



Environment
Agency



Habitat Regulations assessment: Appendices 1 and 2

Hinkley Point C operational water discharge activity
permit variation, EPR/HP3228XT/V005

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Contents

Foreword.....	3
1. Appendix 1: European site location maps	4
1.1. Severn Estuary Special Area of Conservation (SAC)	4
1.2. Severn Estuary Special Protection Area (SPA) and Ramsar	5
1.3. Somerset Levels and Moors SPA	6
1.4. River Usk SAC	7
1.5. River Wye SAC	8
1.6. Bristol Channel Approaches SAC	9
2. Appendix 2: Ecological narrative for the relevant designated features	10
2.1. Habitats	10
2.2. Fish species and fish assemblages	20
2.3. Bird species and birds of internationally important numbers.....	26
2.4. Marine mammals	30
References	31

Foreword

Appendices 1 and 2 of the Habitats Regulations assessment (HRA) for the Hinkley Point C (HPC) operational site water discharge activities (WDA) environmental permit variation application.

Appendix 1 provides figures to demonstrate the location of the relevant European sites considered within the HRA, in relation to the HPC site and the fish recovery and return (FRR) system discharge points.

The site plans provided use the [European Nature Information System \(EUNIS\)](#) website to display the Natura 2000 sites, whose location and boundaries are displayed in turquoise. The location of the HPC site and discharge location is displayed as a green square on each of the figures.

A web link is provided beneath each figure to the site-specific details on the EUNIS website.

Appendix 2 provides the ecological narrative for the relevant designated features of the identified European sites. For each site it lists the habitat types present and the communities within each type and gives a detailed description of the site and how those habitats feature.

It also provides a breakdown of each fish species and fish assemblage which is listed as feature of the sites considered, giving an ecological narrative for each. Ecological narratives are also provided for bird species, birds of internationally important numbers and marine mammals.

1. Appendix 1: European site location maps

1.1. Severn Estuary Special Area of Conservation (SAC)

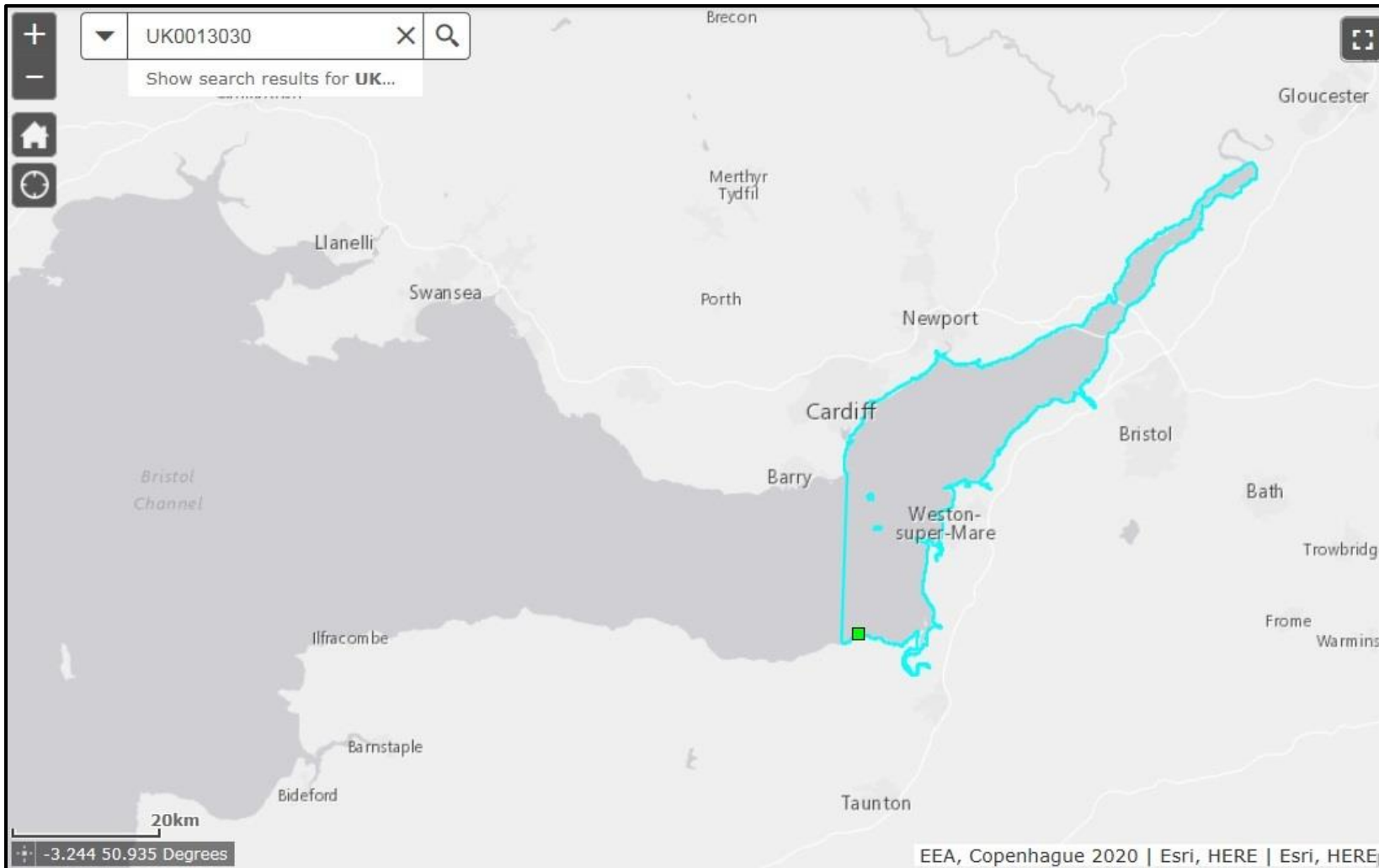


Figure 1: Location of HPC Site and Severn Estuary SAC (ref: UK0013030) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK0013030>)

1.2. Severn Estuary Special Protection Area (SPA) and Ramsar

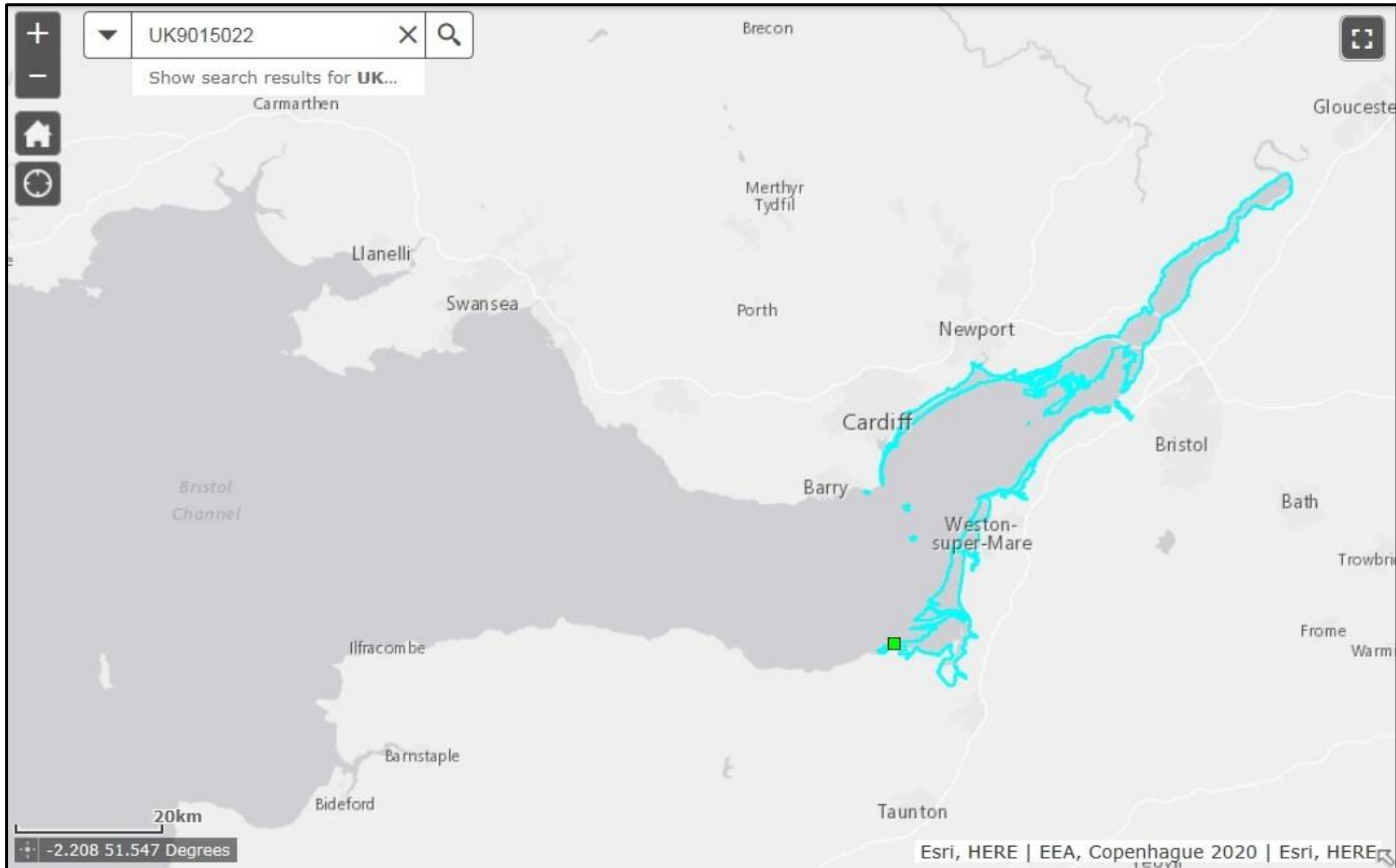


Figure 2: Location of HPC site and Severn Estuary SPA (ref: UK9015022) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK9015022>) and Severn Estuary Ramsar (both the SPA and Ramsar designations share the same boundary (UK11081))

1.3. Somerset Levels and Moors SPA

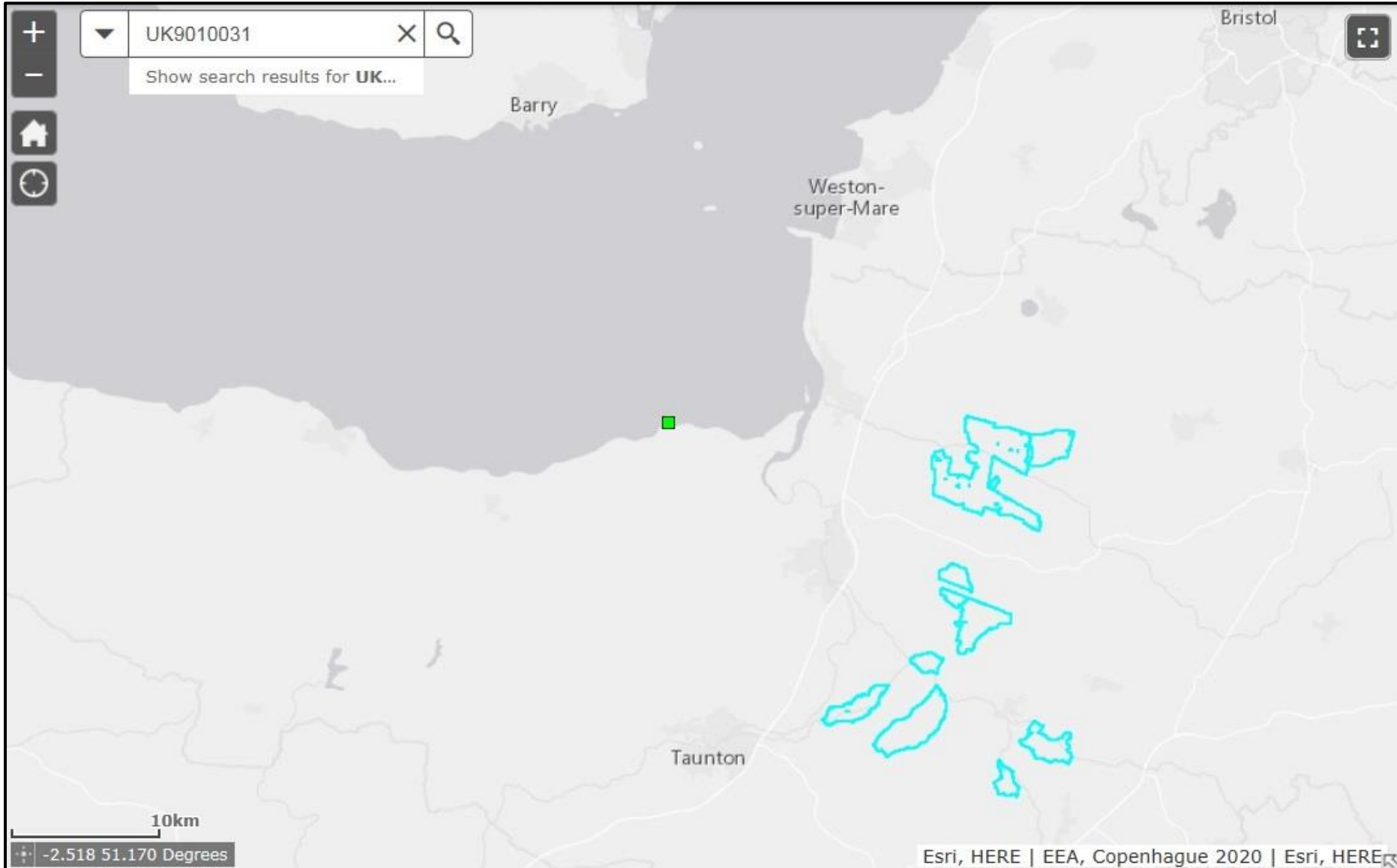


Figure 3: Location of HPC site and Somerset Levels and Moors SPA (UK9010031) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK9010031>) and Somerset Levels and Moors Ramsar (both the SPA and Ramsar designations share the same boundary (UK11064))

1.4. River Usk SAC

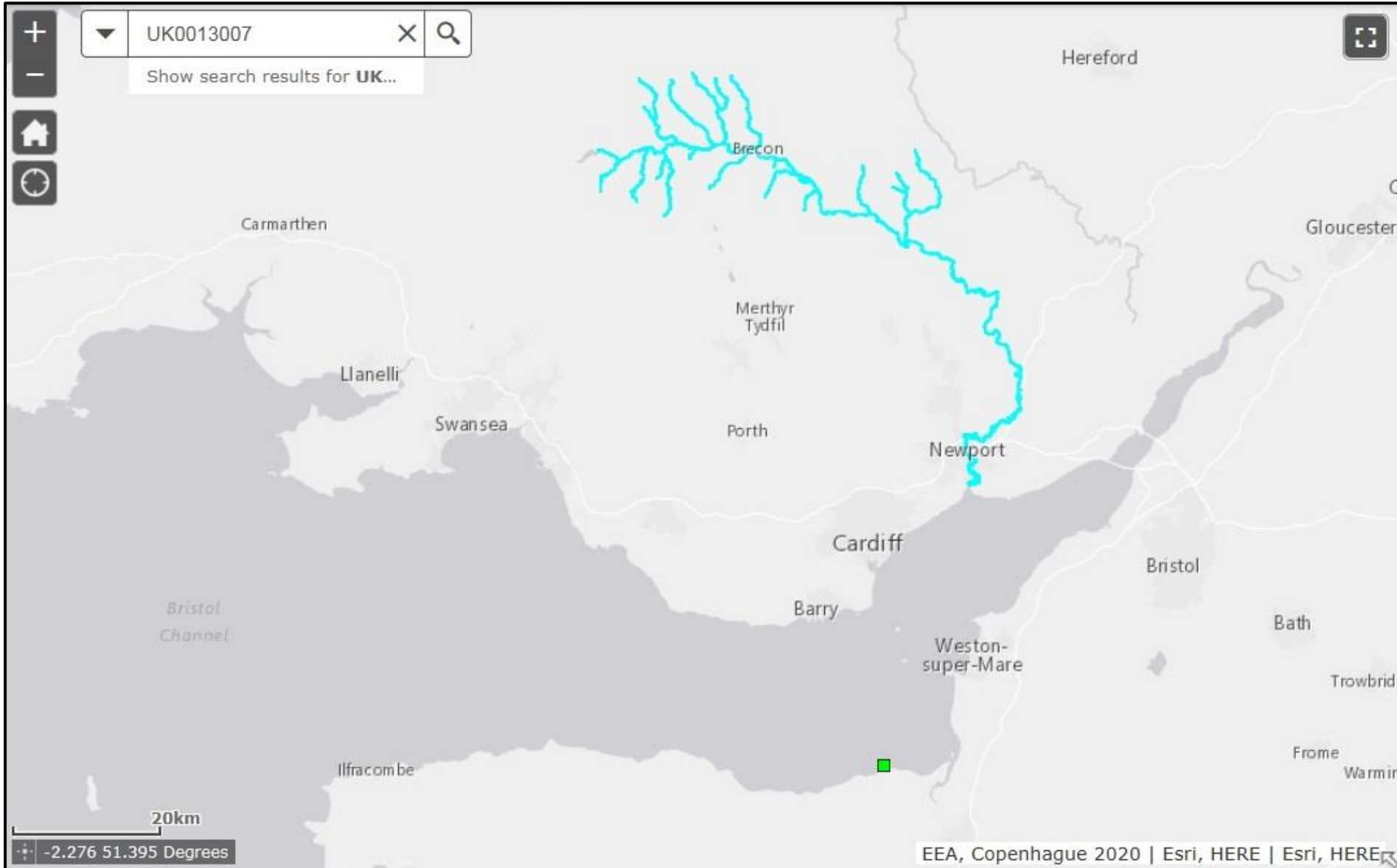


Figure 4: Location of HPC site and River Usk SAC (ref: UK0013007) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK0013007>)

1.5. River Wye SAC

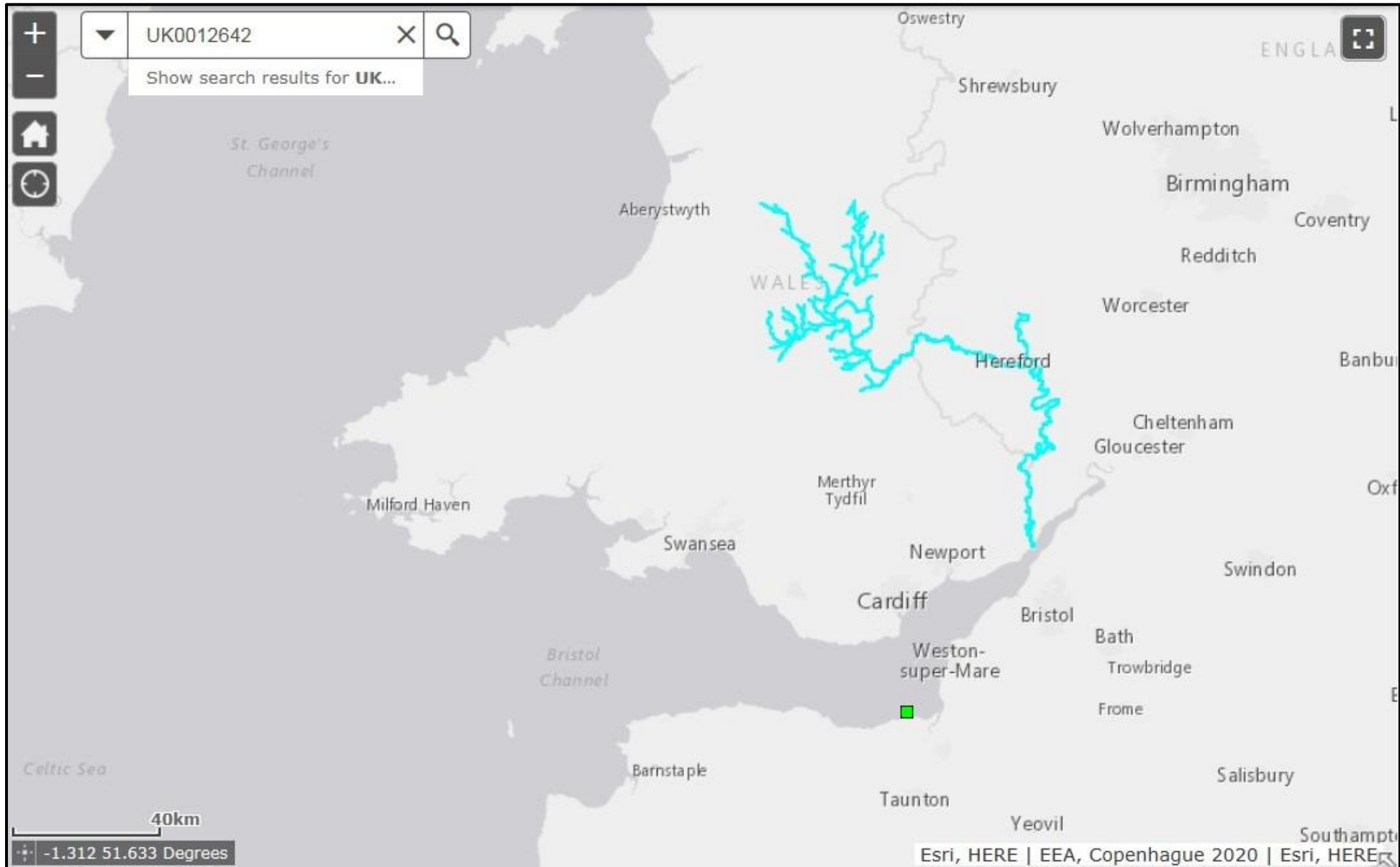


Figure 5: Location of HPC site and River Wye SAC (ref: UK0012642) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK0012642>)

1.6. Bristol Channel Approaches SAC

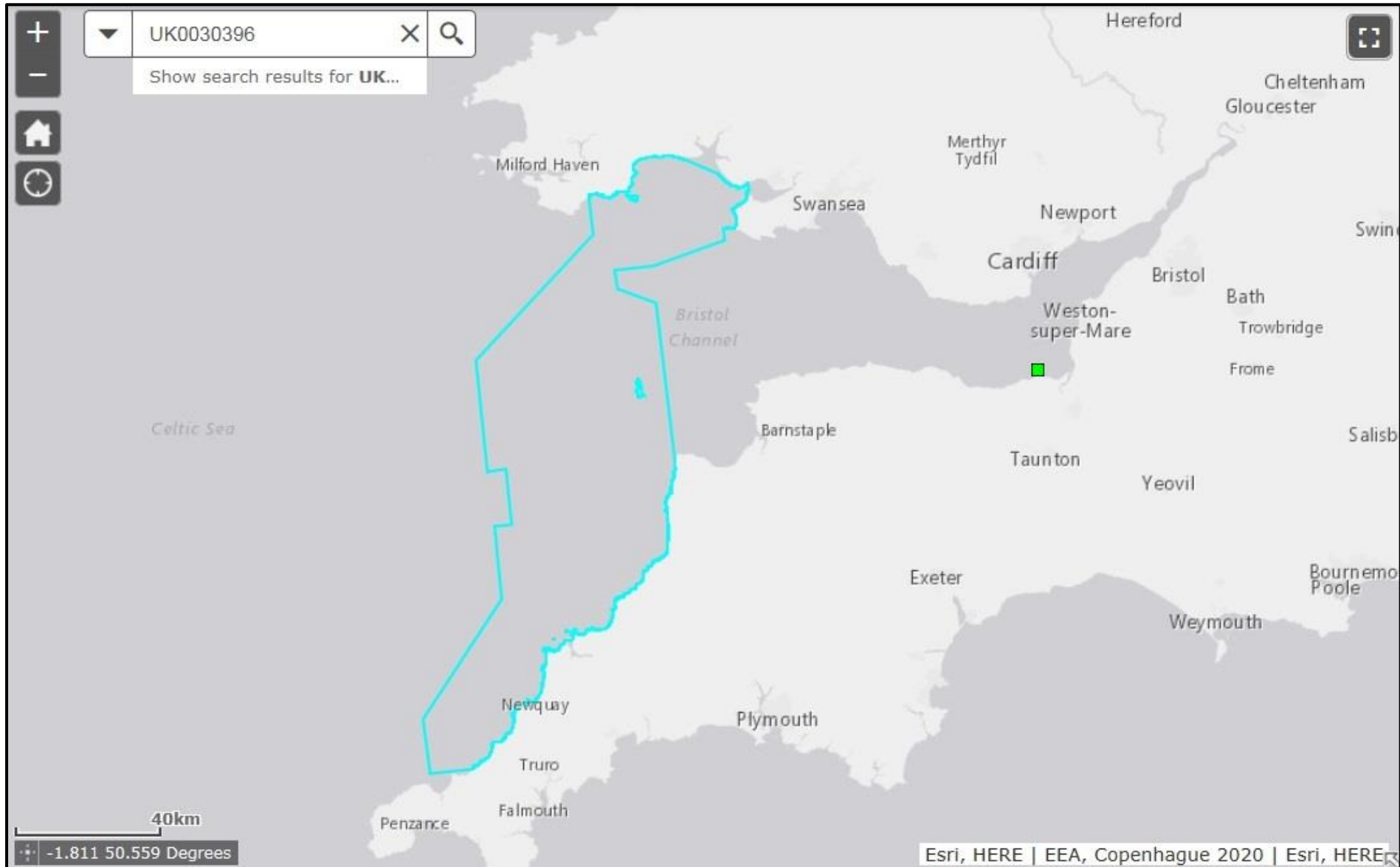


Figure 6: Location of HPC site and Bristol Channel Approaches SAC (ref: UK0030396) (EUNIS, 2020: <https://eunis.eea.europa.eu/sites/UK0030396>)

2. Appendix 2: Ecological narrative for the relevant designated features

2.1. Habitats

The Severn Estuary SAC and Ramsar are designated for a number of habitats covering an area of nearly 74,000ha.

Severn Estuary SAC

Estuaries:

- Atlantic salt meadows
- hard substrate habitats (including eel grass beds)
- intertidal mudflats and sandflats
- notable estuarine assemblages – assemblage of fish species, assemblage of waterfowl species and assemblages of vascular plant species
- reefs
- subtidal sandbanks

Subtidal sandbanks:

- sublittoral cohesive mud and sandy mud communities
- sublittoral sands and muddy sand communities

Intertidal mudflats and sandflats:

- intertidal mud communities
- intertidal muddy sand communities
- intertidal gravel and clean sand communities

Atlantic salt meadows:

- low-mid marsh communities
- mid-upper marsh communities
- transitional high marsh communities
- pioneer saltmarsh communities

Reefs

Severn Estuary Ramsar

Estuaries:

- hard substrate habitats (rocky shores)
- intertidal mudflats and sandflats
- notable estuarine species assemblages
- saltmarshes

The following site description is taken from the Severn Estuary SAC citation, available here: [European Site Conservation Objectives for Severn Estuary SAC - UK0013030](#).

The Severn Estuary lies on the south west coast of Britain at the mouth of four major rivers (the Severn, Wye, Usk, and Avon). The immense tidal range (the second highest in the world) and classic funnel shape make the Severn Estuary unique in Britain and very rare worldwide. This tidal range creates strong tidal streams and high turbidity, producing communities' characteristic of the extreme physical conditions of liquid mud and tide-swept sand and rocks.

The Estuary includes a wide diversity of habitats including Sandbanks which are slightly covered by sea water all the time, Mudflats and sandflats not covered by sea water at low tide, Atlantic salt meadows, and Reefs, which are identified as Annex I habitat types in their own right.

The intertidal zone of mudflats, sand banks, rocky platforms and saltmarsh is one of the largest and most important in Britain. The estuary has a diverse geological setting and a wide range of geo-morphological features, especially sediment deposits. It is important for the interpretation of coastline dynamics and landforms, and also past changes, in sea level, sediment supply, climate and river flow. The estuary's overall interest depends on its large size, and on the processes and interrelationships between the intertidal and marine habitats and its fauna.

The fluctuating salinity and highly mobile sediments with consequent high turbidity limits the benthic invertebrates of the mud and sandflats to relatively few species. Those which are tolerant of such conditions occur in very high densities on the more stable mudflats. Beds of eelgrass *Zostera* spp. also occur on some mudflats. A greater variety of invertebrates occurs on the intertidal rock platforms, a more stable habitat with rock pools and a relatively high cover of seaweeds.

The estuary fringes have large areas of saltmarsh. These are often grazed by sheep and cattle, a significant factor determining the plant communities. A range of saltmarsh types is present, with both gradual and stepped transitions between bare mudflat and upper marsh.

The following sections will focus on the habitat features, sub features and supporting habitats that are considered in detail in the appropriate assessment. These sections are taken from directly the Regulation 33 conservation advice package (available here: [Severn Estuary EMS](#), accessed January 2023). Work is undergoing to update the advice given to Regulation 37 requirements; however, these packages are draft and not available for consideration in this assessment.

2.1.1. Estuaries

This is an Annex 1 habitat with several sub features.

The following information on the estuaries feature is taken from section 5.1 of the Regulation 33 conservation advice package (available here: [Severn Estuary EMS](#)).

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.

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.

The extent of the Estuary feature is 73678 hectares.

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 overarching 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.

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. 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 are also amplified and exceed 7 metres per second close to Avonmouth. 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. 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.

2.1.2. Subtidal sandbanks (Sandbanks which are slightly covered by sea water all the time)

These are an Annex 1 habitat interest feature of the Severn Estuary SAC and sub-feature of the Estuaries SAC and Ramsar interest feature. The following ecological narrative is derived from section 3.2 of the Regulation 33 conservation advice package for the Severn Estuary package (available here: [Severn Estuary EMS](#)).

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 20m below chart datum (but sometimes including channels or other areas greater than 20m deep). The habitat comprises distinct banks (that is, 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. 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.

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.

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.

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, 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.

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.

2.1.3. Mudflats and sandflats not covered by seawater at low tide (Intertidal mudflats and sandflats)

These are an Annex I habitat interest feature of the Severn Estuary SAC and sub-feature of the Estuaries SAC and Ramsar interest feature. The following narrative is derived from section 3.3 of the Regulation 33 conservation advice package for the Severn Estuary package (available here: [Severn Estuary EMS](#)).

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.

Extent and distribution

The intertidal part of the Severn Estuary supports extensive mudflats and sandflats. These cover an area of approximately 20,300 hectares – 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

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.

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. 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 dependent on the salinity which limits the penetration of marine species upstream where freshwater influences are strongest.

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.

2.1.4. Atlantic salt meadows (*Glauco-Puccinellietalia maritmae*)

Atlantic salt meadows are an Annex I habitat interest feature of the Severn Estuary SAC and sub-feature of the Estuaries SAC and Ramsar interest feature. The following narrative is derived from section 3.4 the Regulation 33 conservation advice package for the Severn Estuary package (available here: [Severn Estuary EMS](#)).

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.

Extent and distribution

The Severn Estuary holds the largest aggregation of saltmarsh in the south and south-west of the UK. It covers approximately 1,400 hectares, representing about 4% of the total area of saltmarsh in the UK.

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.

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 I 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.

The pioneer saltmarsh communities play an important role in saltmarsh development as colonising plants (for example, *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 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.

2.1.5. Reefs

Reefs are an Annex I habitat interest feature of the Severn Estuary SAC and sub-feature of the Estuaries SAC and Ramsar interest feature. The following narrative is taken from section 3.5 of the Regulation 33 conservation advice package for the Severn Estuary package (available here: [Severn Estuary EMS](#)).

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).

Extent and distribution

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.

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.

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, sometimes leading to higher species diversity within *Sabellaria* reefs compared to the surrounding sediment or rock habitats (Dubois and others, 2002). *Sabellaria alveolata* reefs cycle through different phases, from newly settled worms through vigorous fast growing reef to older, more biodiverse hummocks. 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.

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 and others, 1998).

2.1.6. Hard substrate habitats (rocky shores) and eel grass beds

Hard substrate habitats including eel grass beds, are identified as notable estuarine assemblages which are an intrinsic part of the estuary ecosystem – these are therefore covered by the ‘estuaries’ feature of the SAC. They are also a sub-feature of the Ramsar interest feature, estuaries.

The following narrative is taken from section 3.6 of the Regulation 33 package for the Severn Estuary package (available here: [Severn Estuary EMS](#)).

Range

There is approximately 1,500 hectares of hard substrate habitat within the Severn Estuary, consisting of boulders, rock, mussel or cobble scars, rocky pools and shingle. 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.

Structure and function

Hard substrate habitats in the Severn Estuary display different characteristics to other areas in Wales. Where there is bedrock, furoid 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.

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.

2.2. Fish species and fish assemblages

2.2.1. River lamprey (*Lampetra fluviatilis*)

The river lamprey is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary SAC
- River Wye SAC
- River Usk SAC
- Severn Estuary Ramsar – feature of the migratory fish assemblage

Ecological narrative for the feature

Two anadromous species of lampreys use the Severn Estuary as a migratory corridor, the sea lamprey and the river lamprey or lampern. The River Severn has always been an important river for both species and remains so, despite the extensive construction of weirs in the 19th century (Bird, 2008).

River lampreys move between river and marine habitats during their lifecycle. Adults spawn in rivers with juveniles (called ammocoetes) residing in silt and filter-feeding for several years before their mouthparts and eyes develop and they migrate downstream to the sea (as transformers). At sea, river lampreys feed parasitically on fish species. After several years at sea or in estuaries, the lampreys return to rivers, becoming sexually mature during this spawning migration. Unlike salmon, which also have a riverine juvenile phase and a more rapidly-growing marine phase, river lamprey are not thought to 'home' to reproduce in the river system in which they themselves were born (Gaudron & Lucas, 2006).

2.2.2. Sea lamprey (*Petromyzon marinus*)

The sea lamprey is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary SAC
- River Wye SAC
- River Usk SAC
- Severn Estuary Ramsar – feature of the migratory fish assemblage

Ecological narrative for the feature

Sea lamprey use the Severn Estuary as a migratory corridor, moving into the Rivers Severn, Wye and Usk to spawn in gravelly sections of the river. Sea lamprey are not known to spawn in the River Parrett or rivers around West Somerset.

Sea lamprey larvae (ammocoetes) remain in the silty deposits of a river for an average of five years (Maitland, 2003). They grow slowly, filter feeding on algae, diatoms and other

organic detritus until they reach 150-200 mm when they undergo a radical metamorphosis into the transformer life stage, during which their eyes and mouthparts develop (Bird, 2008). The transformers begin a downstream migration to the sea in the autumn when rivers are in flood (Baer and others, 2018). Very little is known about this stage in the life-cycle although it is believed that entry into salt water is an important stimulus for the onset of parasitic feeding (Bird, 2008).

Mature adult sea lampreys enter the estuaries of many North Atlantic rivers from April onwards (Maitland, 2003). Sea lamprey usually spawn in late May or June in British rivers, when the water temperature reaches at least 15°C (Maitland, 2003). Sea lampreys are semelparous, reproducing only once before dying (Maitland, 2003). Unlike salmon, which also have a riverine juvenile phase and a rapidly-growing marine phase, sea lamprey do not 'home' to reproduce in the river system in which they were born, instead being attracted into rivers on the basis of pheromone cues from individuals of their own species (Waldman and others, 2008).

2.2.3. Twait shad (*Alosa fallax*)

Twait shad is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary SAC
- River Wye SAC
- River Usk SAC
- Severn Estuary Ramsar – feature of the migratory fish assemblage

Ecological narrative for the feature

Twait shad are one of a small group of migratory fish that make up the migratory fish assemblage that need to pass unimpeded through the Severn Estuary Ramsar site to enter freshwater to successfully complete their life history. The designation is there to protect the migratory pathways to allow sustained reproduction to take place in the rivers that support the Severn Estuary Ramsar population, namely the rivers Severn, Wye and Usk for twait shad. The total population can vary hugely over time based on good year class recruitment that can dominate the population for a series of years.

Shads are members of the herring family of fishes (Clupeidae). Unlike other herrings, shads spawn in freshwater where their larvae develop before entering the sea as juveniles. There are two species of shad spawning in the UK, twait shad and allis shad. The two species are closely related and can interbreed to produce fertile offspring.

Twait shad are generally the smaller of the UK's two shad species, rarely exceeding 45 cm in length. They enter rivers to spawn in spring, usually between April and June. Spawning populations of twait shad occur in four rivers in the UK all of which drain into the Severn Estuary: the Tywi, Usk, Wye and Severn (including its tributary the River Teme).

Most juvenile twaite shad enter the sea in their first year of life, with smaller numbers remaining or returning to the upper estuary into their second year.

The 'at sea' distribution of juvenile shad is poorly understood and although it is likely they will have a preference for the shallower inshore areas, particularly when very small, it is still likely the whole estuary will be used at times as they grow and redistribute.

2.2.4. Allis shad (*Alosa alosa*)

Allis shad is a listed feature of the following sites requiring an appropriate assessment:

- River Wye SAC
- River Usk SAC (it is no longer present in this SAC)
- Severn Estuary Ramsar – feature of the migratory fish assemblage
- Severn Estuary SAC – part of the notable species sub-feature of the estuary feature

Ecological narrative for the feature

Allis shad are part of the migratory fish assemblage feature of the Severn Estuary SAC and Ramsar. In this context, 'migratory fish' refers to fish that migrate between marine and freshwater environments. Adult and juvenile allis shad need to pass unimpeded through the Severn Estuary site, to enter freshwater to spawn and to access marine feeding grounds, respectively. The designation is there to protect the migratory pathways to allow sustained reproduction to take place in the rivers that support the Severn Estuary Ramsar population, namely the rivers Severn and Wye for allis shad, and to allow juveniles access to the sea

2.2.5. Salmon (*Salmo salar*)

Salmon is a listed feature of the following sites requiring an appropriate assessment:

- River Wye SAC
- River Usk SAC
- Severn Estuary Ramsar – feature of the migratory fish assemblage
- Severn Estuary SAC – notable feature of the estuaries sub-feature

Ecological narrative for the feature

Atlantic salmon are anadromous fish, with both freshwater and marine phases within their life cycle. Eggs are laid in autumn or winter in excavated depressions in the river substrate called 'redds'. After developing within the redd, young salmon emerge and live in the river, these being termed 'parr'. After a year or more living in the river, the parr migrate downstream to the sea, physiologically transforming to be adapted to the marine environment. These silvery, downstream migrating juveniles are called 'smolts' (and 'post-smolts' upon entering the estuarine or marine environment until the end of their first winter at sea).

In the Severn, most smolts are in their second year of life. Downstream migration primarily occurs between April and June, being predominantly nocturnal in the early part of the season but taking place during night and day towards the end of the season (Thorstad and others, 2012). Migration is often triggered by increases in flow (Thorstad and others, 2012). In estuaries migration is primarily nocturnal in the early part of the season, switching to be diurnal and nocturnal later in the season (Thorstad and others, 2012).

When adults return to spawn in fresh water they home to their natal river, the river they themselves originate from, and possibly to that part of the catchment in which they originated, although straying does occur (approximately 3%). The significance of such specific homing to natal habitats is that this trait has led to the development of genetically distinct sub-populations, possibly even within individual catchments.

2.2.6. Sea trout (*Salmo trutta*)

Sea trout is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary Ramsar – feature of the migratory fish assemblage
- Severn Estuary SAC. notable feature of the estuaries sub-feature

Ecological narrative

Sea trout are the anadromous form of the species *Salmo trutta*. The freshwater resident form of the same species is known as brown trout and these are ubiquitous in British rivers, including most of those that drain to the Severn estuary. Anadromy is the term given to the life history strategy of fish which breed and spend their juvenile stages in freshwater, then migrate to sea to grow and mature in the marine environment before they return to their natal river to spawn. Anadromous fish are commonly referred to as being 'migratory'. Trout are partially anadromous (Jonsson and Jonsson, 1993; Dodson and others, 2013), this means not all fish in a population necessarily migrate to sea and the proportions that do vary considerably within and between rivers due to interactions amongst environment, genes and maternal effects (Ferguson, and others, 2019; Nevoux and others, 2019).

Most sea trout make comparatively limited migrations (compared to salmon) normally restricted to <150km from their home river and they may stray into other rivers for short periods (Potter and others, 2017). However, although less common, much longer migrations are known to occur in the Irish Sea and adjacent waters, including the Northern coast of the Severn Estuary, as demonstrated by genetic studies (Prodhöl and others, 2017). These are probably influenced by residual currents that are a function of coastal topography and hydrographic patterns (Potter and others, 2017). Particle tracking simulations suggest that the South Wales sea trout stocks, comprising populations from multiple rivers, display more limited migration compared with others in the Irish Sea due to the prevailing current patterns, which tended to keep them in that general area.

2.2.7. European eel (*Anguilla anguilla*)

The European eel is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary Ramsar – part of the migratory fish assemblage
- Severn Estuary SAC – a notable feature of the estuaries sub-feature

Ecological narrative for the feature

Life cycle

European eel life history is complex and atypical among aquatic species, being a long-lived semelparous and widely dispersed stock. The shared single stock is panmictic (Palm and others, 2009) and data indicate the spawning area is in the southwestern part of the Sargasso Sea and therefore outside Community Waters (McCleave and others, 1987; Tesch and Wegner, 1990). The newly hatched leptocephalus larvae drift with the ocean currents to the continental shelf of Europe and North Africa where they metamorphose into glass eels and enter Continental waters. The growth stage, known as yellow eel, may take place in marine, brackish (transitional), or freshwaters. This stage may last typically from two to 25 years (and could exceed 50 years) prior to metamorphosis to the silver eel stage and maturation. Age-at maturity varies according to temperature (latitude and longitude), ecosystem characteristics, and density-dependent processes. The European eel life cycle is shorter for populations in the southern part of their range compared to the north. Silver eels then migrate to the Sargasso Sea where they spawn and die after spawning, an act not yet witnessed in the wild. (ICES, 2014).

2.2.8. Marine fish assemblage

The marine fish assemblage (assemblage of fish species (>100 species)) is a listed feature of the following sites requiring an appropriate assessment:

- Severn Estuary SAC is part of the notable species sub-feature of the estuary feature
- Severn Estuary Ramsar is part of the notable species sub-feature of the estuary feature

Ecological narrative for this feature

Estuarine waters provide highly variable environments which are essential for many fish species that use these dynamic environments for feeding, breeding and as nursery habitats. (Potts and Swaby 1993, Elliott & Whitfield 2011, Vasconcelos and others., 2011, Potter and others. 2015). The waters provide opportunities for freshwater, migratory, estuarine and many marine species (Elliott and others. 2007, Nicolas and others. 2010, Waugh and others., 2019).

The Severn Estuary is the second biggest estuary in the UK, which includes extensive sandflats and intertidal mud supporting vast numbers of fish, benthic invertebrates and wading birds (Bird, 2008). Its relative value as an estuary is highlighted by examining all estuarine waters from St. David's Head on the southwest tip of Wales to Land's End on

the southwest tip of England. Estuarine waters in this area cover over 61,000 hectares, 88% of which is within the Bristol Channel and Severn Estuary.

2.3. Bird species and birds of internationally important numbers

2.3.1. Wading birds and wildfowl

The Severn Estuary SPA and Ramsar and the Somerset Levels and Moors SPA and Ramsar are important for their wading birds and wildfowl.

The Somerset Levels and Moors is considered functionally linked to the Severn Estuary as many species use both sites.

The list of sites and features are given in Appendix 2.

Ecological narrative

The following information is taken directly from section 3.8 of the Regulation 33 conservation advice package for the Severn Estuary SPA and Ramsar (available here: [Severn Estuary EMS](#)). Work is undergoing to update the advice given to Regulation 37 requirements; however these packages are draft and not available for consideration in this ecological narrative and appropriate assessment.

The key supporting habitats for the waterfowl and wildfowl are the intertidal mudflats and sandflats, saltmarshes and hard substrate habitats (rocky shores).

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 (for example, 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
- fresh water quantity, tidal flows, salinity gradients and grazing necessary to maintain saltmarsh conditions suitable for bird feeding and roosting

2.3.2. Bewick's swan (*Cygnus columbianus bewickii*)

The Bewick's Swan is a feature of the:

- Severn Estuary SPA
- Severn Estuary Ramsar
- Somerset Levels and Moors SPA
- Somerset Levels and Moors Ramsar

The following information is taken directly from section 3.8.6 of the Regulation 33 conservation advice package for the Severn Estuary SPA and Ramsar (available here: [Severn Estuary EMS](#)).

Key supporting habitats for Bewick's swan are the following.

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 area 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 outside the Severn Estuary SPA boundary.

2.3.3. Regularly occurring migratory species

The following information is taken from section 3.8.6 of the Regulation 33 conservation advice package for the Severn Estuary SPA and Ramsar (available here: [Severn Estuary EMS](#)).

Supporting habitat for the regularly occurring migratory species is as follows.

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 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.

Gadwall are predominantly a freshwater species preferring the wetland habitats that occur within the SPA behind the flood defences and therefore outside the Severn Estuary SPA – 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.

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 saltmarshes also have an important function providing a safe haven from the tides that flood the mudflats twice a day.

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 also provides important roost sites at high tide particularly for the dunlin and redshank.

Freshwater coastal grazing marsh, improved grassland and open standing waters

These supporting habitats lie within the SPA boundary. 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

2.3.4. Waterfowl Assemblage

The following information is taken directly from section 3.8.6 of the Regulation 33 conservation advice package for the Severn Estuary SPA and Ramsar (available here: [Severn Estuary EMS](#)).

Key supporting habitats for the waterfowl assemblage are as follows.

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.

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 salt pans 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. 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.

2.4. Marine mammals

2.4.1. Harbour porpoise

Harbour porpoise is a listed feature of the following sites requiring an appropriate assessment:

- Bristol Channel Approaches

The following ecological narrative and UK status and distribution information for the harbour porpoise is taken from Joint Nature Conservation Committee (JNCC) Annex II species accounts, accessed January 2023 (available here: [Harbour porpoise \(Phocoena phocoena\) - Special Areas of Conservation](#)).

UK status and distribution, JNCC species accounts

The harbour porpoise is widespread around the UK, including the North Sea, Irish Sea, the seas west of Ireland and Scotland, and northwards to Orkney and Shetland. Since the 1990s it has become much less common around the Northern Isles, but it appears to be returning to the English Channel and southern North Sea, where it was infrequent in the late 1980s. For reasons not yet fully understood, individuals of the North and Celtic Seas population appear to concentrate in some areas close to the coast between June and September. A portion of the population remains in those regions year-round. The west of Wales, the west of Scotland and the Shetland Islands may be examples of this behaviour.

Most of the identified areas with most frequent sightings are in coastal waters. These are often areas where there is a high degree of water mixing, sometimes associated with strong tidal streams. Such areas have high biological productivity and are often associated with important concentrations of small prey fish. There may be offshore areas supporting similar concentrations. However, little is known about these because of the lack of research effort.

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