

Welsh Government

M4 Corridor around Newport

Environmental Statement Volume 3:
Appendix 10.18

Aquatic Environment Baseline Study
2015

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1 Introduction

1.1.1 An aquatic environment baseline study has been undertaken to characterise the ecological characteristics of the aquatic environment within the vicinity of the proposed new section of motorway between Castleton and Magor to inform the ecological baseline for the Environmental Impact Assessment (EIA) of the Scheme. This baseline report has been developed for the purposes of informing the aquatic ecology impact assessment and, in particular, Chapter 10: Ecology of the Environmental Statement (ES).

1.2 Aims and Objectives

1.2.1 The aim of this aquatic environment baseline study was to provide an overview of the aquatic baseline conditions within the vicinity of the new section of motorway, and within the wider study area as appropriate, in order to inform the EIA.

1.2.2 For the purposes of this aquatic environment baseline study, the term 'aquatic' includes all marine and estuarine ecology (habitats and species) and, with respect to freshwater ecology, specifically diatoms, macrophytes, invertebrates and fish within reens and ditches that could be affected by the new section of motorway.

1.2.3 Information on aquatic habitats, flora and fauna within the specified study area has been collated and analysed. The objectives of this report are to present the results of this baseline characterisation desk study, incorporating information on the following.

- The background and the proposed new section of motorway.
- Key data sources and information.
- Ecological characterisation of the study area including information on both freshwater and marine/estuarine ecology.

1.3 Study Area

1.3.1 The proposed new section of motorway is located within and surrounding the town of Newport on the south coast of Wales. Newport is situated approximately 15 km to the east of Cardiff, and approximately 30 km north west of Bristol, across the Severn Estuary, on the Welsh/English border. The River Usk flows through the centre of Newport and joins the Severn Estuary and Bristol Channel, which extends a further 50 km past Newport north east towards Chepstow (20 km) and then Gloucester. The River Ebbw joins the River Usk from the west at Newport Docks prior to joining the Severn Estuary.

1.3.2 The study area encompasses marine and estuarine habitats, as well as intertidal and freshwater habitats. Three buffer zones surrounding the proposed location of the new section of motorway have been considered, extending to 2 km, 5 km and 10 km from the route. The 2 km inner buffer zone contains mainly terrestrial habitat with inland watercourses and some intertidal estuarine habitat extending either side of the River Usk and River Ebbw, whereas the 5 km buffer zone contains the majority of the inner intertidal zones of the Peterstone Wentlooge coast to the south west of the new section of motorway and the Porton Grounds

area past Redwick and Summerleaze. The 10 km buffer zone includes the outer intertidal and some subtidal areas which, at their furthest points, extend north to Cwmbran, north east to Chepstow, south east to the north Somerset coastline of Severn Beach and Portishead and south west to Cardiff. The focus of the data collation and analysis has been within the 2 km buffer, drawing on data for the wider areas up to the 10 km buffer, as available and appropriate.

1.4 Structure of Report

1.4.1 This report is structured as follows.

- Section Two - describes the desktop and web-based data sources and the method used for this aquatic environment baseline study.
- Section Three - details the environmental baseline for the aquatic ecological elements (i.e. freshwater and riparian (interface between land and river/reen) ecology and estuarine and marine ecology).
- Section Four - provides a full reference list for this aquatic environment desktop study.

2 Data Sources

2.1.1 This aquatic environmental baseline study utilised a number of data sources. Data on all topics were collected from within the aquatic environmental baseline study area as described in Section 1.3.

2.2 Desktop Review

2.2.1 There is a substantial amount of historical data from various aquatic studies and monitoring surveys undertaken across the Gwent Levels, River Ebbw, River Usk and Severn Estuary. The key data sources drawn on for this aquatic environmental baseline include the following.

- Natural Resources Wales (NRW) and Environment Agency (EA) datasets from the online DataShare download system (Geostore, 2015).
- The former Countryside Council for Wales (CCW) Monitoring Invertebrate Features of Sites of Special Scientific Interest (SSSIs) (Boyce 2010; 2012; 2013).
- CCW HABMAP Subtidal Mapping Project (2010).
- Environmental Statement and associated technical reports undertaken for Atlantic Array offshore wind farm (RWE, 2013).
- Severn Estuary/Môr Hafren Special Area of Conservation (SAC) and Special Protection Area (SPA) Intertidal Mudflats and Sandflats Condition Assessment 2012 (EcoSpan, 2012).
- Environment Agency (EA) River Basin Management Plan Severn River Basin District (RBMP) (EA, 2009).
- NRW/EA Water Framework Directive (WFD) waterbody monitoring data for macroinvertebrates, macrophytes and phytobenthos from 2000 to 2015.
- NRW intertidal saltmarsh condition surveys from 2008 and 2011.
- EA Water Framework Directive benthic grab surveys for biological monitoring from June 2011.
- NRW intertidal fyke netting surveys from 2009 to 2013.
- EA Water Framework Directive surface water phytoplankton surveys from 2007 to 2013.
- Academic journals and 'grey literature'.

2.3 Site-Specific Surveys

2.3.1 It was agreed with NRW at a meeting on 9 June 2015, that an intertidal biotope survey of the Rivers Usk and Ebbw would not be required to inform the assessment. Therefore, site-specific marine/estuarine surveys within the study area have not been undertaken directly to inform the aquatic environmental baseline.

2.3.2 Site-specific saltmarsh and freshwater ecology surveys have, however, been undertaken to characterise the baseline environment, these include the following.

- National Vegetation Classification (NVC) surveys in June 2014 – including surveys of the River Ebbw seawall and saltmarsh (west bank) and the River Usk saltmarsh – see Appendix 10.4 of the ES.
- NVC survey in 2015 – including survey of the saltmarsh on the east bank of the River Ebbw - see Appendix 10.20 of the ES.
- Baseline aquatic macrophyte survey in 2014 – see Appendix 10.14 of the ES.
- Aquatic macrophyte survey in 2015 – see Appendix 10.30 of the ES.
- Baseline terrestrial and aquatic invertebrate survey in 2014 - see Appendix 10.15 of the ES.

3 Aquatic Environmental Baseline

3.1 Estuaries, Rivers and Reens

3.1.1 The proposed new section of motorway would cross the Rivers Usk and Ebbw. These rivers are both tidal; the River Ebbw flows into the River Usk, which then enters the Severn Estuary. Rivers are a UK Biodiversity Action Plan (BAP) Priority Habitat and a Section 42 Habitat of Principal Importance for Conservation of Biological Diversity in Wales.

3.1.2 Part of the new section of motorway crosses the Caldicot and Wentlooge Levels (Gwent Levels), which contains a network of interconnecting watercourses (reens and field ditches) that feed into the Severn Estuary. Eutrophic standing waters are both a UK BAP Priority Habitat and a Section 42 Habitat of Principal Importance for Conservation of Biological Diversity in Wales.

Severn Estuary

3.1.3 The Severn Estuary (and the area encompassed within the Severn Estuary/Môr Hafren SAC designation) covers the extent of the tidal influence from the upstream limit between Frampton and Awre in Gloucestershire, seawards to a line drawn between Penarth Head in Wales and Hinkley Point in Somerset (Natural England and CCW, 2009).

3.1.4 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 (Natural England and CCW, 2009).

3.1.5 Several major rivers, including the Taff, Usk, Ebbw, Wye, Severn, Avon and Parrett feed into the Severn 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.

River Usk

3.1.6 The River Usk is a tributary of the Severn Estuary and the tidal limit extends upstream approximately 29 km to the weirs at Newbridge on Usk (SECG, 2010). Through Newport, the course of the River Usk is anthropogenically controlled by piled walls and wharves. Along the tidally influenced banks of the Usk, the river is bounded by the extensively developed land of Newport and Caerleon and open spaces with flood protection (SECG, 2010).

3.1.7 The strong tidal currents of the Usk erode and transport large quantities of fine sediment during spring tides, but during neap tides much of this sediment is deposited on the bed, forming very soft or fluid mud deposits, that are remobilised on the next Spring tides. There are significant mud accumulations at the mouth of the River Usk and the channel mouth is regularly dredged in order to maintain access to Newport Docks.

- 3.1.8** In the lower reaches of the estuary, the Uskmouth coastline through to the Goldcliff promontory is fronted by areas of both locally accreting and locally eroding saltmarsh.

River Ebbw

- 3.1.9** The River Ebbw, is in the western part of Newport and converges with the Usk just before entering the Severn Estuary. The Ebbw is designated as a Site of Importance for Nature Conservation (SINC; see Appendix 10.17 of the ES) and is tidal for only approximately 3 km upstream (SECG, 2010).

Reen Network

- 3.1.10** The Gwent Levels are a renowned area for lowland drainage habitat and are the largest example of this habitat in Wales (CWLIDB, 2010). The area is below high tide and so the reens serve as a storage facility when outfalls are tide locked. The water levels in the reens are controlled by a series of sluice structures. Much of the Gwent Levels is designated as SSSIs and the proposed new section of motorway runs through, or in close proximity to, a number of SSSIs including: Gwent Levels–Rumney and Peterstone SSSI; Gwent Levels–St Brides SSSI; Gwent Levels–Nash and Goldcliff SSSI; Gwent Levels–Whitson SSSI; Gwent Levels–Redwick and Llandeenny SSSI; and Gwent Levels–Magor and Undy SSSI.
- 3.1.11** Reens typically have 1 in 1 side slopes, and vary in depth and width, but are typically 3 m in width at the top and 1 m in width at the base. As the water levels are controlled by sluices there is typically very little flow. The field ditches are significantly smaller than these reens and are frequently dry. The ditches commonly run along existing hedgerows on the edge of fields and connect to the reens.
- 3.1.12** The reens and ditches support a wide range of aquatic plants, including many rare or scarce species, which in turn support a wide variety of other wildlife. There is a diverse community of insects (for example water beetles) and other invertebrates inhabiting the reens and ditches (see Section 3.2). The assemblage of water beetles found across the Gwent Levels includes the great silver beetle, which has a very limited distribution in Wales and is restricted to only a few other sites in southern England.

3.2 Freshwater Ecology

Phytobenthos

- 3.2.1** Phytobenthos refers to a mostly microscopic group of organisms called algae found attached to submerged surfaces such as stones and plant stems. They are good indicators of nutrient enrichment and other pressures and can be used to assess river quality. Diatoms are the main plant groups used in these assessments because their silica shells are easily identified under a microscope.
- 3.2.2** Diatoms are an important part of freshwater ecosystems and provide a food source for higher trophic levels. The sensitivity of diatoms to nutrient enrichment, notably phosphate levels, means that they are used as indicators of levels of eutrophication within a waterbody.

Baseline Water Quality – Phytobenthos Data

- 3.2.3** Phytobenthos data from routine monitoring for Water Framework Directive programmes were obtained from NRW for the 'Monks Ditch-source to Wainbridge' and 'Ebbw R-conf Ebbw Fach R to Maes-glas' waterbodies (see Figure 1).
- 3.2.4** Data for Monks Ditch were only available from two samples taken in 2010 and therefore it has not been possible to identify long term trends in the data for this waterbody. Water Framework Directive sampling in the River Ebbw waterbody was carried out in 2008, 2010 and 2013 and therefore gives a better indication of trends in water quality in this waterbody.
- 3.2.5** Based upon guidelines provided by the Water Framework Directive Transition Action Group (WFD UK TAG, 2014), the Trophic Diatom Index (TDI) can be used to indicate Water Framework Directive status class boundaries due to its correlation with eutrophication. TDI is a quantitative measure of relative taxon abundance with an index relative to the degree of eutrophication. An increase in phosphate load within a waterbody as a result of nutrient input leads to an increase in the diatom diversity and abundance within the watercourse and a corresponding decrease in TDI.
- 3.2.6** The two phytobenthos samples from the Monks Ditch waterbody in May and September 2010 indicate High status (TDI = 84) and Moderate status (TDI = 49), respectively. A decrease in TDI through the year is to be expected as light levels stimulate diatom growth in the summer months.
- 3.2.7** For the River Ebbw waterbody samples, the TDI score varied from a high of 89 (equivalent to High status) in September 2008 to a low of 27 (Poor status) in April 2013. There is an overall trend of declining water quality based on averages from the three years of monitoring data, with averages from 2008, 2010 and 2013 of 66 (Good), 51.5 (Moderate) and 37.5 (Poor), respectively. These data alone indicate a trend of increasing eutrophication within the River Ebbw waterbody throughout this period. However, there is large fluctuation within the data as is often the case for phytobenthos samples.
- 3.2.8** The validity of phytobenthos data interpretation is dependent on a wide range of variables such as sampling efficiency, climatic conditions and natural variation, and therefore reliance on this data alone is not recommended in terms of overall assessments of water quality. The data should be read in conjunction with other ecological monitoring data including macrophytes, fish and invertebrates.

Freshwater Macrophytes

- 3.2.9** Macrophytes are an integral component of freshwater ecosystems. They provide habitat and a food source for fish and invertebrates and play an important role in the oxygenation of waterways. The macrophyte assemblage in a watercourse can provide an indication of water quality, with plants responding to changes in nutrient load (e.g. nitrate and phosphate enrichment), channel modification, reduced flow due to water abstraction or impoundment, or chemical factors such as acidification or toxicity.
- 3.2.10** Macrophyte surveys were undertaken in 2014 (see Appendix 10.14 of the ES) at a number of reens, ditches and ponds across the study area and within the

Gwent Levels SSSIs; a total of 81 species of aquatic macrophyte were recorded, the majority of which were plant species found commonly across the UK.

3.2.11 One species of conservation importance was recorded at five sites during these surveys, the tubular water-dropwort *Oenanthe fistulosa* (see Appendix 10.14 of the ES). This species is listed as 'Vulnerable' in the UK by the International Union for the Conservation of Nature (IUCN) Red List, is a Species of Principal Importance in Wales under Section 42 of the NERC Act (2006) and is listed as a UKBAP priority species.

3.2.12 In May 2015, a further macrophyte survey was undertaken by RPS, the full details of which are reported in Appendix 10.30 of the ES. The 2015 aquatic macrophyte survey demonstrated that the more regularly the feature is managed the higher the diversity of aquatic macrophyte species present and, where management has not occurred for some time, the watercourse becomes overgrown and the aquatic plant assemblages, especially those that are floating and submerged, are gradually lost. Two types of receptors were identified in terms of macrophytes: the aquatic macrophyte; and populations of nationally rare, scarce or declining species. The report at Appendix 10.30 of the ES should be consulted for the detailed findings of the survey.

Freshwater Invertebrates

3.2.13 The reens, ditches, ponds and streams within the Gwent Levels support a diverse assemblage of aquatic invertebrates (Bratton, 2002; CCW, 2004). Numerous species of conservation interest are present, making the aquatic invertebrate fauna a principal reason for the notification of these SSSIs. The assemblage of water beetles found across the Gwent Levels includes the great silver beetle *Hydrophilus piceus*. The unmown ditch banks and rough grassland areas provide habitat for the shrill carder bee *Bombus sylvarum*, as they contain the flowers preferred by the bee for sources of nectar and pollen, such as red clover *Trifolium pratense*, creeping thistle *Cirsium arvense* and black knapweed *Centaurea nigra*.

3.2.14 A total of 144 species of Nationally Notable or Red Data Book invertebrates have been recorded from the Gwent Levels (GWT, 2013). The assemblages of water beetles (Coleoptera) and dragonflies and damselflies (Odonata) are both qualifying features of the SSSI designations under the JNCC biological site selection criteria (1989). Species of conservation concern include water beetles such as *Haliphus mucronatus* and *H. piceus*, whilst important species in a Welsh context include the hairy dragonfly and the bladder snail *Physella acuta*, the latter being noted as a non-native species of increasing abundance.

3.2.15 Invertebrate species named in the citations of various designated sites, including the white-clawed crayfish *Austropotamobius pallipes* and crane flies *Tipulidae* spp., are characteristic of faster flowing waters or lowland rivers, and are unlikely to be found in reens and ditches. The crane fly *Nigrotipula nigra* was recorded in the 2014 invertebrate surveys (see Appendix 10.15 of the ES); this species is included in the Scottish biodiversity list but is relatively widespread in England. None of the freshwater invertebrate species named in Section 42 of the NERC Act 2006 have been recorded in any previous surveys of the Gwent Levels SSSIs.

- 3.2.16** The freshwater habitats intersected by the proposed new section of motorway are named in the citations for several of the designated sites (see Appendix 10.17 of the ES). These habitats include reens, ditches and rivers (see Section 3.1) and the diverse invertebrate community within them is cited for the Gwent Levels SSSIs, River Usk (Lower Usk) SSSI, and Newport Wetlands SSSI/NNR. The Gwent Levels SSSIs include a citation for an invertebrate assemblage that is unique in Wales. Several of the non-statutorily designated sites include in their citations freshwater habitats within the SSSIs as notable features.
- 3.2.17** Aquatic invertebrate surveys undertaken in 2014 at reens and ditches within a 50 m corridor of the centreline of the new section of motorway (as reported in Appendix 10.15 of the ES) recorded a total of 130 species of aquatic invertebrates across 41 sample sites (see Figure 2). The majority of species recorded were from two main taxonomic groups, Coleoptera (n=57) and Mollusca (n=25), and to a lesser extent Hemiptera (n=16) and Odonata (n=11).
- 3.2.18** Across all sites surveyed during the 2014 survey, one Red Data Book species was recorded, the great silver water beetle, which was present at two sites (Middle Road Reen and Elver Pill Reen) and has been previously recorded across the Gwent Levels SSSIs (CCW 2008a, 2008b, 2008c, 2008d). The great silver water beetle is listed as 'Near Threatened' on the IUCN Red List and is a UKBAP Priority Species. This species is Britain's largest water beetle and is largely confined to drains in coastal levels (Mackley *et al.*, 2010). The larvae are predatory, feeding on aquatic snails and occurring in ditches thickly choked with vegetation. Adults are herbivorous, and the beetles are found in pools with plenty of vegetation; the species is particularly characteristic of heavily vegetated ditches, dykes and marshes. Those specially favoured are choked with vegetation such as ivy-leaved duckweed *Lemna trisulca* and fringed by common reed *Phragmites australis* (Mackley *et al.*, 2010). The silver water beetle has been recorded from 50 hectads (10 x 10 km) in England and Wales from 1980 onwards. It appears to have contracted in range in that there are no modern records for the English Midlands, the Cambridgeshire Fens, Glamorgan and the immediate vicinity of London. It is, however, well established in the Somerset Levels, the Broads, and coastal levels in Kent, Essex and Sussex (Foster, 2010).
- 3.2.19** One Nationally Scarce species, the predatory water beetle *Hydaticus transversalis* was also recorded at five sites (all in well vegetated ditches or reens) and, like the great silver water beetle, is a Red Data Book Species which has been recorded previously across the Gwent Levels SSSIs (CCW 2008e, 2008f). This species occurs in permanent water in exposed ponds and drainage ditches with rich vegetation. *H. transversalis* has been recorded from 18 hectads in England and four in Wales since 1950, the equivalent values since 1990 being nine and two, respectively. Although this species is well established on the levels on either side of the Severn, it has become locally extinct in several parts of England (Mackley *et al.*, 2010).
- 3.2.20** Other surveys have been undertaken to sample for aquatic invertebrates on the Gwent Levels, most notably those commissioned by CCW in 2009, 2011 and 2012 to assess the condition of the aquatic invertebrate feature of the following SSSIs: Whitson SSSI (Boyce, 2010); Redwick and Llandeenny SSSI and St. Brides SSSI (Boyce, 2012); and Magor and Undy SSSI, Nash and Goldcliff SSSI, Newport Wetlands SSSI and Rumney and Peterstone SSSI (Boyce, 2013). Across these three survey programmes of the seven SSSIs, a total of 80 reens were surveyed between June and August in each of the three years (see Figure

2). A total of 90 aquatic invertebrate species were recorded in the survey of the Whitson SSSI, 101 species in the survey of the Redwick and Llandeenny SSSI and St. Brides SSSI and 148 species were recorded in grazing marsh ditches in the Magor and Undy, Nash and Goldcliff, Newport Wetlands and Rumney and Peterstone SSSIs in 2012.

3.2.21 Several Red Data Book species were recorded including *H. transversalis* (in the Whitson, Rhymney and Peterstone, Redwick and Llandeenny and St Bride's SSSIs), the ornate brigadier soldierfly *Odontomyia ornata* (in the Nash and Goldcliff, Newport Wetlands, Redwick and Llandeenny, and St Bride's SSSIs) and *H. piceus* (the Whitson, Newport Wetlands, Redwick and Llandeenny, and St Bride's SSSIs). The ornate brigadier soldierfly, the larvae of which are aquatic, is restricted to the south of England and Wales, with a notable cluster around the Severn Estuary. The king diving beetle *Dytiscus dimidiatus*, a Nationally Threatened species was recorded in the Rumney and Peterstone SSSI; this species is typical of fens and has a sporadic distribution, with a cluster around the Severn Estuary.

3.2.22 Various other Nationally Scarce species were recorded during the CCW surveys including the following.

- Hairy dragonfly; this species prefers unpolluted well-vegetated waterbodies; uncommon but range increasing.
- Species of water beetle including *Peltodytes caesus*, *Haliplus heydeni* and *Rhantus grapii*, *Enochrus ochropterus*, *Agabus conspersus* and *Scirtes orbicularis* (all characteristic of fens, ditches, grassy pools and wetlands).
- Other Nationally Scarce species of water beetles: *Rhantus suturalis* and *Helophorus griseus* and *Laccobius sinuatus* from the Whitson SSSI (characteristic of silty or grassy pools, fens and drains).
- The water beetle *Enochrus melanocephalus* (prefers brackish water).
- The flecked general soldierfly *Stratiomys singularior* (widespread but sporadic distribution across the southern UK).

3.2.23 Some of the most common species recorded across the three surveys were the faucet snail *Bithynia tentaculata*, the ramshorn snail *Planorbis planorbis* and the whirlpool ramshorn snail *Anisus vortex*. Other common species occurring at over 75% of the sample sites (i.e. at eight or more sites) included the freshwater snails *Physa/Physella* sp., wandering pond snail *Radix balthica* (formerly *Lymnaea peregra*), the saucer bug *Ilyocoris cimicoides*, the water boatmen (*Notonecta glauca*), *Sigara dorsalis* and *Hesperocorixa sahlbergi* and the water beetles *Haliplus ruficollis*, *Noterus clavicornis*, *Agabus sturmii*, *Agabus bipustulatus*, *Hydroporus* spp., *Hygrotus* spp., *Helophorus* spp., and *Anacaena lutescens*. All are widely distributed and characteristic of a wide range of habitat conditions.

3.2.24 Generally, the species diversity at all the SSSIs surveyed was considered to be low in comparison to other grazing marsh systems in southern Britain, for example the Somerset Levels. The reports attributed this low biodiversity to a combination of eutrophication of the reens and ditch habitat as well as the clearing of such ditches. Boyce (2010; 2012; 2013) noted that the heavy growth of the duckweed species *Lemna* spp., (e.g. *Lemna minuta*), choking and suppressing the growth of other macrophyte habitats which are utilised by aquatic

invertebrates. Also, this increased organic material within the still waters of the ditches increases the rate of eutrophication which has a negative effect on water quality.

Baseline Water Quality – Invertebrate Data

- 3.2.25** Data from routine monitoring by NRW (and formerly by the Environment Agency), for Water Framework Directive programmes, were obtained for the following three waterbodies: Monks Ditch-source to Wainbridge; Broadway Reen; and Ebbw R-conf Ebbw Fach R to Maes-glas (see Figure 1).
- 3.2.26** The resolution of the NRW/EA invertebrate data is largely to family or genus level, and therefore the identification of notable species has not been possible. For example, the genus *Haliphus* is identified, which contains approximately 20 individual species, two of which are species of conservation concern in Wales.
- 3.2.27** A total of 125 invertebrate taxa were identified in the NRW data provided (taking into account duplicate recordings; i.e. both family and species recorded), and this gives an indication of a high level of invertebrate species diversity as would be expected to be associated with water quality of Good to High ecological status. This is not necessarily correlated with species diversity within the Gwent Levels and Newport Wetlands SSSIs, where species composition would be characteristic of slow-flowing to still water within the ditches and reens. However, the two downstream sampling sites within the Monks Ditch waterbody (EI substation and d/s Samson court) are both within the Gwent Levels SSSIs. Both sites contain approximately 40 taxa that are not present at the upstream site (Ford Farm – approximately 4 km north of the SSSI), many of which are characteristic of slower-flowing water, including dragonfly/damselfly larvae, true bugs Hemiptera and water beetles.
- 3.2.28** Only a single dataset was provided for the Broadway Reen from recent sampling in April 2015 (NRW, 2015), and as such this has been analysed independently. A total of 22 taxa were recorded in this sample, with a total BMWP (Biological Monitoring Working Party) score of 85 (ASPT (Average Score Per Taxon) = 5.0), equivalent of “good” Water Framework Directive classification status. This is comparable with the two downstream monitoring points in Monks Ditch (refer to Table 3.1) and reflects the similar position of the monitoring point towards the downstream end of the waterbody at the southern extent of the SSSI. Taxa recorded include the blue-tailed damselfly *Ischnura elegans* and the water beetle *Graptodytes pictus*, both of which are characteristic of slow-flowing drains and ponds typical of the SSSI. Species diversity was low in comparison with that expected within the SSSI, with only common and widely distributed species recorded. It is not possible to draw conclusions about trends in water quality or species diversity given the limited availability of data at this sampling point.

Table 3.1: Total number of taxa recorded at each NRW sampling location and associated Biological Monitoring Working Party (BMWP) score, Average Score Per Taxon (ASPT) and estimated equivalent Water Framework Directive status.

Sampling Site	Total number of taxa recorded	BMWP total score (5 year average)	ASPT (5 year average)	Equivalent approximate WFD classification status
Monks Ditch: Ford Farm	94	138 ↓	6.10 ↓	High
Monks Ditch: El sub station	62	89 ↓	4.93 ↓	Good
Monks Ditch: D/S Samson Court	61	75.5 ↓ (2008-14)	4.40 ↓	Good/Moderate
Ebbw River: U/S Rogerstone	61	112 =	5.89 =	High
Ebbw River: Maes Glas	82	118 =	5.81 =	High

Results are presented as a five year average from 2009 to 2014 (unless otherwise indicated); ↑ improving trend in water quality; ↓ deteriorating trend in water quality; = steady water quality.

- 3.2.29** The total number of taxa recorded at the Monks Ditch and River Ebbw sites is provided in Table 3.1. Given that there is significant variation in numbers of samples and resolution of taxon identification, these totals are only broadly comparable. For comparison, the 2014 study of aquatic invertebrates along the proposed new section of motorway (as reported in Appendix 10.15 of the ES) identified a total of 130 species. The CCW SSSI condition assessment surveys undertaken in 2010, 2012 and 2013 identified 90, 101 and 148 aquatic species respectively (Boyce, 2010, 2012 and 2013). As such, there is a favourable indication of trends in aquatic invertebrate biodiversity in these studies.
- 3.2.30** Whilst the NRW data do not provide a direct assessment of water quality within the watercourses crossed by the proposed works, the data do give an indication of waterbody status within the entire waterbodies that these watercourses feed. Therefore a valuable baseline of water quality in the catchment can be obtained; noting though, that habitat management and inputs to watercourses throughout a catchment can impact upon the invertebrate community at a downstream sampling site.
- 3.2.31** Indices for BMWP total score and ASPT are given in Table 3.1 for the two waterbodies described above, with three sampling sites for Monks Ditch and two for the River Ebbw. The estimated equivalent Water Framework Directive status based upon these biotic indices is also presented in Table 3.1 although this is an approximation; assessment of water quality also takes into account waterbody typology, and may differ slightly from that given here.
- 3.2.32** The Monks Ditch waterbody is characterised by an apparent deteriorating trend in water quality across all three sampling sites. Ford Farm (the furthest upstream, north of the existing M4) shows a consistent decline, with each sample scoring lower than the previous for both total BMWP score and ASPT. Each of the downstream sites shows a declining trend with some higher scores recorded in the intervening period. It is evident that the water quality within Monks Ditch Water Framework Directive waterbody decreases downstream, which coincides with the watercourse passing through the SSSI. Further investigation would be

required to establish potential reasons for this declining trend in biological water quality within this waterbody.

- 3.2.33** Sampling data for the River Ebbw waterbody show greater fluctuation in sampling data, with total BMWP score varying between 54 (U/S Rogerstone, October 2011) and 177 (same site, September 2013). However, such variation in sampling data is common, especially in larger watercourses where sampling may be difficult. The overall equivalent classification of High status is indicative of particularly good water quality in the River Ebbw catchment.

Freshwater Fish

Reens and Ditches

- 3.2.34** There is a general lack of data relating to the fish ecology associated with the reen systems of the Gwent Levels; the scientific literature focuses mostly on the ecology of the macrophyte and invertebrate species within such habitats. The ecology of specific reens is often dependant on the frequency with which they are maintained or dredged, as this will impact on the type of communities which will flourish in a particular reen based on the frequency of disturbance, vegetation cover and food availability (CWLIDB, 2010).
- 3.2.35** The reens are, however, known to support a mixed population of coarse fish, including roach *Rutilus rutilus*, tench *Tinca tinca*, bream *Abramis brama* and carp *Cyprinus carpio*; all characteristic of slow-flowing or still water. The reens also support a large population of European eel, which dominate the fish stocks in these features (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 as well as roach, rudd *Scardinius erythrophthalmus* and perch *Perca fluviatilis* (NRW, 2015). Three-spined stickleback *Gasterosteus aculeatus* were also noted during these surveys (NRW, 2015).
- 3.2.36** The conservation designations for the Severn Estuary and its tributaries (i.e., the Severn Estuary/Môr Hafren SAC, Severn Estuary Ramsar Site, River Usk/Afon Wysg SAC and River Wye/Afon Gwy SAC; see Appendix 10.17 of the ES) include the following species: sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, brook lamprey *Lampetra planeri*, twaite shad *Alosa fallax*, allis shad *Alosa alosa*, sea trout *Salmo trutta*, Atlantic salmon *Salmo salar*, European eel *Anguilla anguilla*, and bullhead *Cottus gobio*. While not all of these species are likely to occur within the watercourses of the study area, reens and ditches may be significant habitats in terms of native or spawning ranges as follows.
- Juvenile lamprey (ammocoetes) of all three species (river, brook and sea) lie buried in mud for three to five years during their development, and may occur in small, silted watercourses.
 - European eel spend up to 12 years in still and flowing fresh waters once they return from the sea as glass eels. This species is known to cross waterlogged land and can therefore occur in very small or isolated waterbodies.

- 3.2.37** Bullhead prefer faster flowing water with larger substrate types to seek refuge, and are therefore considered unlikely to occur in the still waters of reens and ditches.
- 3.2.38** There are a number of species of migratory fish which transit through the lower reaches of the River Usk in particular, but also potentially the River Ebbw, to reach natal freshwater spawning grounds; these include Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey and sea trout. These species are however unlikely to occur within reens and slow-flowing waterbodies, as they prefer either estuarine or fast flowing rivers with gravelly substrate suitable for spawning. As these species are transitory through the study area, they are described in full below.
- 3.2.39** Llanmartin Brook, which merges into Monks Ditch and becomes part of the Caldicot Levels drainage system, has previously been considered to be the most diverse in the southern Gwent area for freshwater fish fauna (SEWBRc, 2010). Species recorded in the upper parts of this brook include the minnow *Phoxinus phoxinus*, stone loach *Noemacheilus barbatulus*, European eel, bullhead, gudgeon *Gobio gobio*, brown trout *Salmo trutta*. The majority of these species favour sandy and gravelly rivers and streams, feeding on the bottom and spawning amongst sand, gravel/stone and vegetation. SEWBRc (2010) found three-spined stickleback, with nine-spined stickleback *Pungitius pungitius* and roach more common further downstream in the Monks Ditch area (SEWBRc, 2010). Records from 2006 from the brook around Underwood also indicated signs of approximately six spawning brook lamprey.

Rivers

- 3.2.40** Other freshwater fish species which are common in larger rivers and are likely to be present in parts of the River Usk and the River Ebbw as opposed to the small reen and ditch habitats of the Gwent Levels wetlands include species such as dace *Leuciscus leuciscus* (which is often confused with the chub species *Leuciscus cephalus*), pike *Esox lucius* the spined loach *Cobitis taenia*, chub *Squalius cephalus* and barbell *Barbus barbus* (SEWBRc, 2010). These species have been recorded during NRW (formerly EA) surveys of the River Ebbw (NRW, 2015). Rudd and tench are also common freshwater species to the area, although have generally been recorded further north after being introduced to local reservoirs and rivers as game fish (SEWBRc, 2010).
- 3.2.41** Demersal species include the gudgeon, bullhead, minnow and the nocturnal stone loach, which inhabit small to medium sized flowing rivers and larger lake environments (Freyhof *et al.*, 2005; Fish-UK, 2015). The minnow, gudgeon and bullhead are demersal spawners and as such prefer clean substrate in flowing water for spawning, sometimes migrating upstream to spawn. Stone loach prefer sandy substrates or vegetation cover for spawning as this species spawns close to the surface where the eggs then drift and attach to various substrates, then progresses to gravel substrate with fast flowing water when the benthic larvae are juveniles. Minnow spawn in gravel and also overwinter in coarse substrates but prefer slower moving waters for this purpose (Kottelat and Freyhof, 2007). Minnow is also known to occur in association with salmonid species such as the brown trout present in the Rivers Ebbw and Usk, and generally feeds on algae and plant debris and small freshwater invertebrates, although it is a common prey item itself (Billard, 1997; CRT, 2015). Data provided by NRW (2015) indicate high catches of minnow during some surveys (up to 150 individuals per minute).

Gudgeon and brown trout spawn over sandy and gravelly substrate in shallow water (Frank-Gopolos *et al.*, 2015; Fish-UK, 2015).

- 3.2.42** Bullhead is widespread throughout the River Usk, with the exception of the estuarine area surrounding the mouth of the river; this species is named within the site accounts for the River Usk/Afon Wysg SAC and the River Wye/Afon Gwy SAC (see Appendix 10.17 of the ES), and like minnow, prefers coarse gravelly substrate, although in the southern reaches of the Usk it is thought that this species may prefer softer substrate with abundant vegetation cover (JNCC, 2015). The River Usk is considered to have exceptionally high-quality habitat with good water quality, abundant cover and a variety of aquatic habitats.
- 3.2.43** Stone loach is particularly sensitive to pollution by heavy metals and low oxygen levels, but can tolerate moderate organic pollution, and is therefore often considered to be a good indicator of water quality (Wheeler, 1992). Bullhead is also sensitive to oxygenation, preferring a well-oxygenated environment, and does not tolerate badly polluted rivers (JNCC, 2015).
- 3.2.44** The River Usk also supports a healthy population of brook 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. Brook lamprey are listed as a primary reason for the selection of the River Usk/Afon Wysg SAC and the River Wye/Afon Gwy SAC (see Appendix 10.17 of the ES). The brook lamprey is the smallest of the lampreys found in the UK and is a non-migratory freshwater species, typically occurring in streams. Like sea and river lamprey species, brook lamprey requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. It spawns mostly in parts of the river where the current is not too strong.
- 3.2.45** As discussed above, there are a number of species of migratory fish which transit through the lower reaches of the River Usk in particular, but also potentially the River Ebbw, to reach natal freshwater spawning grounds; these include Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey and brown/sea trout. 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); European eel were also recorded in the River Ebbw fyke net surveys.

3.3 Estuarine and Marine Ecology

Plankton

- 3.3.1** Plankton represents an integral part of the marine ecosystem and provides a crucial source of food to higher trophic levels (i.e. fish, cetaceans). Plankton is divided into two broad groups: phytoplankton (autotrophic) and zooplankton (heterotrophic). In temperate seas and estuaries, the phytoplankton assemblage is generally dominated by diatoms and dinoflagellates.
- 3.3.2** The local abundance, distribution and population dynamics of plankton varies horizontally, vertically and seasonally. Major influences include the following.
- Availability of light,

- Ambient nutrient concentrations (e.g. nitrate, phosphate, silicate and mineral iron),
- Physical state of the water column (e.g., temperature stratification, depth, tidal mixing and salinity),
- Abundance and taxon of other plankton.

3.3.3 Surface water monitoring undertaken by the EA (now NRW) between 2007 and 2013 across the Severn Estuary area and surrounding the mouth of the River Usk shows that the most abundant organisms are microflagellates, with abundances of over 3,000,000 cells/L in some samples. Other relatively common organisms include *Phaeocystis* spp., *Guinardia delicatula*, *Paralia sulcata*, *Cylindrotheca closterium* and *Nitzschia longissima*.

3.3.4 Few seasonal differences were recorded in key species assemblage as microflagellates still dominate across both seasonal extremes, however certain diatoms such as *P. sulcata* were found to be more abundant in spring (compared to autumn) and other diatoms such as *Asterionellopsis kariana* and *Skeletonema costatum* were also recorded in spring (NRW, 2014).

3.3.5 In autumn, microflagellates *P. sulcata* and *A. kariana* remained dominant, although at slightly lower abundances than in spring, and *S. costatum* was recorded as absent. Other species recorded in the autumn months at relatively high abundances include *Leptocylindrus minimus*, *Bacillaria paxillifer* and *Thalassionema nitzschioides* each with abundance counts of around 2000 cells/L. However compared to the microflagellates with over 1,900,000 cells/L and *P. sulcata* with over 29,000 cells/L these species were still minor components of the autumn assemblage.

Benthic Ecology

3.3.6 The intertidal environment within the wider study area is dominated by two main habitat types.

- Estuarine mud habitat - which qualifies as an OSPAR priority habitat (*Intertidal Mudflats*; OSPAR, 2014), UKBAP priority habitat and Section 42 Habitat of Principal Importance in Wales and dominates along the banks of the River Ebbw, River Usk and along the northern banks (Welsh shore) of the Severn Estuary.
- Sand - which dominates the lower intertidal in the eastern part of the study area and the large sandflats in the central parts of the Severn Estuary at Middle and Welsh Grounds which are exposed at low water.

3.3.7 Intertidal habitats identified by CCW (2010) and those which correspond with OSPAR priority habitats within the study area are shown on Figure 3.

3.3.8 Bands of saltmarsh habitat, which also qualifies as a UKBAP priority habitat and Section 42 Habitat of Principal Importance in Wales, are situated along the northern most boundaries of the intertidal along the Peterstone Wentlooge coast. To the east, past the mouth of the Usk, saltmarsh habitat also runs along the Porton Grounds area past Redwick and Summerleaze (CCW, 2010).

3.3.9 The following sections describe the intertidal habitats and species within the River Usk and River Ebbw specifically.

River Usk

- 3.3.10** The River Usk is a tributary of the Severn Estuary and the tidal limit extends upstream approximately 29 km to the weirs at Newbridge on Usk (SECG, 2010). The Lower Usk is a rare example of a mesotrophic lowland river that has not been significantly modified by man. The river features a wide floodplain with meandering channels and has been shaped over the years by fluvio-glacial deposits and alluvial material in the Usk valley. Through Newport, however, the course of the River Usk is anthropogenically controlled by piled walls and wharves. Along the tidally influenced banks of the Usk, the river is bounded by extensively developed land of Newport and Caerleon and open spaces with flood protection (SECG, 2010).
- 3.3.11** The strong tidal currents of the River Usk erode and transport large quantities of fine sediment during spring tides, but during neap tides much of this sediment is deposited on the bed, forming very soft or fluid mud deposits, which are remobilised on the next spring tides. There are significant mud accumulations at the mouth of the River Usk and the channel mouth is regularly dredged in order to maintain access to Newport Docks.
- 3.3.12** In the lower reaches of the estuary, the Uskmouth coastline through to the Goldcliff promontory is fronted by areas of both locally accreting and locally eroding saltmarsh.

Intertidal Benthic Ecology

- 3.3.13** The intertidal areas of the River Usk are characterised by intertidal mud and saltmarsh habitats, with patchy areas of fucoids in the lower intertidal, particularly around the Newport Docks area, and patchy algal turf at the mouth of the River Usk (CCW, 2010; OSPAR, 2014). These key intertidal habitats within the River Usk correspond with the following EUNIS habitats (MESH, 2013; see Figure 3): *A2.3 littoral mud* and *A2.5 coastal saltmarshes and saline reedbeds*. The transitional region between the intertidal and subtidal habitat is characterised by a boundary between *A2.3 littoral mud* and *A5.3 sublittoral mud*. The CCW (2010) intertidal lifeforms data also indicate the presence of fucoids on the intertidal banks of the River Usk, most notably on the east bank to the south of the new section of motorway (see Figure 3). The fucoid communities in the River Usk are likely to be associated with the areas of dumped rubble/rock armour as well as the walls of the Eastern dry dock and old quay legs for example. CCW surveys from 2002 recorded a number of species of fucoid seaweeds from this part of the River Usk including *Fucus vesiculosus* and *F. spiralis*. During the same survey, barnacles including *Balanus crenatus* and the mollusc *Mytilus edulis* were also recorded, likely on the localised areas of hard substrate and shoreline structures (CCW, 2006).
- 3.3.14** Estuarine intertidal mud habitat in the River Usk qualifies as an OSPAR priority habitat (Intertidal Mudflats; OSPAR, 2014), and UKBAP priority habitat/Section 42 Habitat of Principal Importance in Wales. Site condition monitoring of the intertidal mud and sandflats of the Severn Estuary/Môr Hafren SAC and SPA in 2012 (EcoSpan, 2012), included the area around the mouth of the River Usk and indicated that the communities in the littoral muddy sediments in these areas are characterised by biotopes containing the Baltic tellin *Macoma balthica*; this mollusc is considered to be an important prey item for birds and benthic fish and crustacean species. The communities were described as the LMu.MEst.HedMac

Hediste diversicolor and *M. balthica* in littoral sandy mud biotope (EcoSpan, 2012). This study also noted the presence of *Sabellaria alveolata* reefs LS.LBR.Sab.Salv (*Sabellaria alveolata* reefs on sand-abraded eulittoral rock), in the area to the east of the mouth of the River Usk at Usk Patch (EcoSpan, 2012). CCW surveys of the River Usk in 2002 also noted similar infaunal species including ragworm *Hediste diversicolor* and *M. balthica*, in addition to other polychaetes such as *Nephtys hombergii* and *Streblospio shrubsolii* which is common from muddy shores and brackish waters (CCW, 2006).

- 3.3.15** Saltmarsh habitat in the River Usk was surveyed during the National Vegetation Classification (NVC) surveys undertaken by Sturges Ecology in May 2014 (see Appendix 10.4 of the ES and Figure 4). The saltmarsh community at the site on the east bank of the River Usk comprises a dense patch of low diversity vegetation, mainly dominated by sea couch *Elytrigia atherica*, conforming to the NVC community SM24 *Elytrigia atherica* saltmarsh. Several steeper sided creeks and low-lying areas within the saltmarsh were lined by a slightly more diverse mix of common saltmarsh-grass *Puccinellia maritima*, English scurvy-grass *Cochlearia anglica*, annual sea blite *Suaeda maritima* and sea arrowgrass *Triglochin maritima* which were assigned to the NVC community SM13 *Puccinellia maritima* saltmarsh. The seaward edge of the saltmarsh supports a patchy fringe of sea aster *Tripolium pannonicum* and common saltmarsh-grass, with localised common cordgrass *Spartina anglica* likely to be a fragmented mix of SM13 with elements of SM6 *Spartina anglica* saltmarsh.
- 3.3.16** A Nationally Scarce species, the dittander *Lepidium latifolium* was present at the River Usk site; this is also a 'Primary Species'¹ under the *Guidelines for the Selection of Wildlife Sites in South Wales* (GWT, 2004). Stone parsley *Sison amomum*, was also listed during the survey of the River Usk, although it was noted that this is not generally considered an aquatic species (see Appendix 10.4 of the ES).
- 3.3.17** Saltmarsh habitat within the River Usk qualifies as a UKBAP priority habitat and Section 42 Habitat of Principal Importance in Wales.
- 3.3.18** A key saltmarsh species of relevance within the study area is *Salicornia* sp., annual saltmarsh plants otherwise known as glasswort, which colonise muddy sediments within the intertidal. Studies undertaken by NRW in 2008 and 2011 (NRW, 2011) recorded *Salicornia* sp., near the mouth of the River Usk (see Figure 4). *Salicornia* habitats are protected under the Habitats Directive as the Annex I habitat 1310 *Salicornia* and other annuals colonising mud and sand, however it is not listed as a qualifying feature on the SAC citations for either the Severn Estuary or the River Usk/Afon Wysg SAC.

Subtidal Benthic Ecology

- 3.3.19** The subtidal sediments in the centre of the river channel in the lower reaches of the River Usk are dominated by muddy sediments which may be categorised as the EUNIS habitat A5.3 *Sublittoral mud*. The fauna of principal rivers in the Severn Estuary (e.g., River Usk) is reported to be similar to that of the soft sediments of the Severn itself (Morrissey *et al.*, 1994) with communities in these

¹ Primary and Contributory Species – Two lists of vascular plants identified in the *Guidelines for the Selection of Wildlife Sites in South Wales* (GWT, 2004) which are considered rare and/or notable within South Wales. Primary species are those which have been recorded in 15 or fewer 10 km squares across South Wales, whilst Contributory species are those which have been recorded in 30 or fewer 15 km squares (GWT, 2004).

river estuaries dominated by the polychaete *Nereis diversicolor*, the amphipod *Corophium volutator*, the mollusc *M. balthica* and a variety of oligochaetes (Langston *et al.*, 2003). Benthic data collected for Water Framework Directive operational monitoring purposes by the EA in 2011 at sites near the mouth of the River Usk Estuary supports this conclusion with *M. balthica* and *Nephtys* spp. dominating the grab samples in this area.

- 3.3.20** Subtidal benthic biotopes, as mapped by the CCW HABMAP project (2010), are depicted in Figure 5, and show that communities associated with the muddy sediments in these area are largely characterised by the SS.SMu.SMuVS *sublittoral mud in variable salinity* biotope with small patches of SS.SMu.ISaMu.Cap *Capitella capitata in enriched sublittoral muddy sediments* on the western bank of the River Usk in the area immediately to the east of Newport Docks. The SS.SMu.ISaMu.Cap biotope also dominates the sediment at the mouth of the River Usk Estuary and extending into the Severn Estuary.

River Ebbw

- 3.3.21** The River Ebbw, is in the western part of Newport and converges with the Usk just before entering the Severn Estuary. The Ebbw is a designated SINC (see Appendix 10.17 of the ES) and is tidal for only approximately 3 km upstream (SECG, 2010). The west bank of the River Ebbw is topped by a man-made earth bank, separated from the river from a flat strip of grassland. This grassland gives way to a narrow strip of saltmarsh below which is the muddy banks of the intertidal (RSK, 2010). The east bank of the River Ebbw is flatter and has a narrow strip of saltmarsh vegetation which grades into grassland, reedbed and scrub (RSK, 2010).

Intertidal Benthic Ecology

- 3.3.22** Similar to the River Usk, the intertidal areas of the River Ebbw Usk are characterised by intertidal mud, with small patches of algal turf on localised areas of rock armour/rubble, and saltmarsh habitats (CCW, 2010; OSPAR, 2014; see Figure 3). These habitats broadly correspond with the following EUNIS habitats: A2.3 *littoral mud* and A2.5 *coastal saltmarshes and saline reedbeds*. Estuarine mud habitats in the River Ebbw qualify as an OSPAR priority habitat (Intertidal Mudflats; OSPAR, 2014), UKBAP priority habitat and Section 42 Habitat of Principal Importance in Wales. Throughout the lower reaches of the River Ebbw, in the vicinity of the new section of motorway, there are numerous areas of dumped rubble which support sparse communities of green algae. There are also numerous makeshift jetties running from the salt-marsh down to the bottom of River Ebbw channel, made from scaffolding and old barrels towards the lower reaches of the river.
- 3.3.23** Although the site condition monitoring of the intertidal mud and sandflats of the Severn Estuary/Môr Hafren SAC and SPA in 2012 did not fully extend into the reaches of the River Ebbw, it is considered likely that the intertidal communities present in this area will be characterised by similar species (i.e., *M. balthica*) and the same biotope as recorded at the mouth of the River Usk (i.e., the LMu.MEst.HedMac biotope). CCW surveys of the River Ebbw in 2002 also noted similar infaunal species including ragworm *H. diversicolor* and the peppery furrow shell *Scrobicularia plana* which is able to tolerate low salinities in thick mud or muddy sand (CCW, 2006).

- 3.3.24** The 2014 NVC surveys undertaken for the new section of motorway (see Appendix 10.4 of the ES) found that the saltmarsh communities on the western bank of the River Ebbw (see Figure 4) differs from those described above for the River Usk. The western banks of the Ebbw are fringed with heavily sheep-grazed salt-marsh vegetation. The lower saltmarsh community on the surveyed west bank of the river was relatively diverse and characterised by sea aster *Aster tripolium*, sea milkwort *Glaux maritima* and common saltmarsh grass *Puccinellia maritima* grading into red fescue *Festuca rubra* higher up the bank. Most of the Ebbw saltmarsh on the western bank conforms to the NVC SM13 *Puccinellia maritima* salt-marsh, with a tendency towards the SM13b *Glaux maritima* sub-community, and this grades into SM11 *Aster tripolium* salt-marsh in the lowest parts. Communities in the upper reaches of the saltmarsh (between the top of the bank and the base of the seawall) were dominated by saltmarsh rush *Juncus gerardii* and bulbous foxtail *Alopecurus bulbosus* and best classified as SM16 *Juncus gerardii* saltmarsh.
- 3.3.25** The bulbous foxtail *Alopecurus bulbosus*, a Nationally Scarce species was recorded at the 2014 River Ebbw site on the western bank and this is also a 'Primary Species'¹ under the *Guidelines for the Selection of Wildlife Sites in South Wales* (GWT, 2004). The River Ebbw site also listed the coastal 'Contributory Species' (GWT, 2004) wild celery *Apium graveolens* and the greater sea-spurrey *Spergularia media* as present (see Appendix 10.4 of the ES). Saltmarsh habitat within the River Ebbw qualifies as a UKBAP priority habitat and Section 42 Habitat of Principal Importance in Wales.
- 3.3.26** The 2015 NVC survey of the saltmarsh habitat on the eastern bank of the River Ebbw, as reported in Appendix 10.20 of the ES, found a gradual succession from sea aster-dominated saltmarsh vegetation at the seaward edge to coarse grassland and scrub on the higher ground. As found on the western bank of the Ebbw, the lower saltmarsh vegetation can mostly be described as the NVC SM13b *Puccinellia maritima* saltmarsh, *Glaux maritima* sub-community. It also has elements of the SM11 *Aster-tripolium* community where sea aster is particularly dominant at its lower edges. The upper saltmarsh vegetation broadly falls within the SM16 *Festuca rubra* - *Juncus gerardii* saltmarsh community. It is more diverse than the lower zone, and supports several locally notable species including abundant Dittander, and small amounts of Wild Celery, Parsley Water-dropwort and Hard-grass.

Subtidal Benthic Ecology

- 3.3.27** The subtidal sediments in the main channel of the lower reaches of the River Ebbw are similar to those in the River Usk and the wider Severn Estuary (see Figure 5), and comprise muddy sediments corresponding to the EUNIS habitat A5.3 *Sublittoral mud* which are dominated by the polychaete *N. diversicolor*, the amphipod *C. volutator*, the mollusc *M. balthica* and a variety of oligochaetes (Langston *et al.*, 2003).
- 3.3.28** Subtidal benthic biotopes, as mapped by the CCW HABMAP project (2010), are depicted in Figure 5 and show that communities associated with the muddy sediments in the main channel of the River Ebbw are predominately characterised by the SS.SMu.SMuVS biotope which grades into the SS.SMu.ISaMu.Cap biotope where the River Ebbw enters the River Usk. As noted previously for the River Usk, these biotopes also dominate the wider subtidal regions of the central parts of the Severn Estuary.

Fish Ecology

Migratory Species

- 3.3.29** In general, marine/estuarine fish communities tend to show seasonal fluctuations which are related to movements of species between key feeding, spawning and nursery areas throughout the year. For example, during the spring and summer months many species move into shallower, inshore waters to feed and/or spawn, whilst during winter they migrate further offshore into deeper waters and these changes may be linked to both water temperature and the availability of prey species. This influx of fish into shallower coastal waters like those surrounding the mouth of the River Usk are an important consideration, due to the protected species of migratory fish which inhabit these waters.
- 3.3.30** 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, notably the River Usk, River Wye and River Severn but also potentially the network of reens and ditches associated with the Gwent Levels. 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 study area: Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey, sea trout and European eel. All of these species are anadromous with the exception of the catadromous European eel.
- 3.3.31** In addition to the rivers which have been designated as Natura 2000 for, amongst other features, the presence of either all or some of these migratory fish species (e.g., River Usk/Afon Wysg SAC), there are a number of other rivers entering the Severn Estuary which may also support these diadromous species including the River Ebbw (DECC, 2008). In addition, a number of the diadromous fish species stray during their migratory movement and can enter numerous other estuaries and rivers before returning to their natal river. Therefore the following sections contain a summary of all migratory fish species with the potential to be in the vicinity of the new section of motorway.

Sea and River Lamprey

- 3.3.32** Sea and river lampreys are classified as Least Concern on the IUCN Red List, and listed on Appendix III² of the Bern Convention and Annex II³ of the EC Habitats Directive. In addition, river lamprey is on Annex V⁴ of the EC Habitats Directive and Schedule 3⁵ of the Conservation Regulations (1994) and sea lamprey is a priority species on the OSPAR list of threatened and declining species. Sea and river lamprey are given as primary reasons for the selection of the River Usk/Afon Wysg SAC, Severn Estuary/Môr Hafren SAC and River Wye/Afon Gwy SAC.

² Protected Faunal Species.

³ Species known to occur as native populations in the UK and whose conservation requires designation of special areas of conservation.

⁴ Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

⁵ Animals which may not be taken or killed in certain ways.

3.3.33 The River Usk in particular, 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 these species (DECC, 2008).

3.3.34 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 3.2. Sea lamprey migrate upstream and enter rivers such as the Usk and Wye in early spring (Table 3.2). 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).

3.3.35 The brook lamprey is the smallest of the lampreys found in the UK and is a non-migratory freshwater species, typically occurring in streams. Like the sea and river lamprey species described above, brook lamprey requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. This species spawns mostly in parts of the river where the current is not too strong and as a wholly freshwater species is discussed in Section 3.2.

Twaite and Allis Shad

3.3.36 Allis and twaite shad are listed as Least Concern on the IUCN Red List, Annexes II and V of the EC Habitats Directive, Appendix III of the Bern Convention, and Schedule V⁶ of the Wildlife and Countryside Act (1981). Twaite shad are listed as a primary reason for the selection of the River Usk/Afon Wysg SAC, Severn Estuary/ Môr Hafren SAC and River Wye/Afon Gwy SAC. Allis shad are listed as a qualifying feature, but not as a primary reason for the selection of the River Usk/Afon Wysg SAC and River Wye/Afon Gwy SAC. Allis shad are also a priority species on the OSPAR list of threatened and declining species.

3.3.37 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).

3.3.38 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 (Maitland and Lyle, 2001), but rivers in the Severn catchment may no longer support viable breeding populations (Carstairs, 2000). Sites in the UK, such as the River Usk/Afon Wysg 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.

3.3.39 The upstream migration of allis and twaite shad to spawning areas in the Rivers Severn Wye and Usk occurs between March and June, reaching a peak in May.

⁶ Allis shad is protected from killing, injury, or taking by any method as per Section 9(1) of the WCA 1981, twaite shad is afforded protection under Section 9(4) which prohibits damage/destruction of its place of shelter.

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 3.2).

Atlantic Salmon

- 3.3.40** Atlantic salmon is classified as Least Concern on the IUCN Red List, and is listed on Appendix III of the Bern Convention. Freshwater populations are on Annex II of the EC Habitats Directive and Schedule 3 of the Conservation Regulations (1994). This species is also a priority species on the OSPAR list of threatened and declining species.
- 3.3.41** Atlantic salmon are given as a primary reason for the selection of the River Usk/Afon Wysg SAC (and River Wye/Afon Gwy SAC). 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 (life stage which changes body chemistry in preparation for living in salt water) migrate downstream towards marine feeding grounds between April and June; evidence suggests that this migration occurs largely during the night in surface waters (Moore *et al.*, 1998).
- 3.3.42** 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 the 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.

European Eel

- 3.3.43** 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, 2011). 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 biodiversity under the NERC Act 2006.
- 3.3.44** European eel begin their life as eel larvae, and it is thought that these larvae drift from their birthplace in the Sargasso Sea for three years across the Atlantic Ocean on ocean currents to the Severn Estuary. Here they metamorphose into 'glass eels' and subsequently develop into more pigmented 'elvers', grow larger (yellow eel) before reaching reproductive maturation begins.
- 3.3.45** The majority of upstream migration of elvers (juveniles) occurs between April and September (inclusive) and this freshwater phase is a feeding and growing stage, before they migrate out of the estuary. The peak downstream migration of adult eel 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.
- 3.3.46** 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.

Sea Trout

3.3.47 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. Sea trout are classified as Least Concern on the IUCN Red List.

Table 3.2: Summary of migration periods (upstream ↑ and downstream ↓) for diadromous species within the Severn Estuary and its rivers (River Usk and River Wye).

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				↑	↑	↑	↑					

Estuarine and Marine Species

3.3.48 A number of other marine and estuarine species of fish have the potential to be present in the waters of the River Usk and River Ebbw in the vicinity of the new section of motorway. However, in the absence of targeted surveys for non-migratory fish species in these rivers, the assemblage and likely species must be inferred from the numerous studies which have been conducted of the fish community in the wider Severn Estuary area.

3.3.49 Estuarine species of fish rely on the estuary for some aspect of their life-cycle and, as a consequence, are often the most vulnerable to anthropogenic factors affecting habitats and ecology of the estuary. Marine species which occur in large numbers in estuaries 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 and Swaby 1993). Marine estuarine-opportunists can be present in the Severn Estuary in very large numbers at particular times of year. These include sprat *Sprattus sprattus*, herring *Clupea harengus*, whiting *Merlangius merlangus*, bib/pouting *Trisopterus luscus*, poor cod *Trisopterus minutus*, bass *Dicentrarchus labrax* and common

goby *Pomatoschistus microps* (Bird, 2008). These species were also recorded during fyke netting surveys undertaken by NRW between 2008 and 2015 off Goldcliff, to the east of the mouth of the River Usk, and during otter trawl surveys undertaken between 2003 and 2014 off Peterstone/Monkstone at the mouth of the River Usk. During the fyke net surveys, whiting was the most frequently recorded species, particularly in autumn surveys. Dover sole *Solea solea* were also frequently recorded in the fyke nets (NRW, 2015). Both of these species were also recorded in high abundances from the otter trawl surveys at the mouth of the River Usk although gobies were found to numerically dominate these trawls (NRW, 2015). Additional species recorded during the NRW fyke netting/otter trawl surveys in the vicinity of the mouth of the River Usk included demersal flatfish species plaice *Pleuronectes platessa* and flounder *Platichthys flesus*. Small-bodied species were found to be common in the shallower coastal waters such as the five-bearded rockling *Ciliata mustela* and pogge *Agonus cataphractus*.

3.3.50 A few estuarine species spend their entire life-cycle within the Severn Estuary including common goby, black goby *Gobius niger*, sand smelt *Atherina presbyter* and three-spined stickleback (Bird, 2008).

3.3.51 Marine species typically spend their entire life-cycle in the sea and only occasionally enter estuaries; these species therefore have a reduced likelihood of being present in the lower reaches of the rivers Usk and Ebbw. Those recorded in any notable numbers from the Severn Estuary however include conger eel *Conger conger*, Norway pout *Trisopterus esmarkii*, red mullet *Mullus surmuletus* and plaice (Bird, 2008). Some elasmobranch species such as the common dogfish *Squalus acanthias* and the thornback ray *Raja clavata* are also frequently spotted around the coastal areas of south Wales, including the areas of the Bristol Channel and Severn Estuary around Newport.

Spawning and Nursery Grounds

3.3.52 Spawning by marine fish species generally occurs further out into the Bristol Channel, well outside the study area, with many species including whiting, sole, plaice, sprat and bass spawning in the spring. Over the summer months the fish larvae drift through the Bristol Channel inshore and up the Severn Estuary to their coastal nursery grounds in autumn or, for migratory species, further inland to the freshwaters of the River Usk and River Ebbw (Potter and Claridge, 1985). Nursery areas tend to occur in the shallower inshore areas of the Severn Estuary and for species including plaice, sole and whiting are likely to coincide with the areas around the mouth of both the River Usk and River Ebbw where these rivers enter the Severn Estuary (Coull *et al.*, 1998; Ellis *et al.*, 2010).

3.3.53 Several species of fish and elasmobranch have notable nursery areas within the study area and for many marine species, the Severn Estuary and its supporting habitats (e.g. intertidal mudflats, saltmarsh, freshwater rivers etc.) represents both a regionally, and in some cases nationally, important nursery habitat.

3.3.54 The literature cites a number of species with important nursery grounds within the Severn Estuary. These species include whiting, plaice, sole and anglerfish *Lophius piscatorius* (Coull *et al.*, 1998; Ellis *et al.*, 2010).

Marine Mammals

- 3.3.55** Sightings of marine mammals have been made as far up the Severn Estuary as the River Usk and the River Wye at Chepstow, specifically of grey seal *Halichoerus grypus*. Grey seal sightings spanning 2001 to 2011 have mainly been of a single seal on an incoming tide during the summer months between June and October (AER, 2015). In 2006, grey seal sightings were recorded at three locations along the River Wye as well as the River Usk and Newport Moorings (Titcombe, 2011; AER, 2015). Single sightings have also been made close to the mouth of the Usk in 2010 at both Redwick and Goldcliff (AER, 2015).
- 3.3.56** No records for cetacean sightings are available. However, it is thought that due to the shallow and variable water depth, as well as the highly turbid and tidal waters within the study area, that occurrences of cetacean species is unlikely (Peters, 2010).

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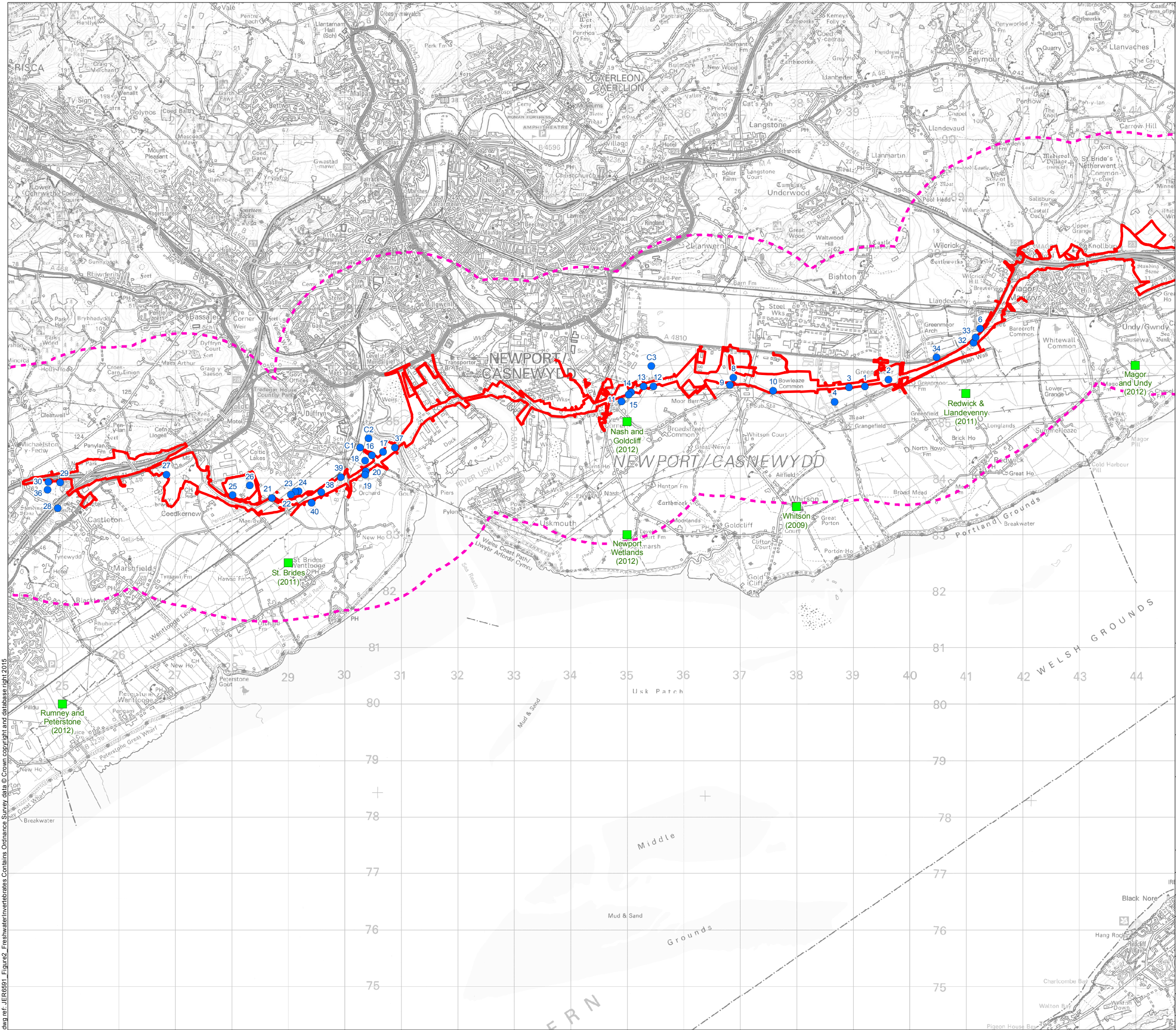
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Figures



- Legend**
- Limit of Permanent and Temporary Works for New Section of Motorway
 - 2km Buffer
 - Aquatic Invertebrate Sample Locations (Boyce Freshwater Invertebrate Surveys, 2009 - 2012)
 - Aquatic Invertebrate Sample Locations (Rachel Hacking Ecology, 2014)



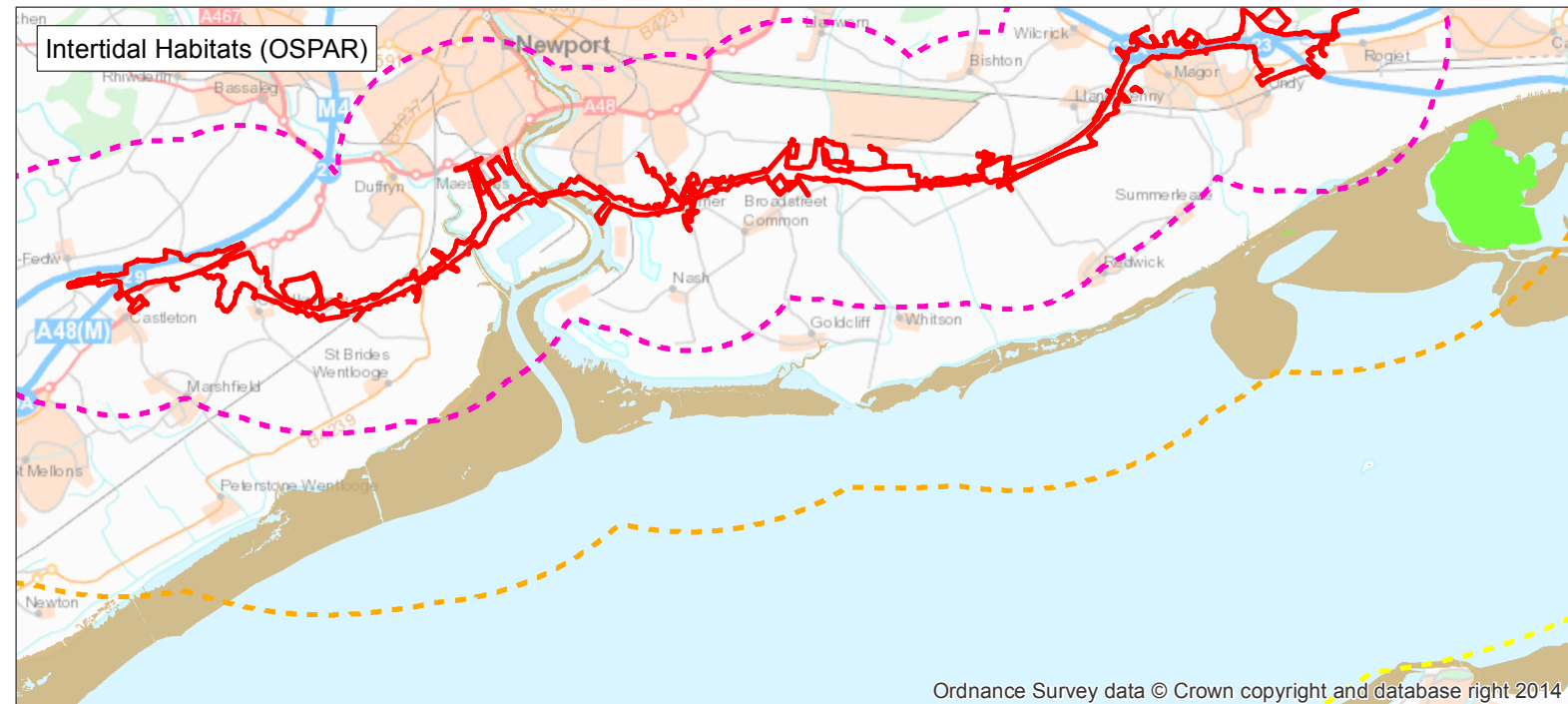
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Appendix 10.18
Aquatic Baseline Environment

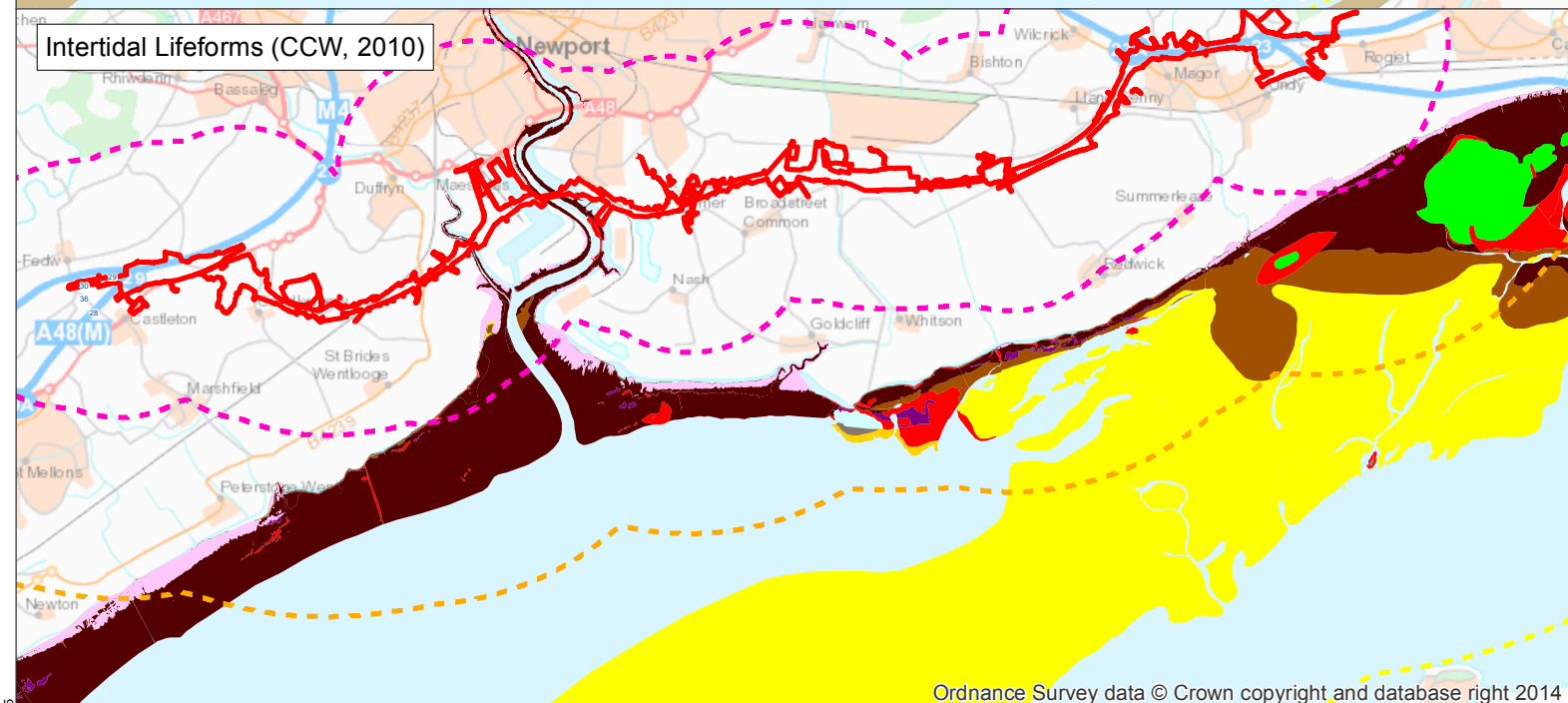
Freshwater Invertebrates

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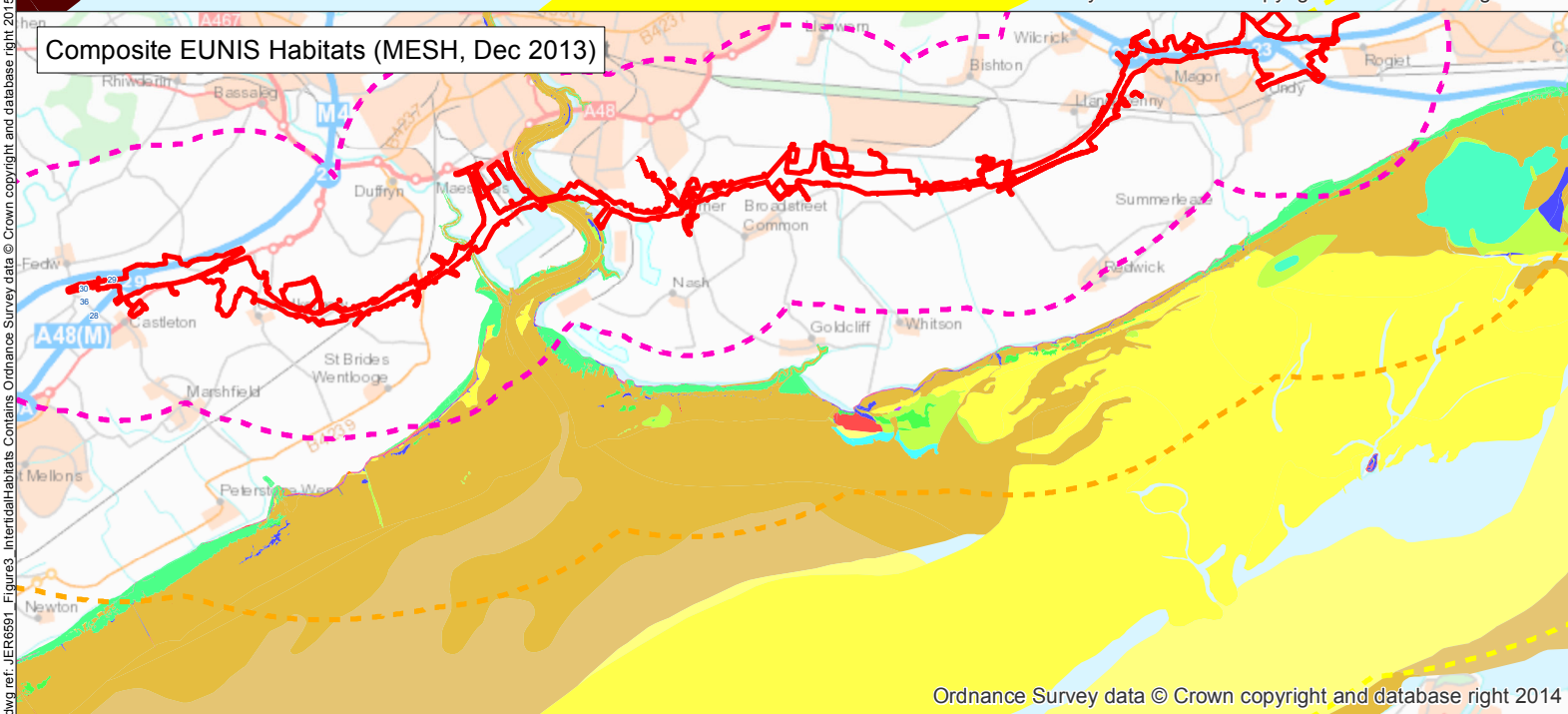




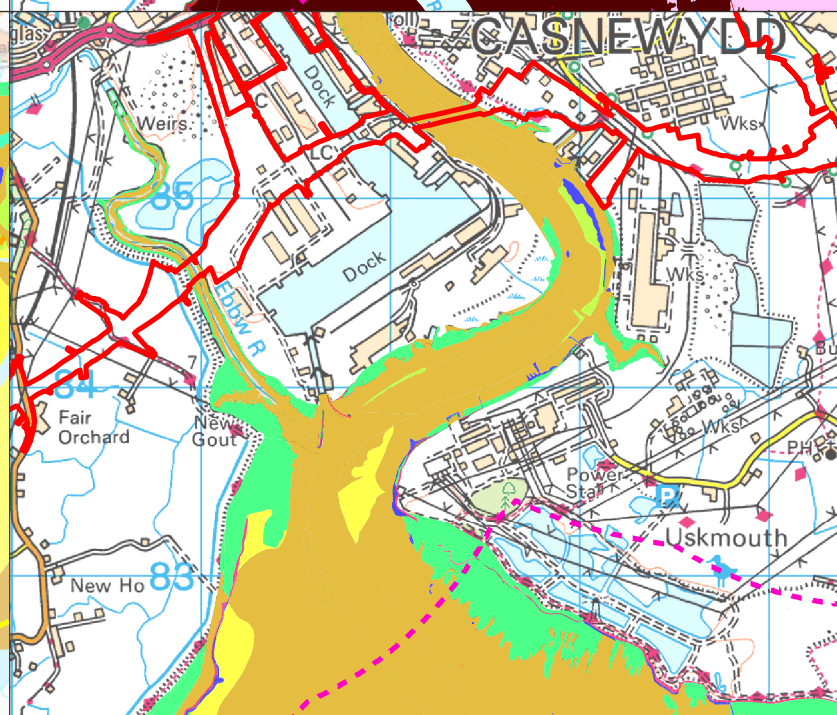
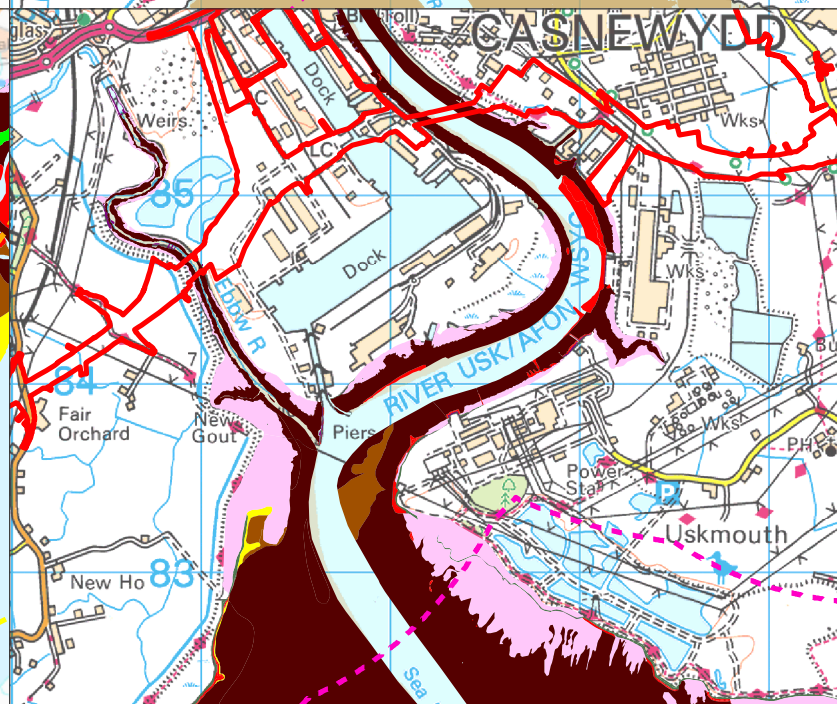
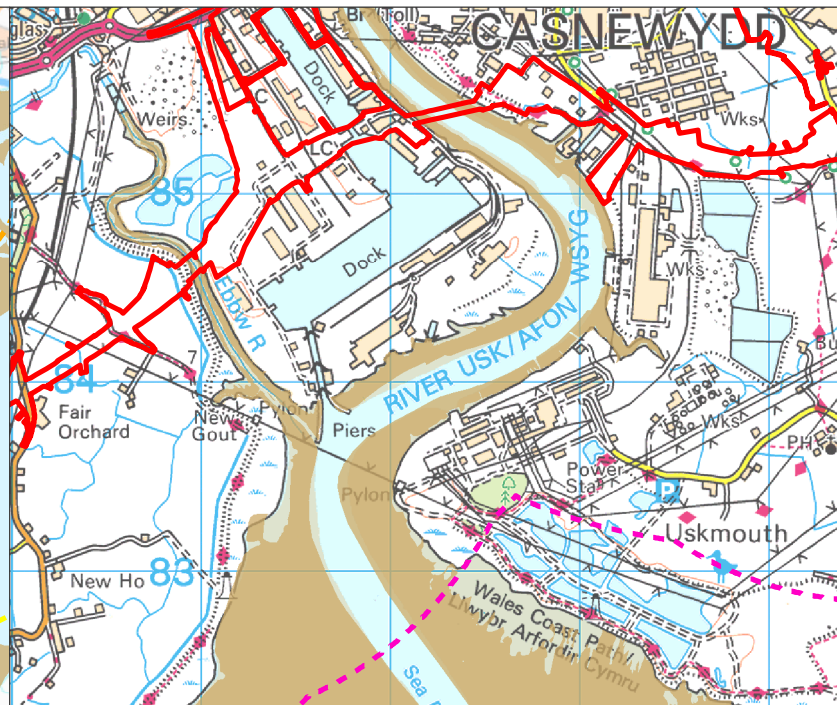
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Legend

- Limit of Permanent and Temporary Works for New Section of Motorway
- 2km Buffer
- 5km Buffer
- 10km Buffer

Intertidal Habitats (OSPAR)


- Intertidal Mudflat
- Seagrass (Zostera) Bed

Intertidal Lifeforms (CCW, 2010)

- Algal turf
- Biogenic sand reefs
- Fucoids
- Lichens & algae
- Mud
- Muddy sandy shore
- Mussels & Barnacles
- Saltmarsh
- Sand
- Sea grass beds
- Shingle, coarse sand, mixed sediments

Composite EUNIS Habitats (MESH, Dec 2013)

- A1.1 - High energy littoral rock
- A1.2 - Moderate energy littoral rock
- A1.3 - Low energy littoral rock
- A1.4 - Features of littoral rock
- A2.1 - Littoral coarse sediment
- A2.2 - Littoral sand and muddy sand
- A2.3 - Littoral mud
- A2.4 - Littoral mixed sediments
- A2.5 - Coastal saltmarshes and saline reedbeds
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A2.7 - Littoral biogenic reefs
- A2.8 - Features of littoral sediment
- A5.1 - Sublittoral coarse sediment
- A5.2 - Sublittoral sand
- A5.3 - Sublittoral mud
- A5.6 - Sublittoral biogenic reefs
- B3.1 - Supralittoral rock (lichen or splash zone)


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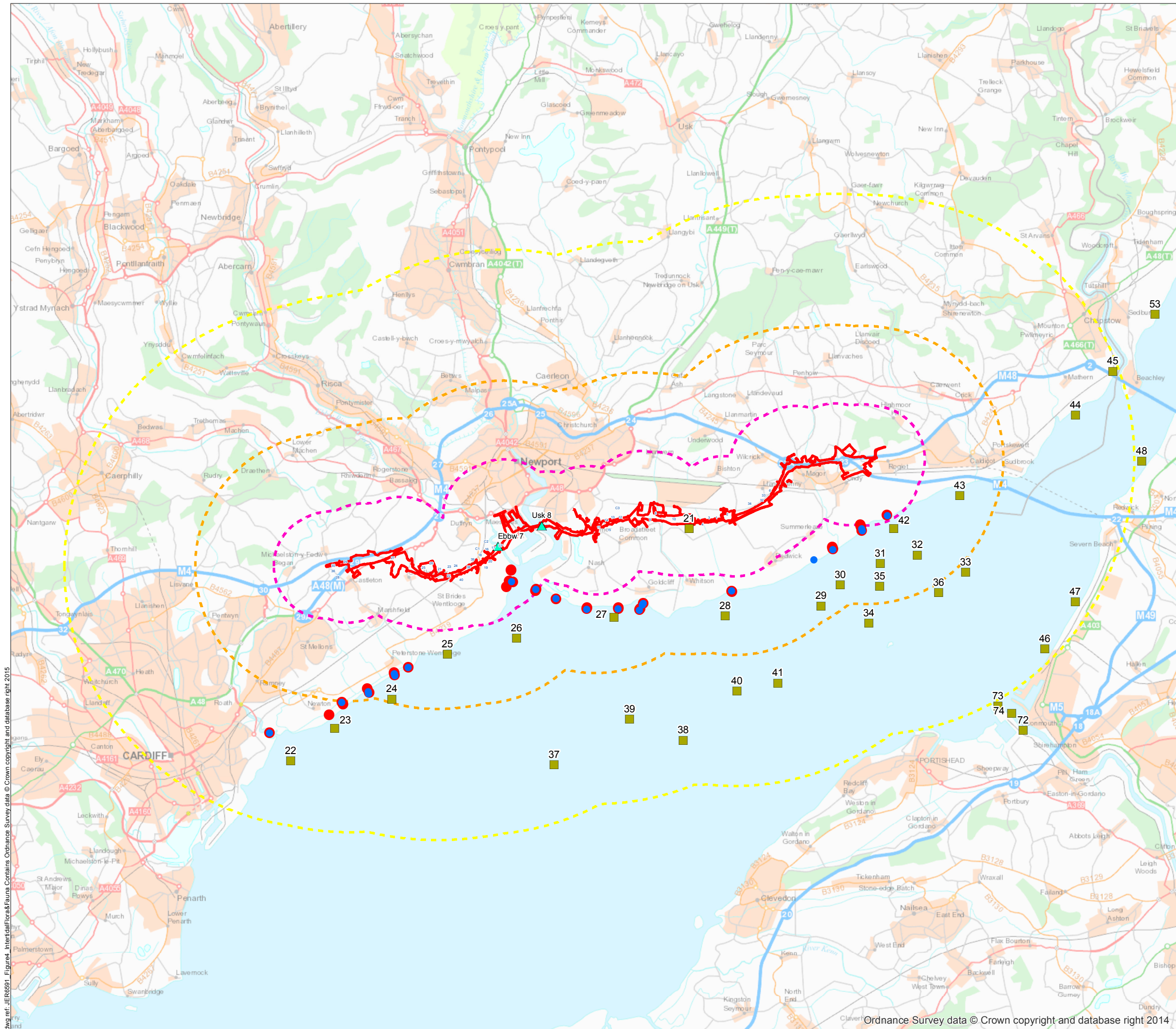
Appendix 10.18
Aquatic Baseline Environment

Intertidal Habitats

Figure: 3
Date: March 2016
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Scale: A3 @ 1:125,000 (Insets at 1:40,000)

Revision: -
Status: DRAFT
Checked: ACP

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dwg ref: JER6591_Figure3_IntertidalHabitats



- Legend**
- Limit of Permanent and Temporary Works for New Section of Motorway
 - 2km Buffer
 - 5km Buffer
 - 10km Buffer
 - Salicornia Sample Location (NRW, 2011)
 - Salicornia Sample Location (NRW, 2008)
 - Intertidal Mudflat Sample Location (EcoSpan, 2012)
 - NVC Saltmarsh Survey Location (Sturges Ecology, 2014)



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Appendix 10.18
Aquatic Baseline Environment

Intertidal Flora & Fauna

Figure: 4	Revision: -
Date: March 2016	Status: DRAFT
Drawn: RJJ	Checked: ACP

