidal mudfalts and sand flats and hard substrate habitats (rocky shores) of the estuary are considered to have **low to moderate sensitivity** and **high exposure** and therefore **moderate to high vulnerability** to changes in salinity. Impacts on these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

xiii. Changes in oxygenation

It is thought unlikely that changes in oxygenation within the Estuary will affect the waterfowl assemblage feature directly but such changes may have marked effects on the community composition of supporting habitats on which these species are dependant for feeding. The saltmarshes, intertidal mudfalts and sand flats and hard substrate habitats (rocky shores) of the estuary are considered to have **low sensitivity** and **high exposure** and therefore **moderate vulnerability** to changes in oxygenation. Impacts on these habitats may affect the long term survival of individuals (in terms of energy and competition) or alter behavior and patterns of use or distribution.

xiv. Introduction of microbial pathogens

The bird assemblage is considered to have **low to high sensitivity** and **high exposure** (due to the high number of sewage discharges) and therefore **moderate vulnerability** to the introduction of microbial pathogens.

Microbial pathogens are most likely to enter the Severn's ecosystem by means of sewage discharges. Waterfowl may be affected by microbial pathogens (bacteria or viruses) on their feeding or roosting grounds and are considered to be particularly highly exposed when feeding and roosting on the intertidal mudflats and sandflats and hard substrate habitats where there may be bioaccumulation of pathogens within food sources (filter feeding organisms). Birds may also be affected by direct infection by pathogens present in the water or river sediments and through the release of endo or exotoxins bacterial toxins. Infection may cause mortality, loss of condition and behavioural changes in individuals and within the population using the site through onward contamination.

xv. Introduction of non-native species

The birds assemblage is considered to have **high sensitivity** and **low exposure** and therefore **moderate vulnerability** to the introduction of non native species.

The saltmarsh cordgrass *Spartina anglica* is an invasive pioneer species whose rapid growth consolidates sediment, raises mudflats and reduces sediment availability elsewhere. This expansion can affect areas of intertidal habitats (mud and sandflats and hard substrate habitats) which are key habitats for roosting and feeding birds. Such expansion is regarded as being a potential threat to intertidal beds of eelgrass *Zostera noltei* in particular which are a food source for some species within the assemblage (Wigeon and European white-fronted goose). However, whilst recognising *S. anglica* as an invasive species, it also has a role in saltmarsh formation and the community SM6 in which it features should be allowed to develop into other Atlantic Salt Meadow or transitional communities which are also of value as feeding and roosting habitats for birds within the assemblage.

The presence of another non-native, the slipper limpet *Crepidula fornicata*, in large numbers may alter the species composition within certain soft mud habitats leading to a decline in overall species richness and consequent implications on food availability for feeding birds. However, *C. fornicata* has yet to penetrate the Estuary, possibly due to the strong water flows.

xvi. Selective extraction of species

The birds assemblage is considered to have **moderate sensitivity** and **moderate exposure** and therefore **moderate vulnerability** to the selective extraction of species.

Wildfowling is carried out all around the estuary. It is believed that there is currently no direct detrimental effect on the overall bird populations but wildfowling is one of many activities that may be contributing (through disturbance) to the decline in some species on the Severn. Continuing monitoring and regulation of wildfowling is achieved by the countyside agencies and through the management of wildfowling by a British Association of Shooting and Conservation (BASC) affiliated associations, applying the BASC wildfowlers code of conduct.

Bait digging is also carried out in localised areas of the mid and outer estuary. Extensive areas of digging can change the availability of prey in the sediment as the area needs a period of recovery and recolonisation. There is currently no evidence that existing levels of activity is detrimental to the birds on the European Marine Site.

The removal of strandline vegetation by beach cleaning removes an important habitat for invertebrates, as well as many of the invertebrates themselves, reducing the quantity and variety of prey available to the birds. Much of the saltmarsh is managed by grazing and changes in management can alter the availability of prey and suitability of roosting sites.

Table 23 Sensitivity, exposure and vulnerability of the Severn Estuary SPA to physical, chemical and biological pressures *(See note in section 5.7 on changes to this table since version issued in1995.)*

Sensitivity		Exposure		Vulnerability	
High sensitivity	OOOO	High Exposure	××××	High vulnerability	⊗⊗⊗⊗ ⊗⊗⊗O ⊗⊗⊗×
Moderate sensitivity	OOO	Medium Exposure	×××	Moderate vulnerability	⊗⊗OO ⊗⊗× × ⊗⊗⊗
Low sensitivity	OO	Low Exposure	××	Low vulnerability	⊗⊗O ⊗××× ⊗⊗× ⊗×× ⊗⊗ ⊗×
No detectable sensitivity	O	No exposure	×	No vulnerability	⊗O
?S =Insufficient information on sensitivity				Unknown vulnerability	

Categories of operations which may cause deterioration or disturbance	Internationally important populations of regularly occurring Annex 1 species		Internationally important migratory species and waterfowl assemblage		
	Intertidal mudflats and sandflats	Saltmarsh	Intertidal mudflats and sandflats	Saltmarsh	Hard substrates
Physical Loss					
Removal/substratum loss	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗
Smothering	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗
Physical Damage					
Changes in suspended sediment	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗
Desiccation and changes in emergence regime	⊗⊗O	⊗⊗OO	⊗⊗O	⊗⊗OO	⊗⊗O
Changes in water flow	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×
Changes in wave exposure	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗
Abrasion / physical disturbance (of habitats)	⊗⊗	⊗⊗O	⊗⊗⊗⊗	⊗⊗⊗×	⊗⊗⊗×
Grazing management	Not relevant	⊗⊗⊗⊗	Not relevant	⊗⊗⊗⊗	Not relevant
Non-physical disturbance					
Noise & visual presence	⊗⊗OO	⊗⊗⊗O	⊗⊗⊗O	⊗⊗⊗⊗	⊗⊗⊗O
Toxic contamination					
Introduction of synthetic compounds	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗×	⊗⊗⊗×
Introduction of non-synthetic compounds	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗⊗	⊗⊗⊗×
Introduction of radionuclides	**?S××**	**?S××**	**?S××**	**?S××**	**?S××**
Non-toxic contamination					
Changes in nutrient loading	⊗×××	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×	⊗⊗××
Changes in thermal regime	⊗×	⊗⊗	⊗⊗⊗	⊗⊗	⊗⊗
Changes in turbidity (light penetration)	⊗××	⊗×	⊗⊗×	⊗×	⊗⊗×
Changes in salinity	⊗×××	⊗⊗⊗×	⊗⊗××	⊗⊗⊗×	⊗⊗××
Changes in oxygenation	⊗×××	⊗⊗××	⊗⊗××	⊗⊗××	⊗⊗××
Biological disturbance					
Introduction of microbial pathogens	⊗⊗××	⊗⊗××	⊗⊗⊗⊗	⊗⊗××	⊗⊗⊗⊗
Introduction of non-native species	⊗×	⊗⊗	⊗⊗OO	⊗⊗	⊗⊗OO
Selective extraction of species	⊗⊗O	⊗⊗O	⊗⊗⊗	⊗⊗⊗	⊗××

5.8 Specific Advice on Operations for the Severn Estuary Ramsar Site

Separate advice for the Ramsar Site features has not been produced here as it repeats the advice given in the previous sections (5.6 and 5.7) for the SAC and SPA respectively due to the overlapping nature of the Ramsar features. The following table therefore cross references the features of these designations and provides a direct reference to the section where advice relevant to the Ramsar features can be found.

Table 24 Cross reference table relating features of the Ramsar Site to the advice on operations for the SAC and SPA

Ramsar interest features	**Relevant SAC and SPA features and supporting habitats**	**Reference section for advice on operations relevant to the Ramsar features**
Ramsar Interest feature 1 : **Estuaries**	**SAC: Annex I habitats** Estuaries Intertidal mudflats and sandflats Atlantic Salt Meadows	 Section 5.6..1 & Table 22 Section 5.6.3 & Table 22 Section 5.6.4 & Table 22
Ramsar Interest feature 2 : **Migratory fish assemblage**	**SAC : Annex II species** River lamprey *Lampetra fluviatilis*; Sea lamprey *Petromyzon marinus*; Twaite shad *Alosa fallax*	 Section 5.6.6 & Table 22 Section 5.6.6 & Table 22 Section 5.6.6 & Table 22
Internationally important populations of waterfowl *Ramsar Interest feature 3:* **Bewick's swan** *Ramsar Interest feature 4:* **European white-fronted goose** *Ramsar Interest feature 5:* **Dunlin** *Ramsar Interest feature 6:* **Redshank** *Ramsar Interest feature 7:* **Shelduck** *Ramsar Interest feature 8:***Gadwall**	**SPA : Internationally important populations of regularly occurring Annex 1 species (Bewick's swan)** SPA: **Internationally important populations of regularly occurring migratory species (same species as column to left)** **Supporting habitats** Intertidal mudflats and sandflats Saltmarsh Hard substrates .	Section 5.7.1 & Table 23 Section 5.7.2 & Table 23 Section 5.6.3 & Table 22 Section 5.6.4 & Table 22
Ramsar Interest feature 9 **Internationally important assemblage of waterfowl**	SPA: **Internationally important assemblage of waterfowl** **Supporting habitats** Intertidal mudflats and sandflats Saltmarsh Hard substrates	Section 5.7.2 & Table 23 Section 5.6.3 & Table 22 Section 5.6.4 & Table 22

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WWT WETLANDS ADVISORY SERVICE, 2003. *Baseline Bird Monitoring of the River Severn.* Report to the Countryside Council for Wales.

7. Glossary

Advisory Group	The body of the representatives from local interests, user groups and conservation groups, formed to advise the management group
Annex 1 Bird species	The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat. These measures ensure the survival and reproduction of the birds in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable
Annex I habitat type(s)	A natural habitat(s) listed in Annex I of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex II species	A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex V	The listing, in the Habitats Directive, of the animal and plant species whose taking in the wild and exploitation may be subject to management measures.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment.
Attribute	Characteristic of an interest feature or supporting habitat which provides an indication of the condition of the feature or supporting habitat to which it applies.
BASC	British Association of Shooting and Conservation
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
Birds Directive	The abbreviated term of *Council Directive* 79/409/*EEC of 1979 on the conservation of wild birds.*
Biodiversity	The total variety of life on earth. This includes diversity within species, between species and ecosystems.
Biotope	The physical habitat with its biological community; a term which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.
BTO	British Trust for Ornithology
CCW	Countryside Council for Wales
Characteristic	Special to, or especially abundant in, a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Community	A group or organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups.
Competent authority	Any Minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legislative powers.
Conservation objective	A statement of the nature conservation aspirations for a site, expressed in terms of the favourable condition that we wish to see the species and/or habitats for which the site has been selected to attain. Conservation objectives for European Marine Sites relate to the aims of the Habitats Directive.
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
Epifauna	Benthic animals living on the seabed.
EN	English Nature (now incorporated into Natural England).
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacles, mussels, fucoid algae and with red algae often abundant on the lower part.

European Marine Site	A European site which consists of, or in so far as it consists of, areas covered intermittently or continuously by seawater.
European Site	A classified SPA, designated SAC, site of Community importance (a site selected as a candidate SAC, adopted by the European Commission but not yet designated), a candidate SAC (in England only) or a site hosting a priority species in respect of which Article 5 of the Habitats directive applies.
Favourable condition	The condition represented by the achievement of the conservation objectives, in other words the desired condition for a designated habitat or a species on an individual site.
Favourable conservation status (FCS)	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function throughout the EC in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
Habitat	The place in which a plant or animal lives.
Habitats Directive	The abbreviated term of *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora.* It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union.
Habs Regs	The Conservation (Natural Habitats &c.) Regulations 1994.
HAT	Highest Astronomical Tide.
Infauna	Benthic animals which live within the sediment.
Infralittoral	The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps.
Interest feature	A natural or semi-natural feature for which a European site has been selected. This includes any Habitats Directive Annex I habitat, or any Annex II species and any population of a bird species for which an SPA has been designated under the Birds Directive.
JNCC	Joint Nature Conservation Committee.
Maintain	The action required for an interest feature when it is considered to be in favourable condition.
Management group	The body of relevant authorities formed to manage the European Marine Site.
Management scheme	The framework established by the relevant authorities at a European Marine Site under which their functions are exercised to secure, in relation to that site, compliance with the requirements of the Habitats Directive.
MNR	Marine Nature Reserve.
Nationally scarce/rare	For marine purposes, these are regarded as species of limited national occurrence.
Natura 2000	The European network of protected sites established under the Birds Directive and the Habitats Directive.
NNR	National Nature Reserve.
Notable species	A species that is considered to be notable due to its importance as an indicator, and may also be of nature conservation importance, and which is unlikely to be a 'characteristic species.'
Operations which may cause deterioration or disturbance	Any activity or operation taking place within, adjacent to, or remote from a European Marine Site that has the potential to cause deterioration to the natural habitats for which the site was designated, or disturbance to the species and its habitats for which the site was designated.
PCB	Polychlorinated Biphenyls.

Peak mean counts (5 yr)	The Severn Estuary is broken down into count sectors. Over the winter months WeBS volunteers count all the birds which are visible within each sector. The yearly figures for each species in the Severn Estuary are then averaged over a five year period to give the 5 yr peak mean count.
Plan or project	Any operation that is within a competent authority's (including relevant authorities) function to control, or over which a competent authority (including relevant authorities) has a statutory function to decide on applications for consents, authorisations, licences or permissions. There is no generally accepted definition of the term "plan or project". This definition may be subject to review and may require further discussion in the context of developing a management scheme for the Severn Estuary SPA.
Ramsar	Site designated under the 1971 Ramsar Convention as a wetland of international importance.
Relevant authority	The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment, or adjacent to, a European Marine Site.
Reporting period	The cycle within which a definitive report on the condition of features protected within the site series will be produced, set as once in every 6 years.
Restore	The action required for an interest feature when it is not considered to be in a favourable condition.
SAC	Special Area of Conservation.
Sensitivity	The intolerance of a habitat, community or individual species to damage from an external force.
SPA	Special Protection Area for birds.
SSSI	Site of Special Scientific Interest.
Strandline	The organic matter particularly rotting seaweed deposited by the tide anywhere along the intertidal.
Supporting Habitats	The key habitats within the European Marine Site necessary to support the interest feature.
TAN 5	Planning Guidance (Wales) Technical Advice Note (TAN)5: Nature Conservation and Planning (Welsh Assembly Government)
TBT	Tri-butyl tin
Vulnerability	The exposure of a habitat, community or individual of a species to an external factor to which it is sensitive.
WeBS	Wetland Bird Survey: a collaborative national surveillance scheme of the UK's waterfowl based on counts undertaken once per month outside of the breeding season.
WWT	Wildfowl & Wetlands Trust

C3 Wye Valley and Forest of Dean Bat Sites/ Safleoedd Ystlumo Dyffryn Gwy a Fforest y Ddena SAC

4.1 Conservation Objective for Feature 1: Greater Horseshoe Bat *Rhinolophus ferrumequinum* (EU Species Code: 1304)

Vision for feature 1

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

- The site will support a sustainable population of greater horseshoe bats in the Wye Valley area.
- The population will viable in the long term, acknowledging the population fluctuations of the species.
- Buildings, structures and habitats on the site will be in optimal condition to support the populations.
- Sufficient foraging habitat is available, in which factors such as disturbance, interruption to flight lines, and mortality from predation or vehicle collision, changes in habitat management that would reduce the available food source are not at levels which could cause any decline in population size or range
- Management of the surrounding habitats is of the appropriate type and sufficiently secure to ensure there is likely to be no reduction in population size or range, nor any decline in the extent or quality of breeding, foraging or hibernating habitat.
- There will be no loss or decline in quality of linear features (such as hedgerows and tree lines) which the bats use as flight lines - there will be no loss of foraging habitat use by the bats or decline in its quality, such as due to over-intensive woodland management
- All factors affecting the achievement of the foregoing conditions are under control.

Performance indicators for Feature 1

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

The performance indicators for maintenance of **favourable condition** of the greater horseshoe bats (*Rhinolophus ferrumequinum*) on the Welsh side of the Wye Valley and Forest of Dean Bat Sites SAC.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A1. Population of Greater Horseshoe Bats	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. An adult bat is defined as any greater horseshoe bat recorded leaving the roost between 7th – 21st July.	*Upper limits:* None required. *Lower limits:* During at least one surveillance visit between 7th –21st July of every year, there will be 80 or more adult bats present.

A2. Recruitment to bat population/productivity	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* During at least one surveillance visit between 7th –28th July of every year, the productivity should be 0.3 or more (i.e. number of births is 30% or more of the total number of adult bats).
Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***
F1. Site security	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* Access to the site under the control of the owner/occupier or site secured against unauthorised access.
F2. External condition of the building	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* Fabric of building sufficient to maintain roost conditions internally with: • Weatherproof roof. • No holes allowing excessive heat loss or high light levels in the roost area. • Walls sound, rainwater goods in adequate condition. • Solar heating sufficient to maintain adequate roost temperature, with no significant shading of the roost. • The building is structurally stable.

F3. Roost access	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* The roost access is in a suitable condition to allow emergence by bats with: • A greater horseshoe bat entrance a minimum of 400mm x 300mm. • An entrance that is unobstructed and allows the bats to fly through unimpeded. • No artificial lights shining on access or associated flight paths.
F4. Disturbance	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required *Lower limits:* Disturbance levels acceptable to bats with: • No increase since previous visit. • Human access to roost controlled and limited.
F5. Internal condition of building	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* The internal fabric of the building is sufficient to maintain the roost location with: • No significant water penetration. • Low light levels with no through draught. • No toxic substances present which would adversely affect the health of the bats.
F6. Temperature of roost area	Site specific requirements based on site monitoring	To be determined

F7. Flight Lines	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005/ 'Monitoring Greater Horseshoe Bats in the Wye Valley through radio tracking and field survey to assess habitat use and condition', G. Billington, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. Broadleaf woodland edge is defined as an area where 90% of the trees are broadleaf. A woodland ride is defined as woodland track >10m wide and greater than 100m in length. Tree lined is defined as a line of trees with <20% gaps over the length and with no individual gaps that are greater than 10m. Type 2A hedgerow is defined as partially managed/unmanaged hedgerow >2m wide and >2m high, not gappy. Type 2B hedgerow is defined as 2A but with gaps. Type 3A hedgerow is defined as hedgerow with trees (overall >30% trees) or tree lined, non gappy. Gappy/gaps is defined as a hedge where there is 20% gaps over the length of the hedge or with single gaps greater than 10m.	*Upper limits:* None required. *Lower limits:* Refer to Figure 2 (Collins *et al*, 2005) for locations of these Areas. 70% of Area A (Hayes coppice up to horizontal line) is maintained as woodland **AND** Within Area A there are a minimum of two woodland rides **AND** Area B is maintained as a broadleaf woodland edge **AND** Within 500m of the roost: • Mally Brook is maintained as a tree-lined stream. • There are at least 400m of hedgerow that are described as type 2 or better, of which no more than 50% will be type 2B. • Type 2 or better hedgerows will be present (at least 50m) both north and south of Mally Brook. **AND** District staff should comment on felling licences applications within 2km of the roost. **Note**: Refer to Collins *et al*, 2005 for development of these habitat definitions and figures.

F8. Feeding habitats	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005/ 'Monitoring Greater Horseshoe Bats in the Wye Valley through radio tracking and field survey to assess habitat use and condition', G. Billington, 2005. Based on Common Standards Monitoring for this feature. Modified according to site specific requirements. Type 2A hedgerow is defined as partially managed/unmanaged hedgerow >2m wide and >2m high, not gappy. Type 2B hedgerow is defined as 2A but with gaps. The River Wye has also been shown to be an important flight line/feeding habitat for greater horseshoe bats.	*Upper limits:* None required. *Lower limits:* • Within Area G (see Figure 3, Collins *et al*, 2005) 40% of the length of field boundaries will be type 2 or better. • Within Area I (see Figure 4) 50% of the length of field boundaries will be of type 2 hedge or better. • An ideal level of cattle grazing for the area has yet to be determined. *Other conditions:* • District staff should comment on any Tir Gofal applications within the 7km survey boundary. Management should look to increase the amount of cattle grazing, conversion of improved pasture to semi-improved and improve the structure of hedgerows (to make them taller and bushier). • The requirements of these bats should be considered when considering riparian management along the stretch of the River Wye that lies within the 7km survey boundary.
F9. Roosts	Justification for limits in document 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005 / 'Monitoring Greater Horseshoe Bats in the Wye Valley through radio tracking and field survey to assess habitat use and condition', G. Billington, 2005. Based on Common Standards Monitoring for this feature. Modified according to site specific requirements.	*Upper limits:* None required. *Lower limits:* • The roost at Osbaston will be maintained according to the criteria outlined in the Common Standards Monitoring for Mammals version: August 2004.

F10. Condition of the habitat within the SSSI boundary	Justification for limits in documents 'Draft Performance Indicators for Greaters', K. Wilkinson, 2005 / 'Monitoring Greater Horseshoe Bats in the Wye Valley through radio tracking and field survey to assess habitat use and condition' G. Billington, 2005. Based on Common Standards Monitoring for this feature. Modified according to site specific requirements. Woodland is defined as an area dominated by broadleaf or conifer trees with no clear felled areas >0.1ha Livox Wood and Harper's Grove Lord's Grove are within close proximity to Newton Court and it is likely that they are used at certain times of the year (one radio-tagged bat was recorded sheltering in Harper's Grove during the 2004 study).	*Upper limit:* The roof of the roost will not be shaded by trees. *Lower limit:* • The wall (refer to Figure 1 in report 'Draft Performance Indicators for Greaters' K. Wilkinson, 2005) is structurally intact **AND** • 70% of the SSSI is referable to broadleaf woodland **AND** • Livox Wood and Harper's Grove Lord's Grove form part of the Wye Valley Woods SAC and therefore CCW has some degree of management control of them. The requirements of these bats should be considered when developing management plans for both these sites.

The feeding habitat and flight line limits represent more of a long-term aim and in some respects represent the ideal landscape. However here we have attempted, using information from radio-tracking and general knowledge of greater horseshoe bat ecology, to identify key areas that will aid the maintenance of FCS of this colony of greater horseshoe bats. This is not a complete list and it is likely that as more information becomes available other areas of habitat will be identified as being of importance.

4.2 Conservation Objective for Feature 2: Lesser Horseshoe Bat *Rhinolophus hipposideros* (EU Species Code: 1303)

Vision for feature 2

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

- The site will support a sustainable population of lesser horseshoe bats in the Wye Valley area.
- The population will viable in the long term, acknowledging the population fluctuations of the species.
- Buildings, structures and habitats on the site will be in optimal condition to support the populations.
- Sufficient foraging habitat is available, in which factors such as disturbance, interruption to flight lines, and mortality from predation or vehicle collision, changes in habitat management that would reduce the available food source are not at levels which could cause any decline in population size or range.

- Management of the surrounding habitats is of the appropriate type and sufficiently secure to ensure there is likely to be no reduction in population size or range, nor any decline in the extent or quality of breeding, foraging or hibernating habitat.
- There will be no loss or decline in quality of linear features (such as hedgerows and tree lines) which the bats use as flight lines – there will be no loss of foraging habitat use by the bats or decline in its quality, such as due to over-intensive woodland management.
- All factors affecting the achievement of the foregoing conditions are under control.

Performance indicators for Feature 2

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

The performance indicators for maintenance of **favourable condition** of the lesser horseshoe bats (*Rhinolophus hipposideros*) on the Welsh side of the Wye Valley and Forest of Dean Bat Sites SAC.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A1. Distribution and population of Lesser Horseshoe Bats	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 / 'Monitoring the Welsh Colonies of Lesser Horseshoe Bats in the Wye Valley', P. Morgan 2006. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. Mwyngloddfa Mynydd-Bach limits based on Common Standards Monitoring for hibernating populations of lesser or greater horseshoe bats. The performance indicators only relate to adult bats; lesser horseshoe bats are sensitive to disturbance and access to the roost to count juvenile bats is considered too disturbing.	*Upper limits:* None required *Lower limits:* For the Welsh side of this SAC to be favourable each of the individual roosts must meet the criteria outlined below. During at least one surveillance visit between 29th May and 17th June of every year, there will be a minimum of adults: **Penallt Old Church** • 250 LHS bats **Itton Court Stud** • 120 LHS bats **The Priory** • 325 LHS bats **Tregeiriog** and **Llangovan Church** • A combined minimum of 180 LHS bats, with a minimum of 40 LHS bats at each roost And during at least one surveillance visit during January of every year, there will be a minimum of: **Mwyngloddfa Mynydd-Bach** 60 LHS bats
Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***

F1. Condition of structures and buildings	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* Fabric of each building sufficient to maintain roost conditions internally with: • Weatherproof roof. • No holes allowing excessive heat loss or high light levels in the roost area. • Walls sound, rainwater goods in adequate condition. • Solar heating sufficient to maintain adequate roost temperature, with no significant shading of the roost. • The building is structurally stable.
F2. Roost access	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. Horseshoe bats prefer to fly through an entrance.	Where: *Upper limits:* None required. *Lower limits:* Each roost access is in a suitable condition to allow emergence by bats with: • A lesser horseshoe bat entrance a minimum of 300mm x 200mm. • An entrance that is unobstructed and allows the bats to fly through unimpeded. • No artificial lights shining on access or associated flight paths.

F3. Hibernaculum access	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. These limits cover only the Mwyngloddfa Mynydd-Bach SSSI. Horseshoe bats prefer to fly through an entrance.	*Upper limits:* None required. *Lower limits:* The site entrance is in suitable condition to allow continued use by bats with: • Existing access unobstructed. • No unplanned new access causing a change to the ventilation. • No change in the size sufficient to affect the airflow and internal temperature. • The access used by the bats is stable. • No recent falls or signs of geological instability. • Vegetation present close to the access but not obstructing it. • No artificial lights shining on access or associated flight paths.
F4. Disturbance	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* Disturbance levels acceptable to bats with: • No increase since previous visit. • Human access to roost controlled and limited.
F5. Temperature of roost area	Site specific requirements based on site monitoring	To be determined
F6. Internal Condition of building	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	*Upper limits:* None required. *Lower limits:* The internal fabric of each building is sufficient to maintain the roost location with: • No significant water penetration. • Low light levels with no through draught. • No toxic substances present which would adversely affect the health of the bats.

F7. Site Security	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements.	Access to each site is under the control of the owner/occupier and the site is secured against unauthorised access.
F8. Condition of the habitat within the SAC boundary	Justification for limits in document 'Draft Performance Indicators for Lessers', K. Wilkinson, 2005 / 'Monitoring the Welsh Colonies of Lesser Horseshoe Bats in the Wye Valley', P. Morgan 2006. Based on Common Standards Monitoring for this feature. Modified according to site-specific requirements. Mwyngloddfa Mynydd-Bach limits based on Common Standards Monitoring for hibernating populations of lesser or greater horseshoe bats. The performance indicators only relate to adult bats, Lesser horseshoe bats are sensitive to disturbance and access to the roost to count juvenile bats is considered too disturbing.	*Upper limits:* None required. *Lower limits:* **Penallt Old Church** The line of trees leading from the church porch to the entrance should be maintained AND **Mwyngloddfa Mynydd-Bach** The extent of the woodland/scrub is as mapped in 2006.

Other factors considered include –
Owner/occupier objectives - the owners/occupiers of the land typically have an interest from the land. This factor will be controlled through management agreements and the SSSI legislation. An operational limit is not required.

Weather conditions - Weather conditions have an effect on the breeding success of the lesser horseshoe bats. In particular, poor weather conditions during the adult breeding season will reduce opportunities for foraging and therefore affect adult condition and reproductive outputs. This factor is outside the influence of the site manager and an operational limit is not required.

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: Greater Horseshoe Bat *Rhinolophus ferrumequinum* (EU Species Code: 1304)

Conservation Status of Feature 1

The greater horseshoe bat numbers of Newton Court Stable Block SSSI are monitored annually in June. The assessment found the SSSI to be in **Favourable condition**. But FCS is **Unfavourable declining**

Newton Court Stable Block SSSI *Current assessments are:*
MU1 Unfavourable declining

Management Requirements of Feature 1
The current status of the feature overall is unfavourable. The following outlines which attributes are considered favourable/unfavourable at each site. The site-specific monitoring report provides more detail on the condition of the site.

Building condition
The external condition of Newton Court is currently in a poor state. While the roof is largely intact and provides a waterproof environment for the roost, holes in the fabric of the roof allow heat loss and too much light into the roost. The current roof is tin causing large fluctuations in diurnal temperature making the roost too hot during the day and too cool at night. However, this appears to have no effect on the bat population. The building is currently structurally stable due to recent remedial work, but this is unlikely to be enough to maintain it in the long term.

Habitat management
The habitat surrounding Newton Court is of paramount importance to maintaining the population. The loss of flight lines in the form of walls, hedges or woodland rides within 1km around the roost should be prevented, as this is where juvenile bats learn to forage and navigate. There should be a similar aim to maintain or improve the quality of woodland and grazed pasture around and between areas identified as being used by the bats. Management of river habitats in the area is also critical due to the diversity of insect life that sustains the bats.

The overall aim for the landscape surrounding Newton Court is to improve the feeding opportunities for the greater horseshoe bats and the fight links between these feeding areas and the roosts (nursery, hibernation and transitory). Increases in the amount of land that is cattle grazed, development of 'less managed' bushier hedgerows and conversion of improved grassland to semi-improved grassland, particularly close to the notified nursery roost, would improve the extent and quality of available greater horseshoe bat feeding habitat.

5.2 Conservation Status and Management Requirements of Feature 2: Lesser Horseshoe Bat *Rhinolophus hipposideros* (EU Species Code: 1303)

Conservation Status of Feature 2
The lesser horseshoe bat numbers for all component SSSIs are annually monitored. The assessment of all 3 component SSSIs showed lesser horseshoe bats to be favourable in two of the three areas. As all of the three SSSIs units have to be in good condition for the LHB overall to be favourable the feature is in **unfavourable condition**, and in this case we can give condition information at the unit level**.**

Llangovan Church SSSI Current assessments are:
MU1 Favourable maintained
Mwyngloddfa Mynydd Bach SSSI Current assessments are:
MU1 Favourable maintained
Wye Valley Lesser Horseshoe Bats SSSI Current assessments are:
MU1 Favourable maintained
MU2 Unfavourable declining
MU3 Unfavourable maintained
MU4 Unfavourable declining

Management Requirements of Feature 2
The current status of the feature overall is unfavourable. The following section outlines which attributes are considered favourable/unfavourable at each site. The site-specific monitoring report provides more detail on the condition of the site.

Structure Condition

At **Mwyngloddfa Mynydd-Bach** structural integrity of the rock forming the adit may require management to prevent further collapse. Rockfall deep within the adit should not affect the viability of the mine as a habitat, but rockfall closer to the entrance may block access and could result in the complete loss of this site as a hibernaculum roost. Given the current unsupported state of the rock, collapse should be considered imminent.

Habitat management

The habitat surrounding these sites is of paramount importance to maintaining the population. The loss of flight lines in the form of walls, hedges or woodland rides within 1km around the roost should be prevented, as this is where juvenile bats learn to forage and navigate. There should be a similar aim to maintain or improve the quality of woodland and grazed pasture around and between areas identified as being used by the bats. Management of river habitats in the area is also critical due to the diversity of insect life that sustains the bats.

The overall aim for the landscape surrounding the management units is to improve the feeding opportunities for the lesser horseshoe bats and the fight links between these feeding areas and the roosts (nursery, hibernation and transitory). Increases in the amount of land that is cattle grazed, development of 'less managed' bushier hedgerows and conversion of improved grassland to semi-improved grassland, particularly close to the notified nursery roost, would improve the extent and quality of available lesser horseshoe bat feeding habitat.

Llangovan Church – no issues except surrounding habitat.

Mwyngloddfa Mynydd Bach – no issues except surrounding habitat.

Wye Valley Lesser Horseshoe Bats SSSI

MU1 – no issues, but important to continue liaison with owner/occupiers and monitor the progress of planned extension.
MU2 – issue with declining numbers needs to be investigated, possibly another unknown roost in the area.
MU3 – no issues, but important to continue liaison with owner/occupiers.
MU4 – issue with declining numbers, requires investigation into possible reasons including building condition.

Surrounding habitat management important for all units.