Sanitary Survey - Review

Bigbury & Avon – 2023

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Initial Consultation

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Environment Agency	November 2022
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Consultation on draft report

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Devon and Severn Inshore Fisheries and Conservation Authority	March 2023
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A sanitary survey relevant to the bivalve mollusc beds in Bigbury & Avon was undertaken in 2014 in accordance with Regulation (EC) 854/2004 (which was replaced by retained EU Law Regulation (EU) 2017/625, with sanitary survey requirements now specified in retained EU Law Regulation (EU) 2019/627). This provided appropriate hygiene classification zoning and monitoring plan based on the best available information with detailed supporting evidence. In line with regulatory and EU guidance the Food Standards Agency undertake targeted sanitary survey reviews to ensure public health protection measures continue to be appropriate. This report provides a review of information and recommendations for a revised sampling plan if required. Carcinus Ltd. (Carcinus) undertook this work on behalf of the FSA. Carcinus Ltd accepts no liability for any costs, losses or liabilities arising from the reliance upon or use of the contents of this report other than by its client.

Dissemination

Food Standards Agency, South Hams District Council. The report is publicly available via the Carcinus Ltd. website.

Recommended Bibliographic Citation:

Carcinus Ltd., 2023. Review of the Bigbury & Avon 2014 Sanitary Survey. Carcinus report on behalf of the Food Standards Agency, to demonstrate compliance with the requirements for classification of bivalve mollusc production areas in England and Wales under retained EU Law Regulation (EU) 2019/627.

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1 Introduction

1.1 Background

The Food Standards Agency (FSA) is responsible for carrying out sanitary surveys in classified production and relay areas in accordance with Article 58 of retained (EU) Regulation 2019/627 and the EU Good Practice Guide (European Commission, 2021). In line with these requirements, sanitary surveys must be reviewed to ensure public health protection measures continue to be appropriate. Carcinus is contracted to undertake reviews on behalf of the FSA.

The report considers changes to bacterial contamination sources (primarily from faecal origin) and the associated loads of the faecal indicator organism *Escherichia coli* (*E. coli*) that may have taken place since the original sanitary survey was undertaken. It does not assess chemical contamination, or the risks associated with biotoxins. The assessment also determines the necessity and extent of a shoreline survey based on the outcome of the desktop report and identified risks. The desktop assessment is completed through analysis and interpretation of publicly available information, in addition to consultation with stakeholders.

1.2 Bigbury & Avon Review

This report reviews information and makes recommendations for a revised sampling plan for existing Mussel (*Mytilus* spp.) and Pacific oyster (*Crassostrea gigas*) classification zones in Bigbury & Avon (Figure 1.1). This review explores any changes to the main microbiological contamination sources that have taken place since the original sanitary survey was conducted and their impact on the classified shellfishery. Data for this review was gathered through a desk-based study and consultation with stakeholders.

An **initial consultation** with Local Authorities (LAs), Inshore Fisheries and Conservation Authorities (IFCAs) and the Environment Agency (EA) responsible for the production area was undertaken in November 2022. This supporting local intelligence is valuable to assist with the review and was incorporated in the assessment process.

Following production of a draft report, a wider **external second round of consultation** with responsible Local Enforcement Authorities (LEAs), Industry and other Local Action Group (LAG) members was undertaken in March 2023. It is recognised that dissemination and inclusion of a wider stakeholder group, including local industry, is essential to sense-check findings and strengthen available evidence. The draft report is reviewed taking into account the feedback received.

The review updates the assessment originally conducted in 2014 and sampling plan as necessary and the report should be read in conjunction with the previous survey.

Specifically, this review considers:
(a) Changes to the shellfishery (if any);
(b) Changes in microbiological monitoring results;

(c) Changes in sources of pollution impacting the production area or new evidence relating to the actual or potential impact of sources;

(d) Changes in land use of the area; and

(e) Change in environmental conditions.

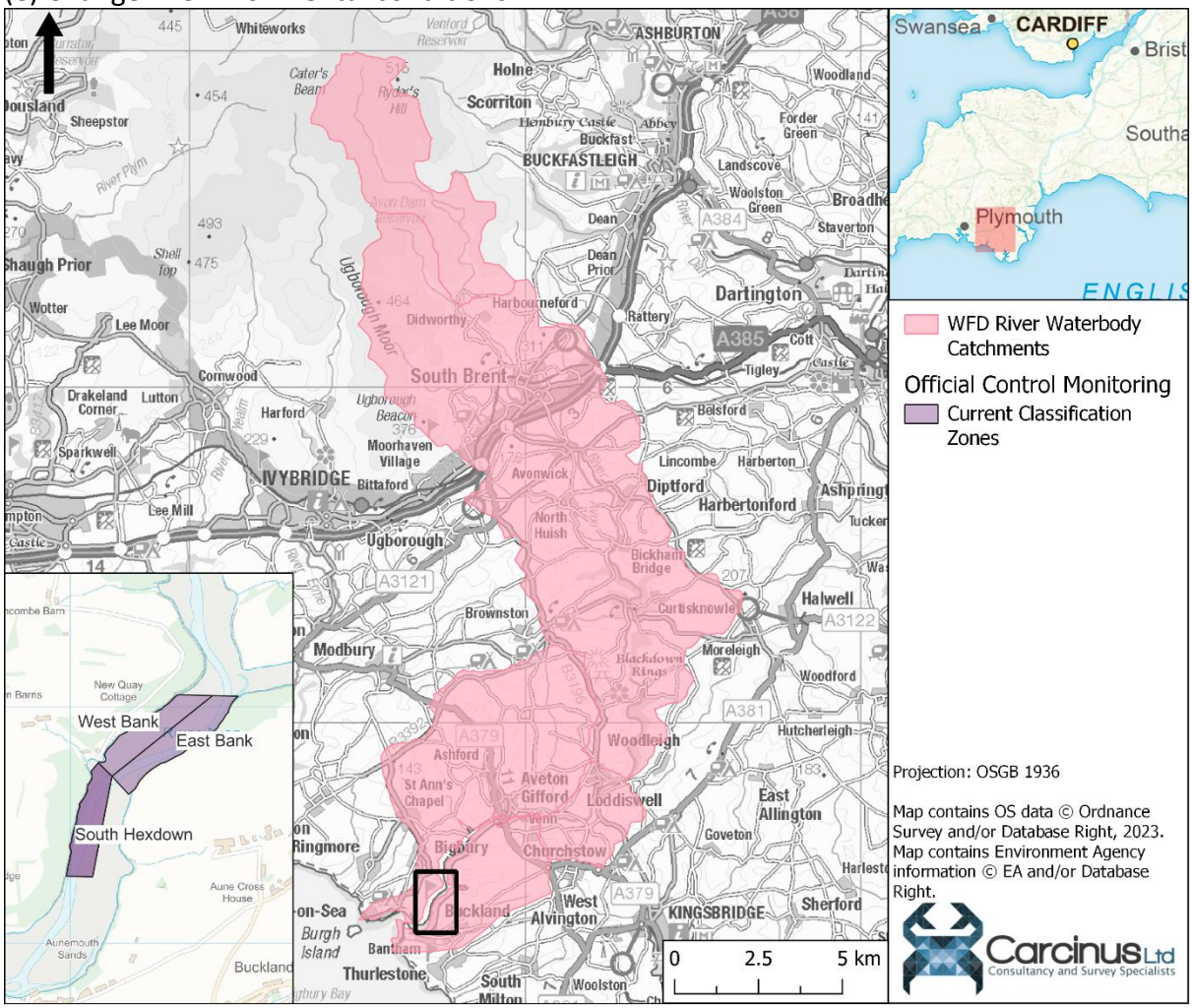

Figure 1.1 Location of the Bigbury and Avon BMPA in south Devon. Location of shellfish classification zones indicated by the black box.

Sections 2 - 6 detail the changes that have occurred to the shellfishery, environmental conditions and pollution sources within the catchment since the publication of the original sanitary survey. A summary of the changes is presented in section 7 and recommendations for an updated sampling plan are described in section 8.

1.3 Assumptions and limitations

This desktop assessment is subject to certain limitations and has been made based on several assumptions, namely:

- Accuracy of local intelligence provided by the Local Authorities and Environment Agency
- The findings of this report are based on information and data sources up to and including December 2022;

- Only information that may impact on the microbial contamination was considered for this review; and
- Official Control monitoring data have been obtained through a request to Cefas, with no additional verification undertaken. The data are also available directly from the Cefas data hub[1]. Results up to and including December 2022 have been used within this study. Any subsequent samples have not been included.

2 Shellfisheries

2.1 Description of Shellfishery

The Bigbury and Avon Bivalve Mollusc Production Area (BMPA) is situated within the Avon estuary, which runs on an approximately south-west / north-east axis in south Devon (Figure 1.1). The boundaries of the BMPA are defined as being the entirety of the estuary from the tidal limit at the Aveton Gifford weir. Shellfish production in this BMPA is located in one area, which extends downstream from the confluence of Stiddicombe Creek and the Avon Estuary, to approximately 500 m upstream of the village of Bantham.

The Local Enforcement Authority (LEA) responsible for this fishery in terms of food hygiene official control purposes (including sampling) is South Hams District Council.

A summary of the fishery for each species is summarised in the sections below.

2.1.1 Pacific oyster

During initial consultations, Devon and Severn Inshore Fisheries and Conservation Authority (D&S IFCA) indicated that the main focus of the fishery is cultured Pacific oyster, and that it is a private fishery leased by the FBO from the Duchy of Cornwall. As it is a private fishery, no byelaws apply to the harvest of this species in this area.

D&S IFCA also stated that typically there are three year-classes being grown at any one time, with approximately 600,000 shells in place each year, varying in size from seed oysters to harvestable shells. Approximately 15 tonnes of shellfish are harvested from this BMPA annually.

2.1.2 Mussels and other species

At the time of the original sanitary survey (2014), the only fishery in the area was for Pacific oysters. However, D&S IFCA indicated during initial consultation that the FBO operator is keen to invest more in shellfish culture in the area, including mussels and native oyster (*Ostrea edulis*).

In April 2022, an application to classify the *South Hexdown* Classification Zone (CZ) for mussel harvesting was submitted by the LEA and sampling of this species from the existing RMP location was started in the same month. This CZ has been officially classified since October 2022.

[1] Cefas shellfish bacteriological monitoring data hub. Available at: https://www.cefas.co.uk/data-and-publications/shellfish-classification-and-microbiological-monitoring/england-and-wales/.

There are currently no applications in place to harvest native oyster.

2.2 Classification History

The original sanitary survey recommended the creation of three classification zones for Pacific oysters, each representing three discrete blocks of trestles. For much of the period between the original sanitary survey and this review, two of these zones (*East Bank* and *West Bank*) were declassified. They have both been classified since 2019, and the other zone (*South Hexdown*) has been classified since 2016. As stated above, the *South Hexdown* mussel zone has been classified since October 2022. The location and classification status of all active CZs, along with all RMPs sampled in the area since 2010, are presented in Figure 2.1.

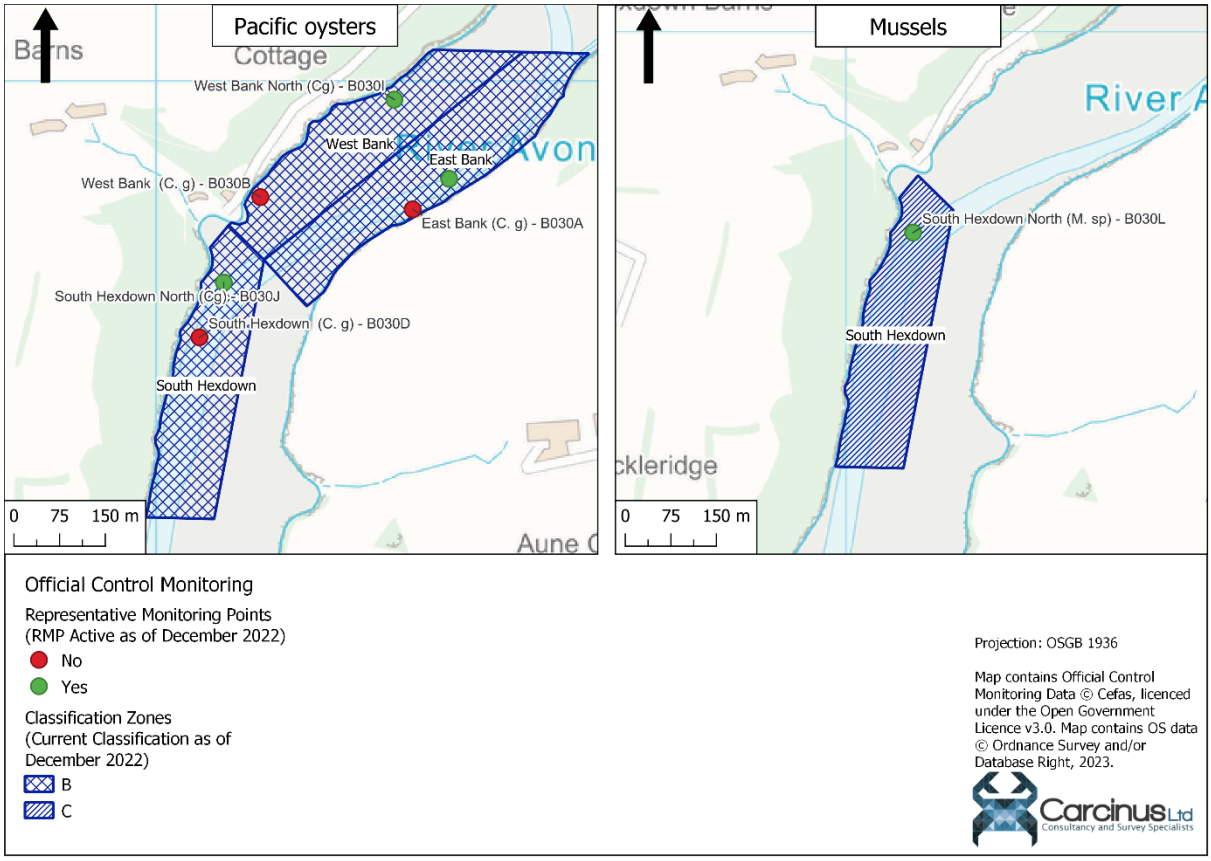

Figure 2.1 Current Classification Zones and associated Representative Monitoring Points in the Bigbury & Avon BMPA. See Figure 1.1 for the position of these zones within the wider catchment.

3 Pollution sources

3.1 Human Population

The 2014 sanitary survey cites population data for the catchment using the 2011 Census. A subsequent Census was conducted in March 2021, and so the results of these two surveys have been used to give an indication of population trends across the catchment in the last 10 years. Changes in human population density within Census Super Output Areas (lower

layer) wholly or partially contained within the Bigbury & Avon catchment at the 2011 and 2021 Censuses are presented in Figure 3.1.

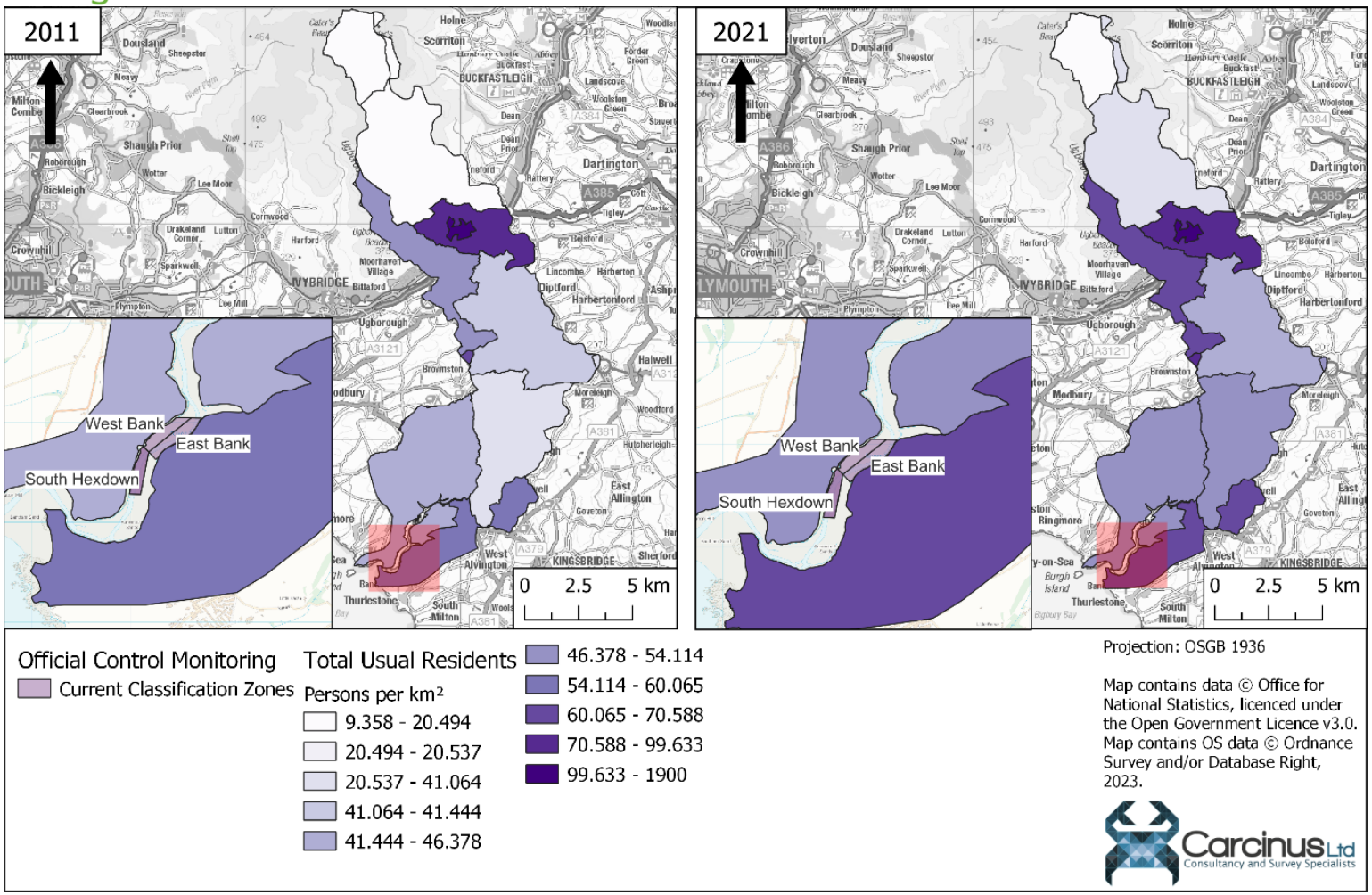

Figure 3.1 Human population density in census Super Output Areas (lower layer) wholly or partially contained in the Bigbury & Avon catchment at the 2011 and 2021 Censuses.

The maps presented in Figure 3.1 indicate that whilst population density across the catchment has increased fairly uniformly, much of the area remains very rural, with population densities of <70 people per km². The main urban centres of the catchment are the village of South Brent in the upper catchment, as well as the hamlets of Bantham, West Buckland, East Buckland and North Upton on the southern side of the estuary. At the 2011 Census, the population in the catchment was approximately 19,926 people. By the 2021 Census, this had increased to an estimated 22,073 people, an increase of approximately 10%. The greatest potential for urban runoff comes from the hamlet of Bantham, as this is the only settlement immediately adjacent to the shoreline. However, the overall risk of this source of contamination remains low in comparison to other sources due to the relatively low population numbers.

A search for 'new dwelling' of planning applications to South Hams District Council between 2015 and 2022 returned 126 results, suggesting that there has been some increase in housing, either a driver of, or as a result of, the population increase mentioned in the previous paragraph. Any increase in population would place additional loading on the Wastewater Treatment Network, changes to which are discussed in the next section. During secondary consultations, the EA informed the authors of this review that developers must have confirmation from the Water Company that additional flows can be accommodated as part of the planning process.

The original sanitary survey states that the Local Authority district that the catchment falls in (South Hams) receives a significant volume of tourism. The county of Devon received over 24 million visitor nights in 2019 (Devon County Council, 2021). As concluded in the original sanitary surveys, the highest numbers of visitors will come during summer months, and the associated loading to the wastewater treatment network will therefore also occur during these periods. No evidence has come to light during this study to indicate that the existing capacity is not sufficient to handle the increase.

Analysis of the 2021 Census suggests that there are currently approximately 22,000 people residing in the Bigbury & Avon catchment, an increase of 10% since 2011. The main population centres of the catchment have not changed, although population density has generally increased across the catchment. It is also likely that the volume of tourists the area receives has increased since the publications of the original sanitary surveys, although there is no evidence that the existing wastewater treatment network does not have sufficient capacity to accommodate this increase. Overall, the recommendations made in the original sanitary survey to account for the impact of human populations remain valid.

3.2 Sewage

Details of all consented discharges in the vicinity of the Bigbury & Avon BMPA catchment were taken from the most recent update to the Environment Agency's national permit database at the time of writing (October 2022). The locations of these discharges within the BMPA and near the Classification Zones are shown in Figure 3.2.

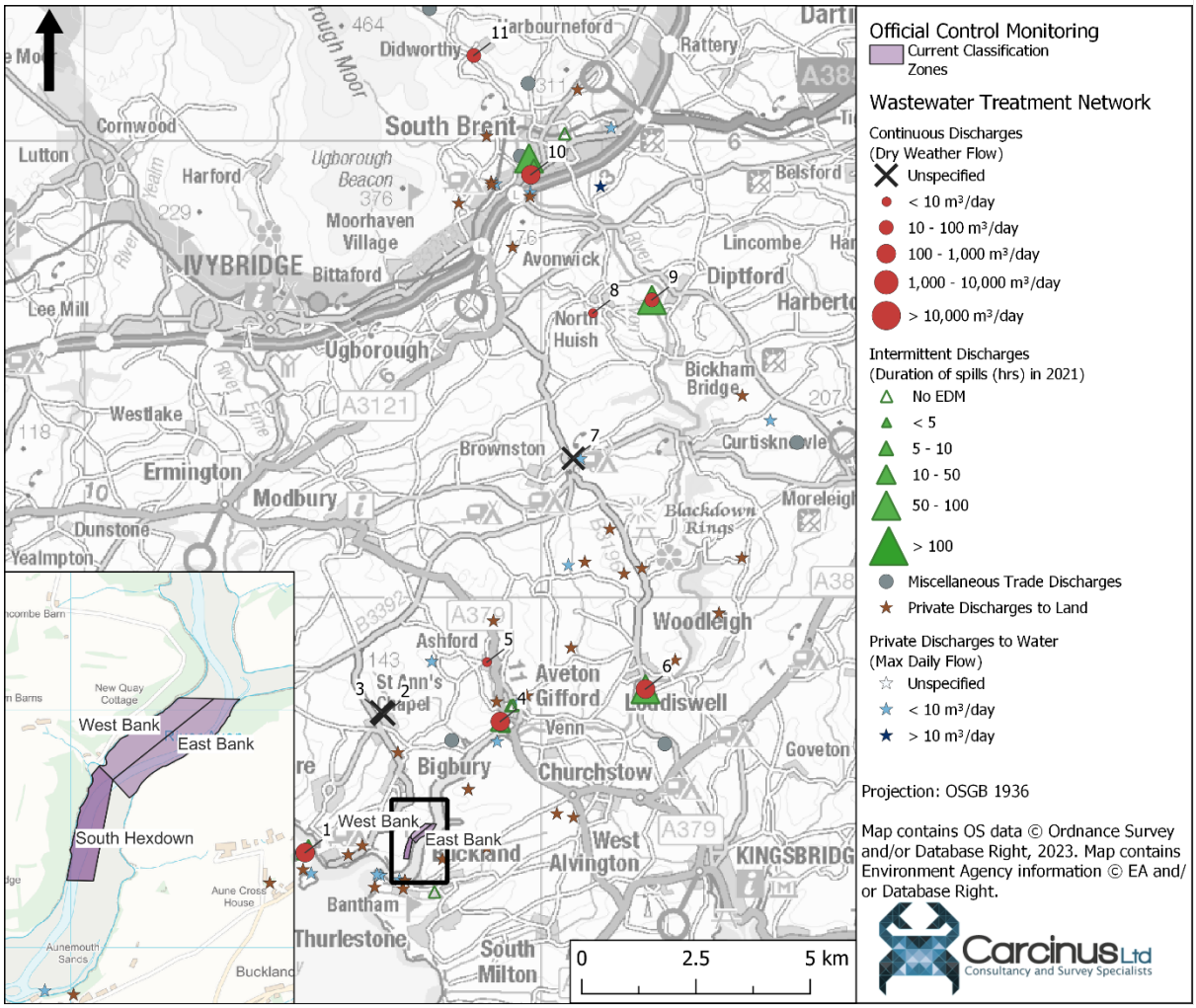

Figure 3.2 Locations of all consented discharges in the vicinity of the Bigbury and Avon BMPA. Labels refer to continuous discharges, details of which are provided in Table 3.1.

Table 3.1 Details of all continuous discharges in the Bigbury and Avon BMPA catchment. Discharges are ordered by distance from the nearest CZ to that outfall.

ID	Discharge Name	Permit Number	NGR	Treatment	Dry Weather Flow (m^3/day)	Distance to nearest CZ (km)
1	BIGBURY & CHALLABOROUGH STW	200261/FN/01	SX6483044420	BIOLOGICAL FILTRATION	470	2.15
2	ST ANN'S CHAPEL STW	SWWA 383	SX6655047450	Unspecified	Unspecified	2.56
3	ST ANNES CHAPEL STW	NRA-SW-7692	SX6650047500	SEPTIC TANK	Unspecified	2.63

ID	Discharge Name	Permit Number	NGR	Treatment	Dry Weather Flow (m^3/day)	Distance to nearest CZ (km)
4	AVETON GIFFORD STW	201967	SX6910047290	UV DISINFECTION	306	2.64
5	ASHFORD FARM STW	203732	SX6881048590	BIOLOGICAL FILTRATION	4.9	3.71
6	LODDISWELL WWTW	DRA 1349	SX7228048000	BIOLOGICAL FILTRATION	197	5.44
7	CALIFORNIA CROSS STW	SWWA 456	SX7070053050	Unspecified	Unspecified	8.54
8	NORTH HUISH STW	204035	SX7113056230	SEPTIC TANK	4	11.7
9	DIPTFORD SEWAGE TREATMENT WORKS	200400	SX7242056520	BIOLOGICAL FILTRATION	44	12.4
10	SOUTH BRENT WWTW	DRA 1062	SX6977059260	BIOLOGICAL FILTRATION	509	14.36
11	DIDWORTHY STW	201414	SX6852061870	BIOLOGICAL FILTRATION	13	16.84

The original sanitary survey identified that there were 13 water company continuous discharges of potential relevance to the catchment. Two of these were located slightly outside the catchment considered this report, are more than 10 km from the BMPA and have a small consented discharge volume (< 40 m^3/day). As such they are not considered further within this report. The original survey identified that the most significant discharge was likely to be the Aveton Gifford STW (ID 4 in Table 3.1), given its location upstream of the CZs, within the estuarine waters of the Avon. The remaining discharges were situated either just outside the Avon (Bigbury & Challaborough STW), or in the upper catchment, discharging to watercourses feeding into upper reaches of the estuary. The Shellfish Water Action Plan for the Bigbury & Avon shellfish water, published by the Environment Agency, provides details of upgrades to continuous water company outfalls. No improvements to treatment methodologies occurred in Asset Management Plan (AMP) 6 (2015 – 2020), and none are planned for AMP7. The improvements that have occurred relate to storm tank storage capacity and are discussed in subsequent paragraphs. During secondary consultation, the EA confirmed that there had been no evidence of non-compliance at any water company owned discharges since the 2014 sanitary survey was published.

In addition to the continuous discharges, the original sanitary survey identified a series of intermittent outfalls associated with the continuous discharges. Intermittent discharges comprise Combined Storm Overflows (CSOs), Storm Tank Overflows (STOs) and Pumping

Station Emergency Overflows (PSs). During AMP6 and AMP7, Event Duration Monitoring (EDM) was installed at several of the discharges within the catchment. Summary data for 2020 and 2021 was published by the Environment Agency in March 2021 and in March 2022, respectively (Environment Agency, 2022). Details of the EDM data from 2021 for those discharges in the Avon catchment are presented in Appendix I.

Three of the 15 intermittent discharges identified in the 2014 Sanitary Survey had EDM capability fitted, and that report provided spill data for the period 2007 – 2012. In 2012, Aveton Gifford STW CSO spilled 18 times and Jubiliee Street CSO 9 times. In 2020 and 2021, Aveton Gifford STW CSO spilled 16 and 7 times respectively. No EDM is available from the Aveton Gifford PSCSO/EO or Jubilee Street from 2021 (Jubilee Street is listed as being no longer active), but in 2020 no spills were recorded at Aveton Gifford PSCSO/EO and Jubilee Street CSO spilled on only 4 occasions.. The Shellfish Water Action Plan for Bigbury and Avon states that the following upgrades to the intermittent discharge network took place between 2015 and 2022:

- South Brent STW CSO was designed and constructed; and
- Loddiswell STW SSO had permanent EDM and Telemetry installed, with capacity to be improved by 2025.

The only intermittent discharges likely to have any impact on the bacteriological health of the BMPA continue to be those around Aveton Gifford, as these discharge to within the tidal excursion of the estuary. There are some intermittent discharges in the upper catchment which spill more frequently than those in Aveton Gifford, but they are located more than 5 km from the nearest CZ.

In addition to water company owned discharges, privately owned discharges require consideration in any assessment of contamination sources affecting a fishery. Many such discharges remain although as concluded in the original sanitary survey, they are unlikely to have a significant impact on the bacteriological health of the shellfishery, as their consented discharge volumes are small (less than 10 m^3/day). During secondary consultations, the EA confirmed that there were no recorded non-compliances at privately owned discharges in this catchment since the 2014 sanitary survey was published.

The water company infrastructure in the area continues to be relatively sparse, reflecting the low population size of the catchment. There are no discharges within the boundaries of the CZs themselves, and the only discharges likely to be of any significance are those in Aveton Gifford, although usage of UV disinfection on the final effluent from the water company outfall means that the impact will be minimal. There is likely to be a trend of increasing contamination levels as you move farther up-estuary and closer to Aveton Gifford, although this has not changed since the original sanitary survey was published. As such, the recommendations given in that document to account for this source of pollution remain valid.

3.3 Agricultural Sources

The 2014 Sanitary Survey cites population data for the Avon catchment based on the 2010 Livestock Census. To allow subsequent comparison, a data request was made to the Farming Statistics Office of the Department for Environment, Food and Rural Affairs (DEFRA) for livestock populations within the catchment presented in *Figure 1.1* for 2013 and 2021, the next two census years. Figure 3.3 and Table 3.2 present the changes in livestock populations within the Bigbury and Avon catchment between 2013 and 2021 based on the June Survey of Agriculture and Horticulture[2].

[2] June Survey of Agriculture and Horticulture. Further information available at: https://www.gov.uk/guidance/structure-of-the-agricultural-industry-survey-notes-and-guidance#june-survey-of-agriculture-and-horticulture-in-england.

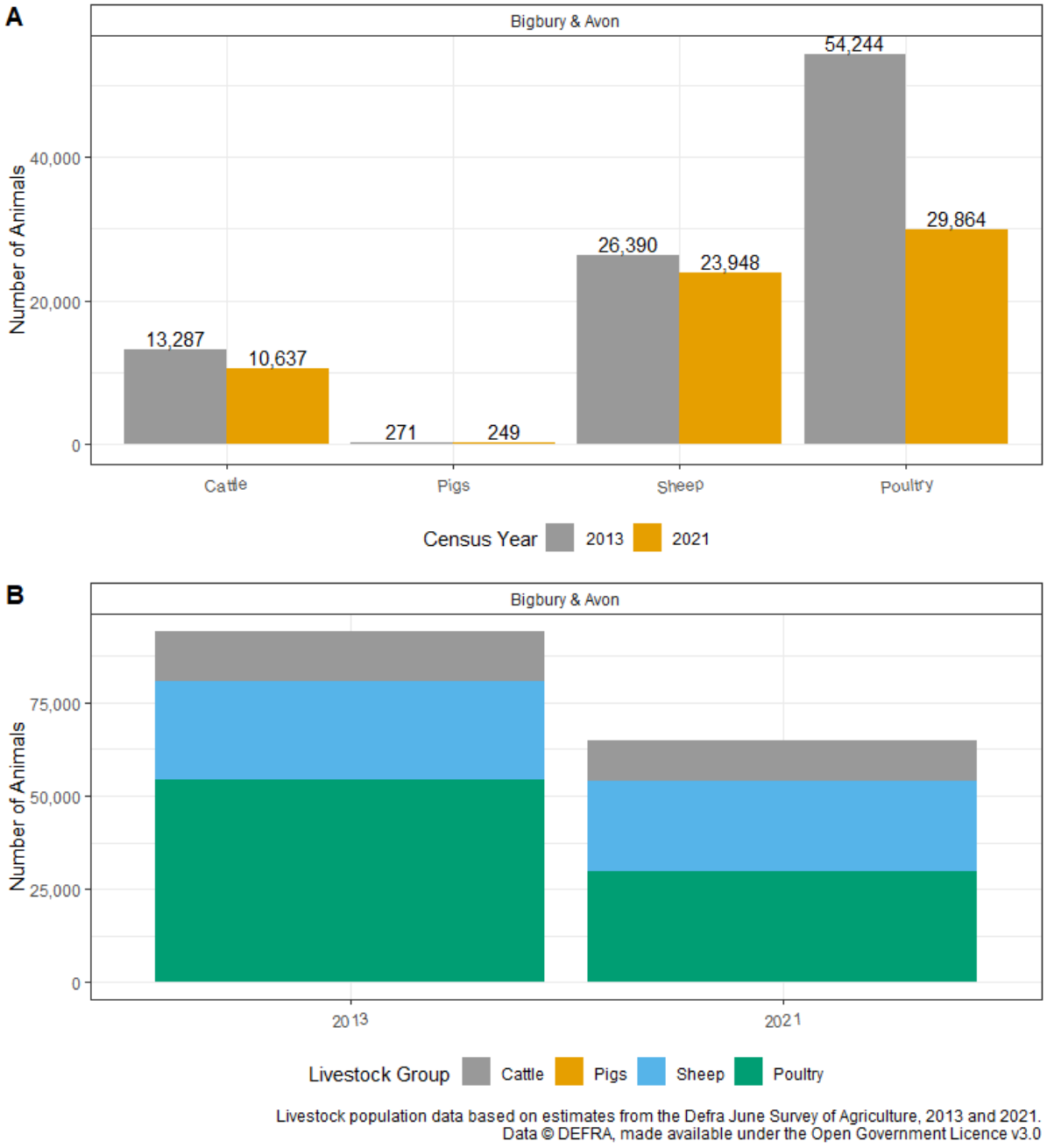

Figure 3.3 Changes in livestock populations within the Avon catchment. Panel A shows populations broken down by different livestock groups, and panel B shows the aggregated population.

Table 3.2 Summary of changes to livestock populations living within the Avon catchment.

	Livestock Population	
Livestock Group	**2013 Census**	**2021 Census**
Cattle	13,287	10,637
Pigs	271	249
Sheep	26,390	23,948
Poultry	54,244	29,864

	Livestock Population	
Livestock Group	**2013 Census**	**2021 Census**
Total	**94,192**	**64,698**

The data presented above show that livestock populations in all groups have fallen between 2013 and 2021, but that the dominant groups in terms of population size continue to be poultry and sheep. It should be noted that the animal numbers from the 2013 and 2021 census represent a snapshot of livestock populations in a single day, but populations will vary throughout the year. Highest numbers of animals will occur in spring, following the birthing season, and the lowest in autumn and winter when animals are sent to market.

The principal route of contamination of coastal waters by livestock is surface runoff carrying faecal matter. The change in land cover in the Avon catchment between 2012 and 2018 is shown in Figure 3.4. This figure shows that a significant proportion of the catchment is rural, either reserved for pasture or other agricultural purposes. Furthermore, all the land on the south side of the estuary adjacent to the classification zones is farmland. The land on the north side of the estuary is the Bigbury Golf Club, which is not expected to contribute any contamination to the shellfishery. Pasture areas adjacent to shorelines represent the greatest contamination risk to the classification zones. This is due to run-off from the land travelling less distance before reaching the CZs, resulting in less dilution and less *E. coli* die off. Run-off from rivers further up the catchment will have a lower risk of contamination to the CZs, because the increased distance will result in further dilution and die-off of the *E. coli* contained in the faecal matter. The Shellfish Action Plan for Bigbury and Avon notes that diffuse agricultural runoff is responsible for a large share of the *E. coli* loading within the catchment, and that there is the potential for a 40% reduction in this source of pollution through a combination of advice, regulation and incentive over the next 40 years. The Catchment Sensitive Farming (CSF) initiative is a project run by Natural England and the EA that aims to reduce agricultural runoff. The Action Plan notes that work around Stiddicombe Creek headwaters is already underway to stop cattle defecating in the watercourse. Furthermore, the Action Plan notes that of the 712 farms in the catchment, 34 are engaged with CSF, 112 with Countryside Stewardship and 135 farms have received CS or CSF advice, with 187 CSF measures put in place and 210 CS and CSF Faecal Indicator Organism (FIO) grants.

Another potential route of contamination from livestock-associated factors is slurry spreading. The spreading of slurry to fields is controlled under the Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018, known as the Farming Rules for Water, which came into force in April 2018. Furthermore, silage and slurry storage for agricultural purposes is subject to The Water Resources (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 (SSAFO). All farmers must comply with the SSAFO regulations when building new slurry stores, or substantially altering (e.g. enlarging) existing ones. All stores must be built at least 10m from any watercourse, including field drains or ditches, and be built or altered to last for at least 20 years with proper maintenance. Since

2021, the EA now has ART (Agricultural Regulatory Taskforce) Officers that have all been assigned a catchment and will engage, inspect, advise and if necessary, enforce the Silage, Slurry and Agricultural Fuel Oil regulations and the new (2018) Farming Rules for Water. In theory, these legislative changes should have reduced the pollution that this activity causes to shellfish beds. The Shellfish Water Action Plan for this area did not indicate that there were any problems associated with slurry use in this catchment.

Livestock populations fell by 30% between 2013 and 2021, although populations are still fairly high for the size of the catchment (at an average density of 100 animals per km^2). Land cover maps suggest that the areas of pasture have remained broadly similar in size, and that all the CZs within the Fishery Order area are backed by agricultural land. The overall risk of this source of contamination is assessed to have reduced slightly due to the works undertaken by the EA and farmers in the area, although diffuse agricultural runoff is still a potentially significant source of pollution and should be taken into consideration in any updated sampling plan.

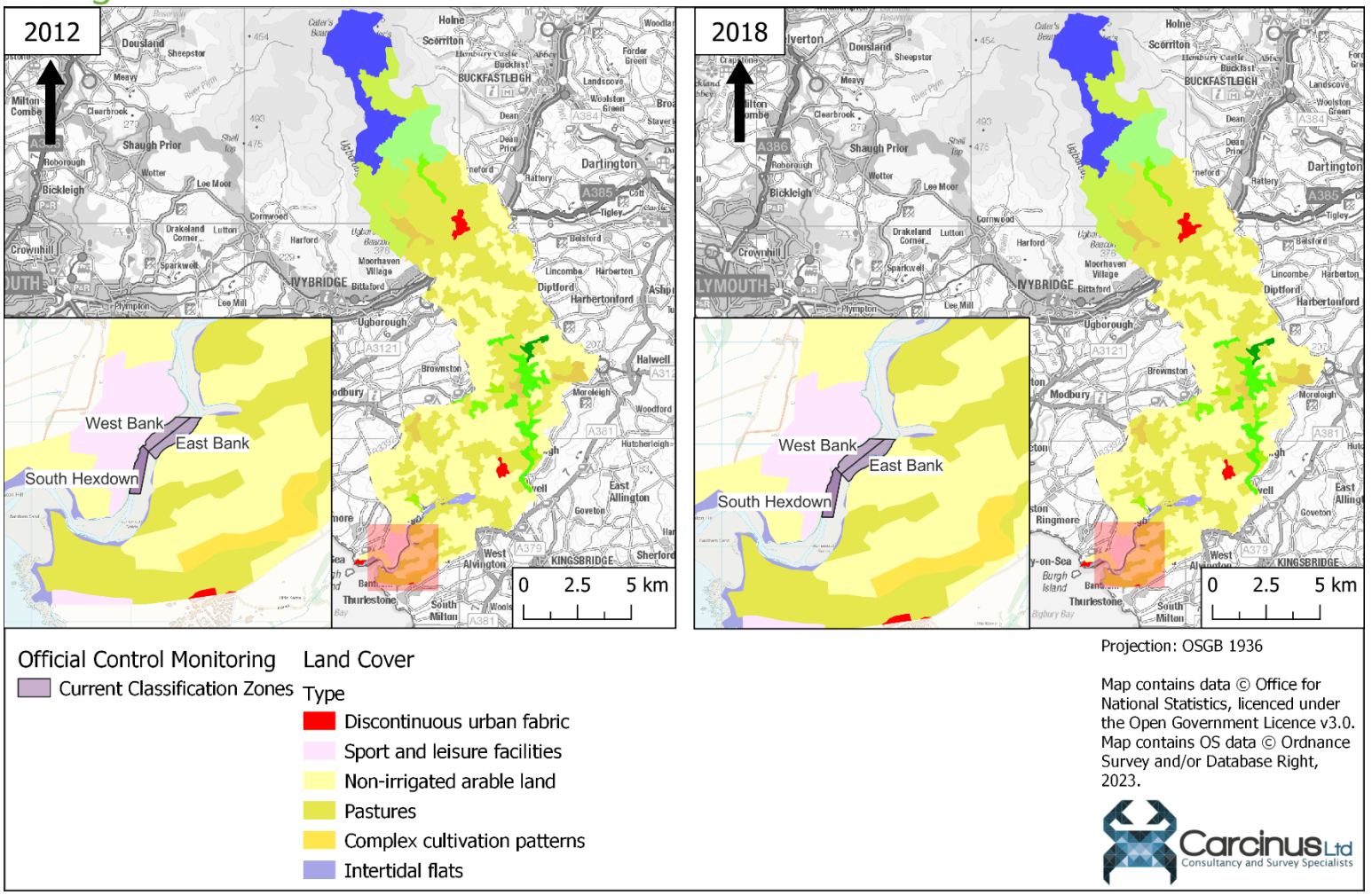

Figure 3.4 Land cover change between 2012 and 2018 within the Avon catchment. Note – items in the figure legend are those contained in the inset-maps.

3.4 Wildlife

The Avon estuary complex contains a variety of habitats that support a significant diversity of wildlife species, and was designated as a Marine Conservation Zone (MCZ) in 2019 (DEFRA, 2019) . The original sanitary survey identifies that the most significant wildlife aggregation in terms of its impact on shellfish hygiene was overwintering waterbirds (waders and wildfowl). This group are of potentially significant importance given that the frequently forage (and defecate) directly on intertidal shellfish beds.

In the five winters to 2013/14, an average total count of 2,222 waterbirds (including non-native species, supplementary counts[3], gulls andterns) were recorded in the Avon estuary (Holt *et al.*, 2015). In the five winters to 2019/20 (the most recent year for which data is available), the average count was 2,226 (an increase of 0.18%). The estuary also contains a nationally significant population of Greenshank. Compared to other estuaries in south Devon, this still represents a relatively small population of overwintering wading birds, and so whilst there may be a small amount of contamination, it is not considered to be a significant source within this shellfishery. Furthermore, as the contamination from this source is spatially and temporally very variable, it is difficult to define RMP locations to capture this.

The 2021 Special Committee on Seals (SCOS) report (SCOS, 2022) identifies that there is a small breeding colony of grey seals near Salcombe, approximately 10 km southeast of the BMPA, and that within southwest England, the population is expanding. It is therefore reasonable to assume that grey seals will forage within the Avon estuary from time to time, although any contamination is likely minimal and does not require additional consideration in any updated sampling plan.

No other wildlife populations of significance are noted.

3.5 Boats and Marinas

The discharge of sewage from boats is a potentially significant source of pollution to the Bigbury & Avon BMPA. Boating activities in the area have been derived through analysis of satellite imagery and various internet sources, and compared to that described in the original sanitary surveys. Their geographical positions are presented in Figure 3.5.

The original sanitary survey describes that there are no commercial ports, harbours or marinas within the Avon estuary, and that boating activities are restricted to usage of moorings and anchorages. This situation remains, meaning that contamination likely continues to be minor. There does remain a small passenger ferry that operates between Bantham and Cockleridge Ham in the summer months, but there are no toilets on board and so no contamination expected. Vessels of a sufficient size to contain on board toilets may still make overboard discharges from time to time, particularly when moving through the

[3] Supplementary counts are from the Goose and Swan Monitoring Programme (GSMP). Available at: https://www.bto.org/our-science/projects/goose-and-swan-monitoring-programme.

main navigational channels or anchored/moored overnight. The greatest risk of this source of contamination will occur in summer months when vessel numbers are highest. It is difficult to define exactly when overboard discharges will be made, and so it is challenging to account for this source of pollution in any updated sampling plan.

There are no fishing vessels that operate out of this estuary. No impacts from merchant shipping are expected.

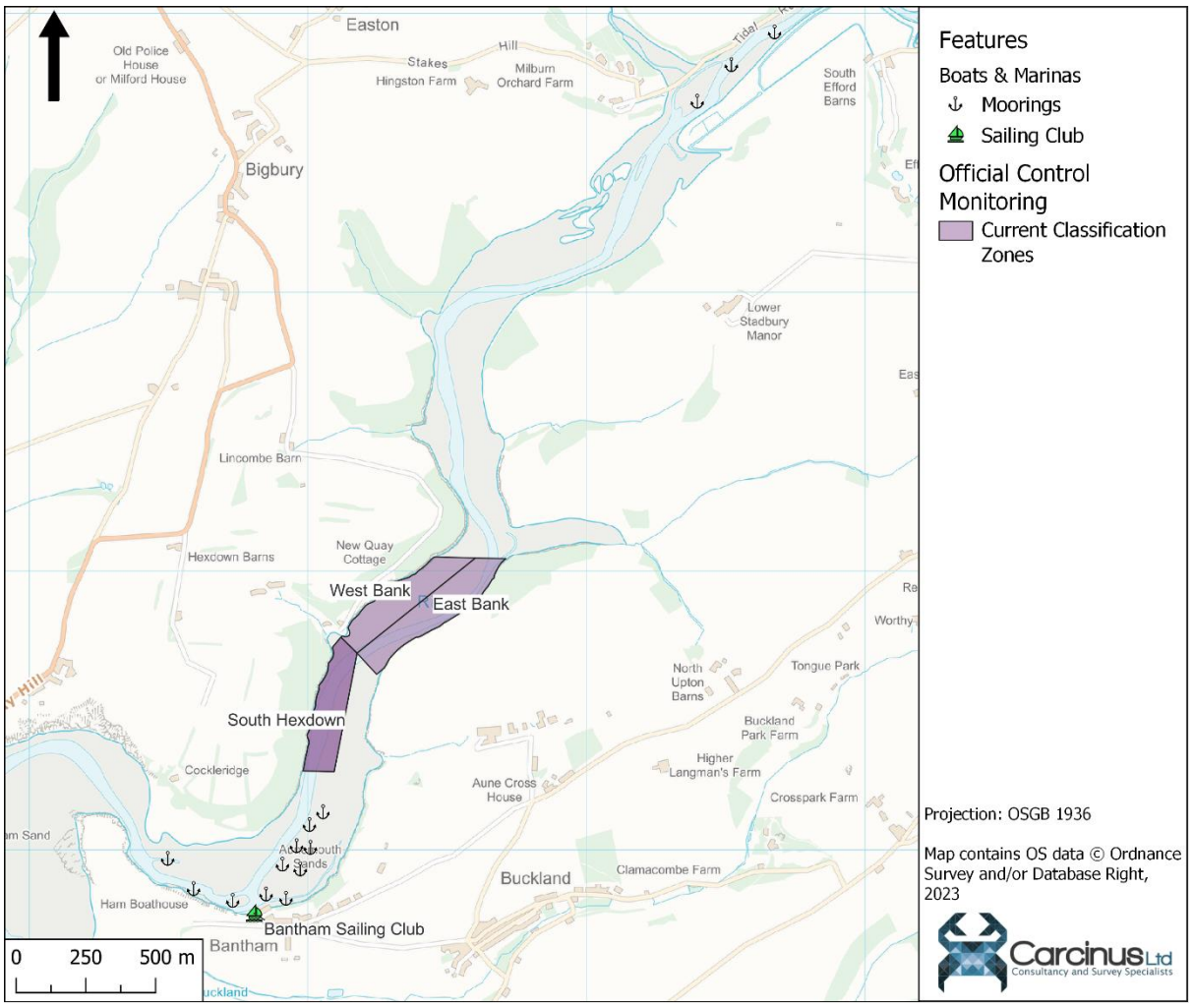

Figure 3.5 Locations of moorings, marinas and other boating activities in the vicinity of the Bigbury & Avon BMPA.

3.6 Other Sources of Contamination

Utility misconnections are when foul water pipes are wrongly connected and enter surface waters without treatment, potentially putting raw sewage directly into watercourses via surface water drains. Areas at greatest risk of this source of contamination are areas of urban fabric, although the Shellfish Action Plan for this Shellfish Water notes that there is no evidence of utility misconnections within the Avon catchment.

Limited impact from dog fouling is expected as much of the shoreline is relatively inaccessible to pedestrians, with steep, wooded banks starting from the shoreline.

4 Hydrodynamics/Water Circulation

The dominant pattern of water movement is likely to be tidal circulation, with contamination carried downstream on an ebbing tide and upstream on a flooding tide. Interrogation of freely available nautical charts of the area[4] indicates that much of the Classified Area within the Avon Estuary dries at low tide. This means that bivalves growing in these areas will not be exposed to contamination carried down the main river channel at low water, but any contaminated land-runoff will not be dispersed and diluted if it occurs directly onto shellfish beds.

No significant changes to the hydrodynamics of the area have occurred since the publication of the original sanitary survey, and as such the recommendations made in that report to account for the hydrodynamics of the area remain valid.

5 Rainfall

Rainfall data for the Davey Park Farm rain gauge (RG) (ID: 365790) were requested from the Environment Agency for the period 2000 – Present. This station was chosen as it is geographically the closest monitoring station to the BMPA, located 4.6 km southeast of the CZs. As monitoring at this station only began in 2009, these data were subdivided into 2009 – 2013 (pre sanitary survey) and 2012 – 2022 (post sanitary survey) and processed in R (R Core Team, 2021). This data was used to determine whether any changes in rainfall patterns had occurred since the original sanitary survey was published. The rainfall data is summarised in Table 5.1, and the average daily rainfall totals per month are shown in Figure 5.1.

Table 5.1 Summary statistics for rainfall for the period preceding and following the original sanitary survey from the Davey Park Farm RG monitoring station.

Period	Mean Annual Rainfall (mm)	Percentage Dry Days	Percentage Days Exceeding 10 mm	Percentage Days Exceeding 20 mm
2009 - 2013	954.4	42.922	29.049	17.497
2014 - 2022	1076.089	39.31	31.701	19.655

[4] Navionics Chart Viewer. Available at: https://webapp.navionics.com/?lang=en#boating@6&key=_~jxHbdyC

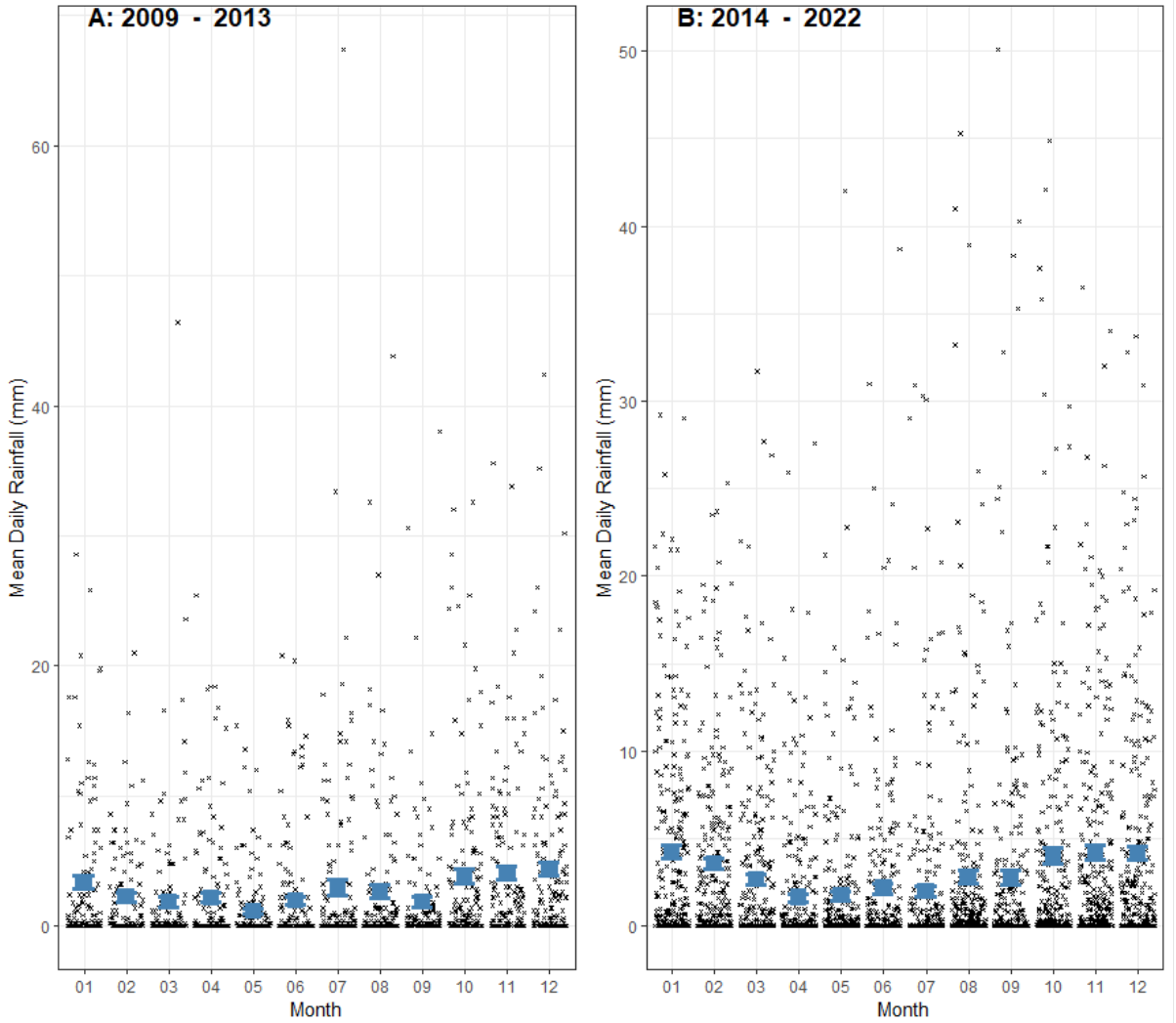

Figure 5.1 Mean daily rainfall per month at the Davey Park Farm RG monitoring station (NGR: SX 70940 41980) for the periods (A) 2009 - 2013 and (B) 2014 - 2022.

The rainfall data show that the annual rainfall levels in the catchment have increased, with the percentage of dry days falling and the percentage of days with heavy (>10 mm) rainfall increasing. Two sample t-tests indicated that there was no significant difference ($p > 0.05$) in the mean daily rainfall per month for the 2009 – 2013 and 2014 – 2022 periods.

Rainfall leads to increased faecal loading through two factors; elevated levels of surface runoff and increased spill events from intermittent discharges, particularly during periods of heavy rain. Rainfall levels during both periods were greatest in winter months (November – February), and so levels of runoff etc. would be expected to be greatest during this time. However, as the rainfall patterns have remained (statistically) similar across the two time periods, significantly altered bacterial loading due to these factors is unlikely and as such RMP recommendations made in the original sanitary survey to capture the influence of runoff and spill events remain valid.

6 Microbial Monitoring Results

6.1 Summary Statistics and geographical variation

The mean results of Official Control monitoring for *E. coli* concentrations at RMPs sampled in the Bigbury & Avon BMPA since 2010 are presented spatially in Figure 6.1 and summary statistics are provided in Table 6.1. This data was obtained through a request to Cefas, but it is freely available on the datahub[1].

A total of seven RMPs have been sampled within this BMPA since 2010, six involving the collection of Pacific oyster samples and one the collection of mussel samples. Sampling at the RMP locations recommended in the original sanitary survey, did not start until 2016 for South Hexdown North B030J and 2018 for West Bank North (B030I) and East Bank North (B030K). Sampling at the previous RMPs B030A, B030B and B030D ceased in July 2014. Sampling at the South Hexdown North mussel RMP (B030L) started in April 2022, as discussed in Section 2.1.2.

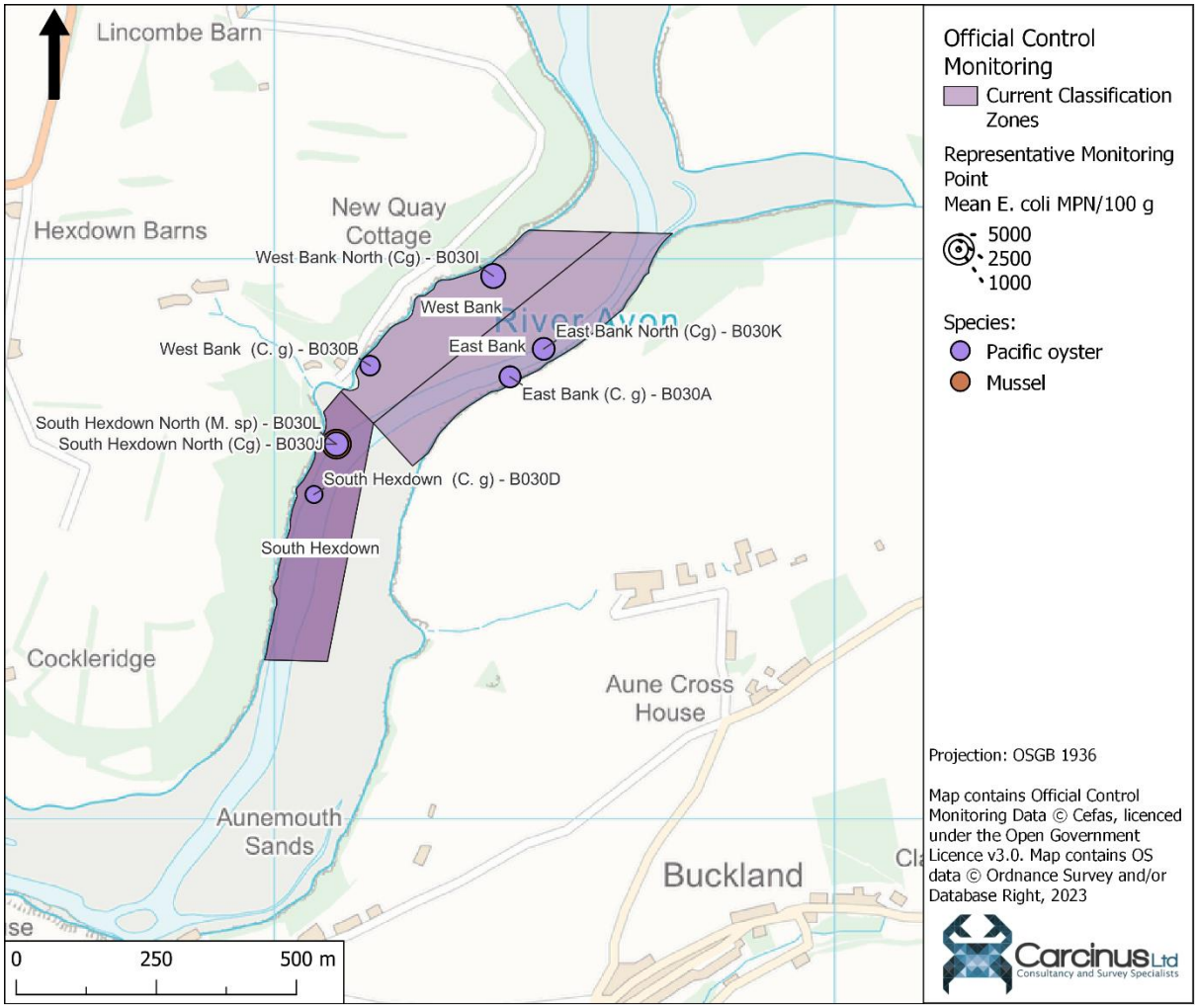

Figure 6.1 Mean E. coli *results from Official Control monitoring at bivalve RMPs in the Bigbury & Avon BMPA.*

Table 6.1 Summary statistics of Official Control Monitoring conducted at RMPs in the Bigbury and Avon BMPA since 2010.

RMP (Species)	NGR	Species	No.	First Sample	Last Sample	Mean	Min Value	Max Value	% > 230	% > 4,600	% > 46,000
East Bank (C. g) - B030A	SX67424479	Pacific oyster	49	12/01/2010	15/07/2014	2861.633	170	16000	87.7551	28.57143	0
East Bank North (Cg) - B030K	SX67484484	Pacific oyster	48	29/08/2018	07/12/2022	3030.583	78	17000	91.66667	22.91667	0
South Hexdown (C. g) - B030D	SX67074458	Pacific oyster	51	12/01/2010	15/07/2014	2145.882	20	16000	84.31373	11.76471	0
South Hexdown North (Cg) - B030J	SX67114467	Pacific oyster	75	06/07/2016	07/12/2022	3429.333	130	35000	94.66667	22.66667	0
South Hexdown North (M. sp) - B030L	SX67114467	Mussel	14	04/04/2022	07/12/2022	4670.714	690	13000	100	35.71429	0
West Bank (C. g) - B030B	SX67174481	Pacific oyster	52	12/01/2010	15/07/2014	2607.115	170	18000	92.30769	19.23077	0
West Bank North (Cg) - B030I	SX67394497	Pacific oyster	51	29/08/2018	07/12/2022	3509.765	78	24000	90.19608	15.68627	0

All RMPs in this BMPA have returned more than 85% of results above the Class A threshold of 230 *E. coli* MPN/100 g. Furthermore, more than 10% of results at all RMPs have exceeded 4,600 *E. coli* MPN/100 g, although no RMP has returned a result above 46,000 *E. coli* MPN/100 g. There is only one instance of RMPs being co-located for both species, and in this instance (at South Hexdown), the Mussel RMP has returned on average higher results (although to date only 14 samples have been collected, restricting the comparisons that can be drawn. The RMPs recommended in the original sanitary survey are further upstream than the previous positions to reflect the probable pollution gradient in the estuary. This pattern appears to be supported in the data, as those RMPs further upstream have returned on average higher monitoring results (although there is no-temporal overlap so again the comparisons that can be drawn are limited to a degree).

Figure 6.2 and Figure 6.3 present boxplots of *E. coli* monitoring at mussel and Pacific oyster RMPs in the BMPA respectively. One-way analyses of variance (ANOVA) tests were performed on the data to investigate the statistical significance of any differences between the monitoring results from the two RMPs. Significance was taken at the 0.05 level. All statistical analysis described in this section was undertaken in R (R Core Team, 2021).

No significant differences ($p>0.05$) were found in the data from Pacific oyster RMPs, and it is not appropriate to statistically compare monitoring results from more than one species due to differences in the rate of *E. coli* uptake.

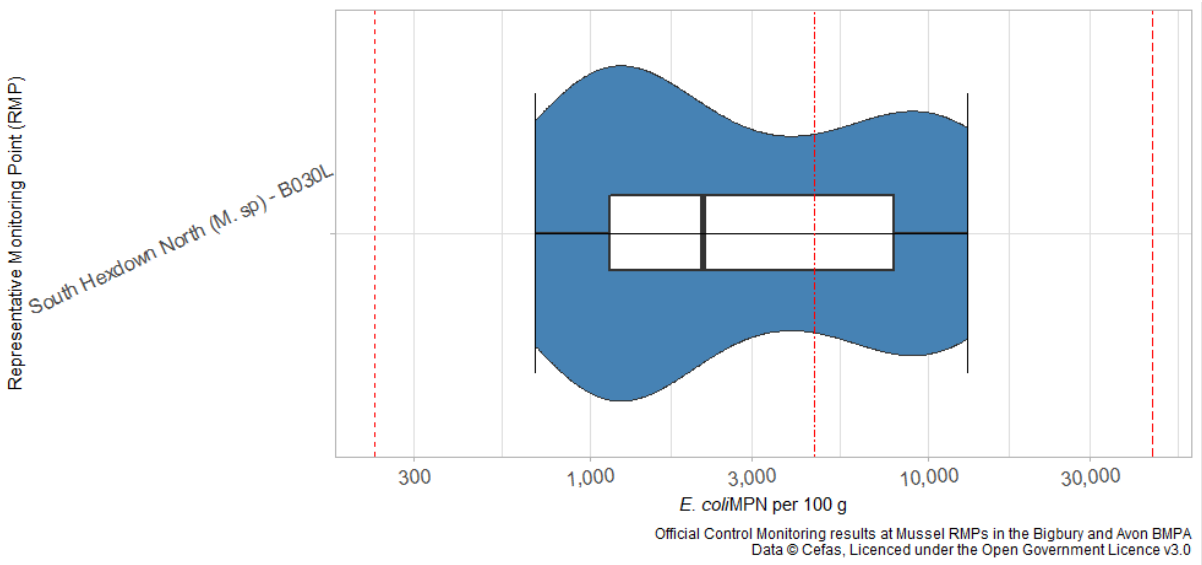

Figure 6.2 Box and violin plots of E. coli concentrations at mussel RMPs in the Avon Estuary BMPA since 2010. Central line indicates median value, box indicates lower-upper quartile range and whisker indicates minimum/maximum values, excluding outliers (points >1.5 x the interquartile range). Boxplots are overlaid on the distribution of the monitoring data. Horizontal dashed lines indicate classification thresholds at 230, 4,600 and 46,000 MPN/100 g respectively.

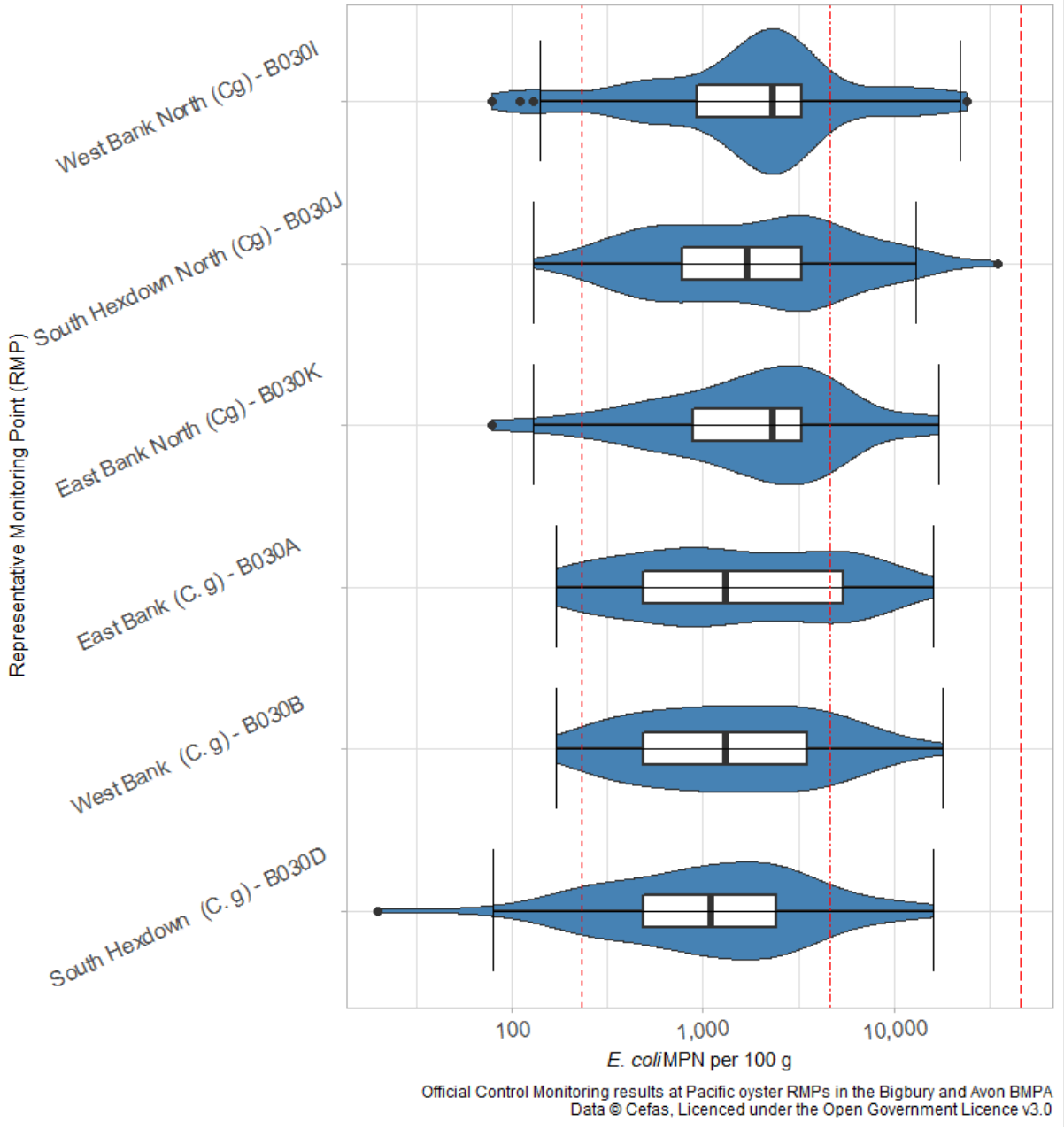

Figure 6.3 Box and violin plots of E. coli concentrations at Pacific oyster RMPs in the Avon Estuary BMPA since 2010. Central line indicates median value, box indicates lower-upper quartile range and whisker indicates minimum/maximum values, excluding outliers (points >1.5 x the interquartile range). Boxplots are overlaid on the distribution of the monitoring data. Horizontal dashed lines indicate classification thresholds at 230, 4,600 and 46,000 MPN/100 g respectively.

6.2 Overall temporal pattern in results

The overall temporal pattern in shellfish flesh monitoring results for RMPs sampled in the Bigbury and Avon BMPA is shown in Figure 6.4 for mussels and Figure 6.5 for Pacific oysters.

Limited temporal trends can be drawn from the mussel data (Figure 6.4) as sampling has only been ongoing since April 2022. However, results from later in the year have tended to

be higher than those earlier in the year, possibly due to increased levels of rainfall (and therefore runoff) during these periods.

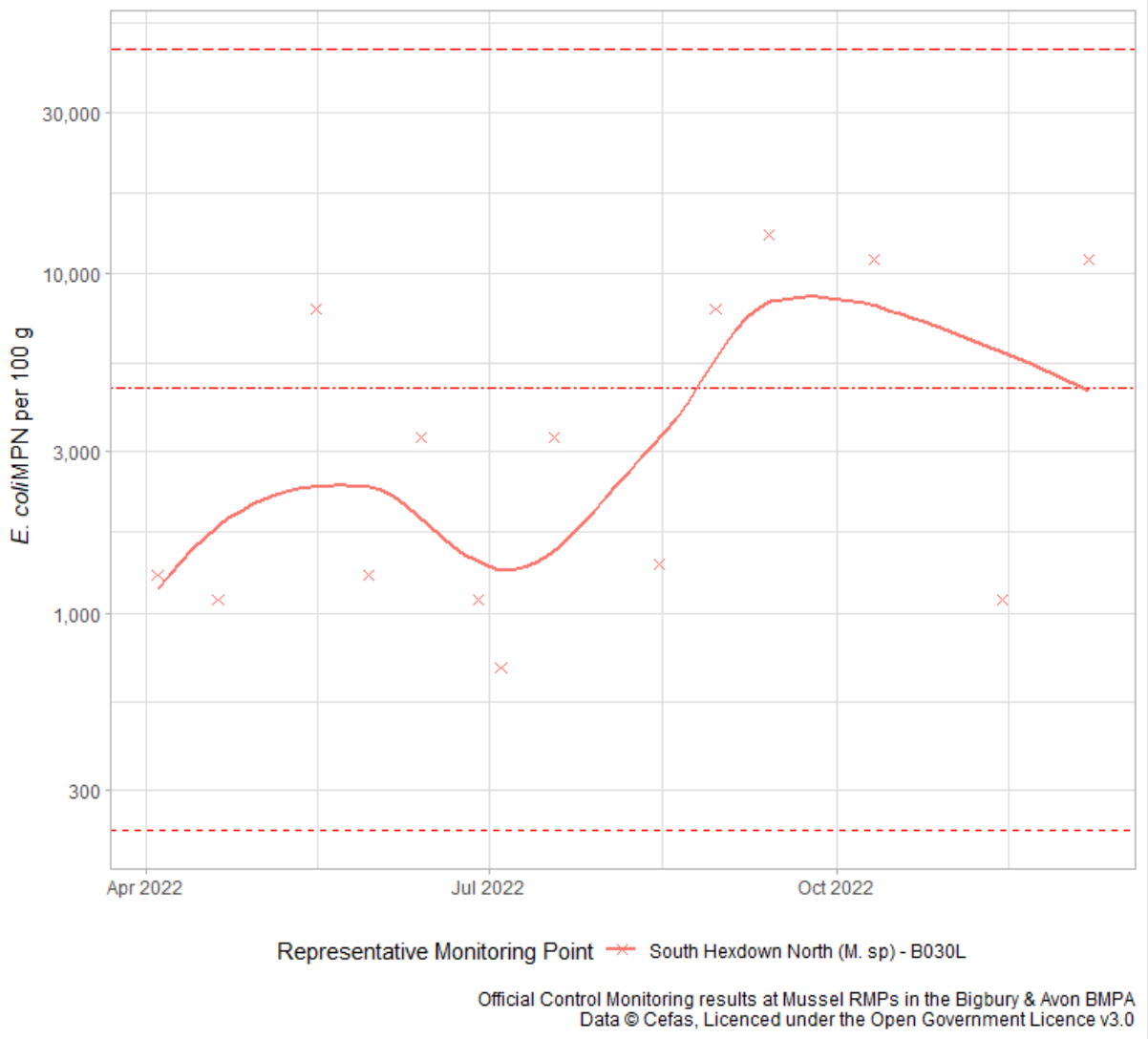

Figure 6.4 Timeseries of E. coli levels at mussel RMPs sampled in the Bigbury & Avon BMPA since 2010. Scatter plots are overlaid with a loess model fitted to the data. Horizontal lines indicate classification thresholds at 230, 4,600 and 46,000 MPN/100 g respectively.

The temporal separation of the two monitoring periods can clearly be seen in the Pacific oyster data (Figure 6.5). Prior to the publication of the original sanitary survey, the three RMPs (B030A, B030B & B030D) returned broadly similar results. The trend lines fitted to the more recently sampled RMPs (B030J, B030K & B030I) suggest that shellfish flesh monitoring results are improving, with the trend lines indicating a pattern of declining *E. coli* concentrations in samples. This is likely due to the efforts being made in this catchment to reduce the impact of agricultural sources of pollution.

Figure 6.5 Timeseries of E. coli levels at Pacific oyster RMPs sampled in the Bigbury & Avon BMPA since 2010. Scatter plots are overlaid with a loess model fitted to the data. Horizontal lines indicate classification thresholds at 230, 4,600 and 46,000 MPN/100 g respectively.

6.3 Seasonal patterns of results

The seasonal patterns of *E. coli* levels at RMPs in the Bigbury & Avon BMPA were investigated and are shown for Pacific oysters in Figure 6.6. No plot is shown for mussel RMPs as the single mussel RMP B030L has only been sampled since April 2022 and there is therefore only one result for each season.

The data for each year were averaged into the four seasons, with, spring from March – May, summer from June – August, autumn from September – November and winter comprising data from December – February the following year. Two-way ANOVA testing was used to look for significant differences in the data, using both season and RMP (if there is more than one RMP for a given species) as independent factors (i.e., pooling the data across season and RMP respectively), as well as the interaction between them (i.e., exploring seasonal differences within the results for a given RMP). Significance was taken at the 0.05 level.

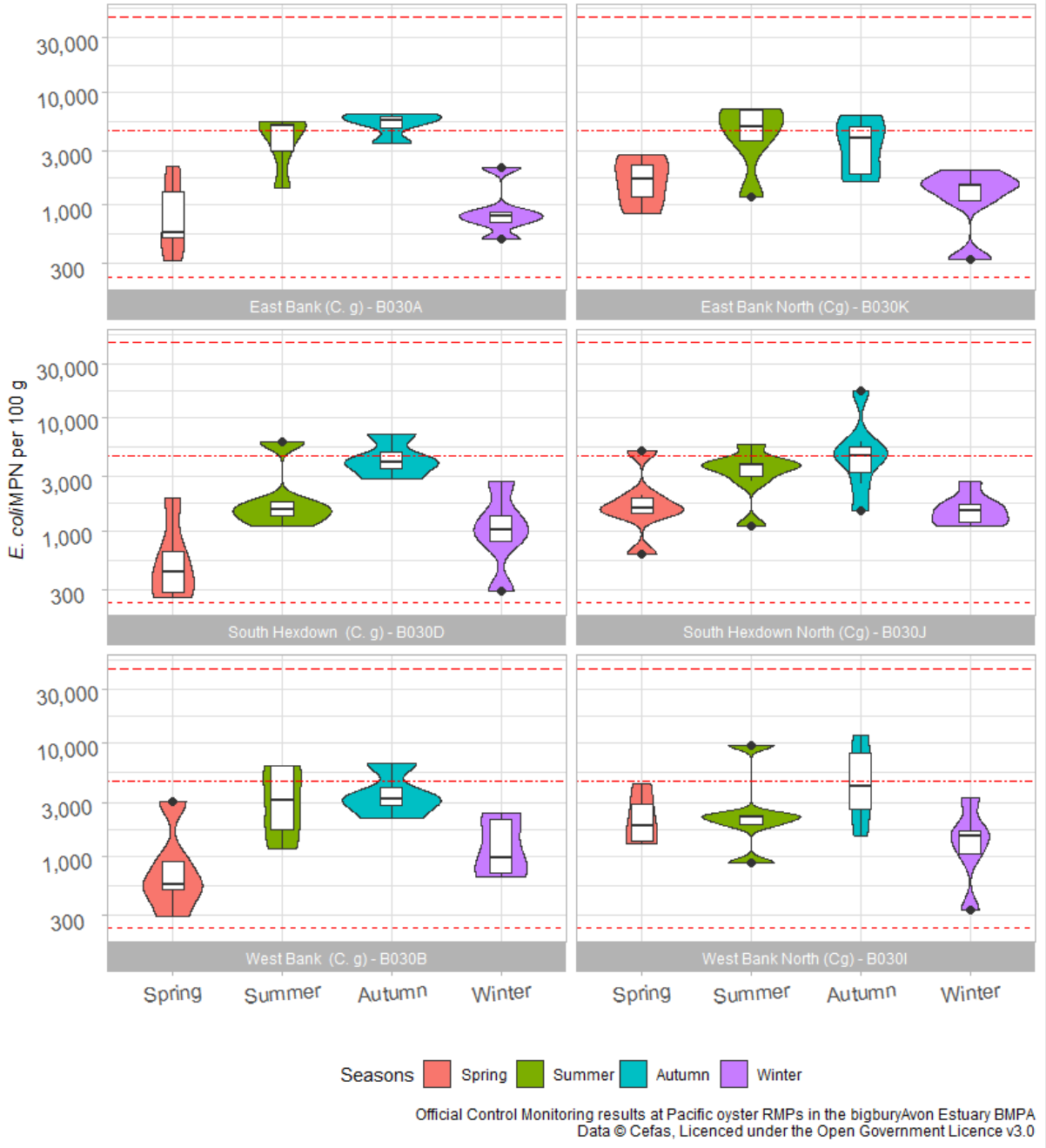

Figure 6.6 Boxplots of E. coli levels per season at Pacific oyster RMPs sampled within the Bigbury and Avon BMPA. Boxplots are overlaid on violin plots of the data showing the distribution of the data. Horizontal dashed lines indicate classification thresholds at 230, 4,600 and 46,000 MPN/100 g respectively.

The monitoring data from Pacific oyster RMPs suggest that in general results in autumn months are higher than at other times of year, possibly due to the increased levels of runoff that occurs at this time of year, along with the slurry spreading that often takes place in autumn. When the data were pooled across RMPs, results collected in autumn months were significantly greater than spring and winter ($p = 0.000$), but not summer ($p = 0.080$). Additionally, results from summer months were significantly greater than spring ($p = 0.001$)

and winter (p = 0.000). Higher monitoring results in summer and autumn arelikely due to increased levels of tourism (summer) and higher agricultural runoff (autumn) causing greater faecal loading to the estuary.

6.4 Action States

No action state results have been recorded at any of the RMPs sampled in the Bigbury and Avon BMPA since the original sanitary survey was published.

7 Conclusion and overall assessment

Classification Zones within the Bigbury & Avon BMPA are located in one area of the estuary, extending downstream from the confluence of Stiddicombe Creek and the Avon Estuary, to approximately 500 m upstream of the village of Bantham. The fishery primarily involves the harvest of cultured Pacific oyster (with approximately 15 tonnes harvested annually), although the FBO is interested in expanding the fishery to include mussels and native oyster. In October 2022, a formal zone for mussel harvest was classified. At the time of writing, there are four classification zones within the estuary, three for Pacific oyster and one for mussels.

The results of the 2021 Census were compared to that of the 2011 Census to give an indication of population changes in the catchment since the original sanitary survey was published. These data suggest that the population has grown by approximately 10%, although the main conurbations remain the same. The land immediately surrounding the classification zones of this production area continue to have low population densities, and so the greatest potential for urban runoff remains Aveton Gifford at the head of the estuary and Bantham on the southern side. It should be noted however that the overall risk of urban runoff to this BMPA remains low.The population will increase in summer months due to the volume of tourism that the area receives , although no information has come forward during the desk assessment or initial consultation to suggest the existing capacity of the sewage network is insufficient to handle this increase.

The Shellfish Action Plan for this shellfish water does not list any upgrades to treatment methodologies employed at continuous water company discharges in the catchment, nor any reductions to consented spill volumes. There have been some improvements to the intermittent discharge network, mainly involving increasing storage capacity so that spills occur less often. Comparison of EDM data from the time of the original sanitary survey and now suggests that spills occur at a similar frequency, and so the overall risk of this source of contamination remains similar.

Livestock populations across the catchment were estimated to have fallen by 30% between 2013 and 2021, although the average density remains approximately 100 animals per km^2. The amount of rural land immediately adjacent to the estuary suggests that contamination from this source is likely to be a significant concern for this fishery, although several improvements to farming infrastructure in recent years should have reduced the impact

that this causes to a degree. No issues with slurry usage were reported during initial consultations.

There are no significant wildlife populations within the Avon estuary likely to contribute significant levels of bacteriological contamination. There may be a small amount of contamination from wading birds or visiting marine mammals, although this is not considered to be a significant source within this shellfishery. Furthermore, as the contamination from this source is spatially and temporally very variable, it is difficult to define RMP locations to capture this.

There are no marinas or yacht clubs in the Avon estuary, as the small, shallow subtidal channel means that for most states-of-tide the estuary is relatively inaccessible. Satellite imagery suggests that a number of moorings remain in the estuary, and so some contamination from vessels of a sufficient size to contain onboard toilets is likely. The risk of this source of pollution is not assessed to have increased significantly, and it remains challenging to account for this source of pollution in any updated sampling plan.

A total of seven RMPs have been sampled within the Bigbury & Avon BMPA since 2010. Of these, four are currently sampled. Sampling at the three inactive RMPs stopped following the recommendations of the 2014 sanitary survey, but sampling at the new positions did not start until 2016 (for South Hexdown North B030J) and 2018 (for East Bank North B030K and West Bank North B030I). These dates coincide with the reclassification of these zones.

No significant differences were found in the monitoring data when all the monitoring results from each RMP were pooled. However, results from Summer and Autumn were significantly higher than those from other times of year.

Based on the information available, there do not appear be any significant knowledge gaps that would justify a shoreline survey. There have been some changes to the sources of contamination in the area, although these have been reliably accounted for by the desk-based assessment.

Having reviewed and compared the desk-based study with the findings of the original sanitary survey in 2014, the FSA are also content that a shoreline assessment is not required.

8 Recommendations

8.1 Pacific oyster

East Bank

This CZ covers an area of 0.06 km² and extends from the shoreline to where it meets the *West Bank* CZ. The 2014 sanitary survey did not identify any point sources of contamination within the zone, and identified that the primary influence was likely to be land runoff arriving in the CZ from upstream sources. It recommended placing the RMP at the mid-point of the northern end of the trestles to capture the dominant concentration gradient. It is

recommended that, provided the trestles do not extend further upstream than the current RMP position of SX 6748 4484, the RMP should be retained.

West Bank

This zone covers an area of 0.05 km² and extends from the shoreline to where it meets the *East Bank* CZ. The 2014 sanitary survey did not identify any point sources of contamination within the CZ (but noted the presence of a small stream to the south which received effluent from a small private discharge), and identified that the primary influence was likely to be land runoff arriving in the CZ from upstream sources. It recommended placing the RMP at the northern end of the trestles to capture the dominant concentration gradient. It is recommended that, provided the trestles do not extend further upstream than the current RMP position of SX 6739 4497, the RMP should be retained.

South Hexdown

This is the furthest downstream CZ within the Bigbury and Avon BMPA, covering an area of 0.049 km². The 2014 sanitary survey did not identify any point sources of contamination within the zone, and identified that the primary influence was likely to be land runoff arriving in the CZ from upstream sources. It recommended placing the RMP at the northern end of the trestles to capture the dominant concentration gradient. It is recommended that, provided the trestles do not extend further upstream than the current RMP position of SX 6711 4467, the RMP should be retained.

8.2 Mussels

South Hexdown

This CZ has been classified since October 2022 and covers the same boundaries as the Pacific oyster CZ of the same name. To date it has been classified using mussel samples from an RMP in the same position as the Pacific oyster RMP, but it is not currently included in the sampling plan for this BMPA. An investigation into the use of indicator species shows that *Mytilus* spp. accumulates *E. coli* to a similar or greater degree than *C. gigas* (Cefas, 2014). As such it is recommended that a mussel RMP be retained, although there would be the option to classify the *South Hexdown* Pacific oyster zone based on results from mussel samples should the LEA desire this.

8.3 General Information

8.3.1 Location Reference

Production Area	**Bigbury & Avon**
Cefas Main Site Reference	
Ordnance survey 1:25,000	
Admiralty Chart	

8.3.2 Shellfishery

Species	Culture Method	Seasonality of Harvest
Pacific oyster (*Crassostrea gigas*)	Cultured	Year Round

Mussels (*Mytilus* spp.)	Cultured	Year Round

8.3.3 Local Enforcement Authority(s)

Name	**South Hams District Council** **Follaton House** **Plymouth Road** **Totnes** TQ9 5NE
Website	www.southhams.gov.uk
Telephone number	01803 861 234
E-mail address	Environmental.Health@swdevon.gov.uk

*Table 8.1 Proposed sampling plan for the Bigbury & Avon BMPA. Suggested changes are given in **bold red** type.*

Classification Zone	RMP	RMP Name	NGR (OSGB 1936)	Lat / Lon (WGS 1984)	Species Represented	Harvesting Technique	Sampling Method	Sampling Species	Tolerance	Frequency
East Bank	B030K	East Bank North	SX 6748 4484	50°17.315'N 03°51.697'W	Pacific oyster	Trestle culture	Hand	*C. gigas*	10 m	Monthly
West Bank	B030I	West Bank North	SX 6739 4497	50°17.385'N 03°51.776'W	Pacific oyster	Trestle culture	Hand	*C. gigas*	10 m	Monthly
South Hexdown (P oysters)	B030J	South Hexdown North	SX 6711 4467	50°17.219'N 03°52.005'W	Pacific oyster;	Trestle	Hand	*C. gigas*	10 m	Monthly
South Hexdown (mussels)	**B030L**	**South Hexdown North**	**SX 6711 4467**	**50°17.219'N 03°52.005'W**	**Mussels; Pacific oyster**	**Trestle**	**Hand**	***Mytilus* spp.**	**10 m**	**Monthly**

9 References

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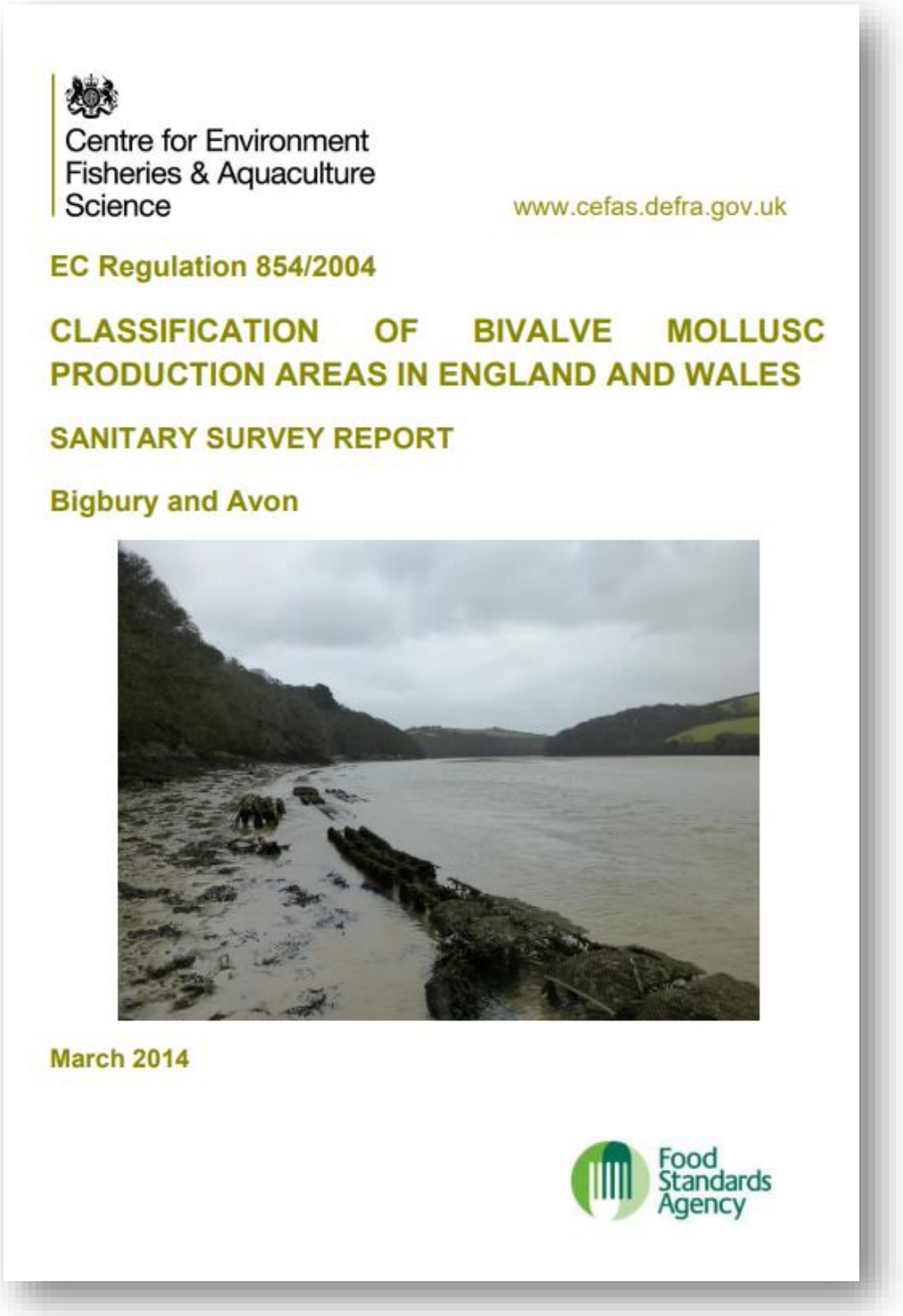
Appendices

Appendix I. Event Duration Monitoring Return for Intermittent Discharges in the Bigbury & Avon catchment, 2022

Site Name	NGR	Receiving Water	No. spills in 2021	Duration of spills in 2021	Distance to nearest CZ (km)
BRENT MILL CSO	SX 6973 5962	RIVER AVON	26	52.77	14.71
AVETON GIFFORD STW	SX 6910 4729	RIVER AVON ESTUARY(E)	7	11.3	2.64
BIGBURY & CHALLABOROUGH STW	SX 6483 4442	BIGBURY BAY(C)	0	0	2.16
HEATHER PARK PUMPING STATION	SX 7051 6016	TRIB OF HORSE BROOK VIA SWS	0	0	15.37
DIPTFORD SEWAGE TREATMENT WORKS	SX 7242 5652	RIVER AVON	83	97.69	12.4
PUMPING STATION AT WARREN POINT	SX 6490 4457	BIGBURY BAY (COASTAL)	3	0.33	2.1
FOOTBALL FIELD CSO	SX6983559470	RIVER AVON (S)	Unspecified	Unspecified	14.58
JUBILEE STREET CSO	SX6938047650	RIVER AVON (S)	Unspecified	Unspecified	3.09
SOUTH BRENT WWTW	SX 6975 5940	RIVER AVON	61	1121.54	14.5
LODDISWELL WWTW	SX 7228 4800	RIVER AVON	60	72.2	5.44
THE WARREN PUMPING STATION	SX 6478 4440	BIGBURY BAY (C)	0	0	2.2



Centre for Environment
Fisheries & Aquaculture
Science

www.cefas.defra.gov.uk

EC Regulation 854/2004

CLASSIFICATION OF BIVALVE MOLLUSC PRODUCTION AREAS IN ENGLAND AND WALES

SANITARY SURVEY REPORT

Bigbury and Avon

March 2014

Food Standards Agency

Follow hyperlink in image to view full report

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