sweep
Water Quality & Aquaculture
REPORT

Wholescape Assessment of Water Quality Status, drivers and impacts in the Exe Estuary Catchment and implications for ecosystem health and services, including Shellfish Aquaculture.

APPENDICES TO THE REPORT

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sweep

WESTCOUNTRY RIVERS TRUST

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Contents

NOTE: Section numbering refers to that in the accompanying full report.

1 Legal framework for the protection of water quality in the UK

1.1: Water Framework Directive

The Water Framework Directive (WFD) interlinks or subsumes several 'daughter' Directives and Regulations. These include the Drinking Water Directive (98/83/EC), Groundwater Directive (2006/118/EC), Urban Waste Water Treatment Directive (91/271/EEC), Sewage Sludge (use in agriculture) Directive (86/278/EEC), Bathing Water Directive (2006/7/EC), Ecological Quality Standards Directive (2008/105/EC), Freshwater Fish Directive (78/659/EEC) and the Shellfish Waters Directive (79/923/EEC).

The objective of the WFD is to achieve by 2027 at least 'Good' ecological status for all surface waters, freshwater rivers and lakes, transitional waters (estuaries), coastal waters up to 1 nautical mile offshore, or 'High' ecological status for internationally important protected conservation areas such as the Exe Estuary (**Section 3.2**). Assessment of ecological status is based on a number of biological quality elements supported by physical and chemical quality elements (outlined in more detail in **Section 4**). Under the WFD, chemical status is assessed up to 12 nautical miles offshore (overlapping with the Marine Strategy Framework Directive (see **below**).

Measures for improving water quality are designed and implemented via regional River Basin Management Plans (RBMPs). The South West RBMP covers the South West River Basin District, which extends from Lands End to the Isle of Wight and to Weston-super-Mare (Environment Agency, 2020). RBMPs focus in particular on water bodies that need special protection from potentially harmful activities (e.g. municipal, agricultural and industrial activities) due to their specific designated uses, including nature conservation, drinking water abstraction, bathing, fisheries and shellfish production (see **below**).

1.2: Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSFD - 2008/56/EC) assesses and protects the environmental status of marine waters from the high water spring tide mark up to the outer limit of the UK's Exclusive Economic Zone (EEZ). The Directive requires that Good Environmental Status (GES) is achieved in marine waters by 2020 and sets out eleven qualitative descriptors which describe what the environment will look like when GES has been achieved (**Appendix 1**). Descriptor 5 requires nutrient pollution and excess algal growth (eutrophication) to be minimised, while Descriptors 8 and 9 refer to ensuring that concentrations of contaminants cause no adverse effects in marine organisms or in humans who consume seafood.

The MSFD is enacted in the UK by the Marine and Coastal Access Act (2009) and in Lyme Bay by the South Marine Plan. This Marine Plan has the prime objective (1) "To encourage effective use of space to support existing, and future sustainable economic activity through co-existence, mitigation of conflicts and minimisation of development footprints." Objective (11) is "To complement and contribute to the achievement or maintenance of Good Ecological Status or Potential under the Water Framework Directive and Good Environmental Status under the Marine Strategy Framework Directive." (HM Government, 2018a).

1.3: Shellfish water protected areas

There are 96 designated shellfish water protected areas in England and 32 (on third) of these are located within the South West River Basin District (Environment Agency, 2020), including five in the Exe estuary and three in adjoining coastal waters in Lyme Bay (West) (**Section 4.4**). Shellfish Water Protected Areas (England and Wales) Directions 2016 require that 75% of shellfish samples taken within any 12 month period from all UK shellfish waters should contain ≤ 300 *E. coli* /100 mL in shellfish flesh and intravalvular fluid (HM Government, 2016). However, the classification of shellfish waters is ultimately determined by EU food hygiene regulation (EC) No. 854/2004 (European Council, 2004a) requiring Official Control monitoring of *E. coli* in shellfish against a series of classification limits (A, B and C – **Appendix 1 Table 1**). Classifications determine whether or not shellfish are safe to eat, or if they require purging (depuration) before consumption (and EU export) (**Section 4.4**).

Appendix 1 Table 1: Classification of shellfish waters based on faecal indicator organism (FIO) counts in bivalve shellfish (minimum of 10 samples required per year for Class A; 8 samples for Class B & C)

Class	*E. coli* mean probable number /100g shellfish flesh	Treatment required
A	≤ 230 (80% of sample results) < 700 (100% of sample results)	May go direct for human consumption
B	≤ 4600 (90% of sample results) < 46000 (100% of sample results)	Must be depurated, heat treated or relaid to meet Class A
C	≤ 46000 (100% of sample results)	Must be laid for at least 2 months, followed where necessary by treatment in a Purification Centre to meet Class A requirements
P	> 46000	Prohibited from production or collection

Food Hygiene Regulation (EC) No 1881/2006 also sets maximum permitted levels of chemical contaminants in bivalve shellfish to safeguard human consumers (**Section 4.3**).

1.4: Freshwater fish protected areas

There are 954 Freshwater Fish Waters in the SW River Basin District (Environment Agency, 2009). The objective for freshwater fish waters designated under the Freshwater Fish Directive (78/659/EEC), prior to the Water Framework Directive, is to protect or improve the quality of running or standing freshwaters to enable them to support indigenous fish species or species which are desirable for water management purposes. Water quality standards for freshwater fish (including sensitive salmonid fish and less sensitive cyprinid fish) are laid out in the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (HM Government, 2015). Standards representing 'Good' water quality for salmonid fish include: dissolved oxygen (≥75%); Biochemical Oxygen Demand (≤4 mg/L); acid neutralising capacity (≥75); total ammonia as nitrogen (0.2 mg/L).

1.5: Bathing water protected areas

Bathing water protected areas are those in which a large number of people (~100 people) are expected to bathe at any one time. There are 194 designated coastal bathing waters (and zero freshwater bathing waters) in the SW River Basin District. There are 29 bathing water areas in Lyme Bay West (between Dartmouth and Beer); 18 are located between Hopes Nose (Torquay) and Beer and 2 of these are located at the mouth of the Exe Estuary (**Section 4.5**). Under the UK Bathing

Water Regulations 2013 (SI:1675, enacting the EU Bathing Water Directive 2006/7/EC), waters must be tested for faecal indicator organisms (FIOs – *E. coli* and/or intestinal enterococci) at weekly intervals between 1 May and 30 September, with a minimum of 20 samples tested annually. There are three measurement criteria for each FIO, including a minimum standard, which must be met in order for a bathing area to pass and standards of Good and Excellent water quality (**Appendix 1 Table 2**). In addition to these criteria, bathing water quality is assessed based on: blue-green algal (cyanobacterial) concentrations; proliferations of macro-algae (seaweed) or marine phytoplankton; the presence of waste or any other incident that may pose a risk to bathing water quality and bathers' health.

Appendix 1 Table 2: Standards for coastal and transitional waters

[(A)]Based upon a 95-percentile evaluation; [(B)]Based upon a 90-percentile evaluation.

Faecal Indicator Organism	Classifications based on number of colony forming units per 100 mL of water		
	"Excellent"	"Good"	"Sufficient"
Intestinal enterococci	100[(A)]	200[(A)]	185[(B)]
Escherichia coli	250[(A)]	500[(A)]	500[(B)]

1.6: Drinking water protected areas

Drinking Water Protected Areas (Surface Water) are areas in which raw water is abstracted for drinking water supplies from rivers and reservoirs. Water quality monitoring and environmental standards are set out in the Water Supply (Water Quality) Regulations 2016 (SI:2016/614, enacting the EU Drinking Water Directive). There are 120 Drinking Water Protected Areas (DrWPAs) in the SW River Basin District, including three in the Exe Estuary catchment, which cover a total area of 113.6 km^2 (17.3% of the Exe Estuary catchment – 655 km^2) (**Section 4.6**). Drinking water protected areas: Exe (Barle to Culm - GB108045015050) 103.2 km^2; Exe (Haddeo to Barle - GB108045015060) 3.7 km^2 ha; Exe (Culm to Creedy - GB108045009060) 6.9 km^2; plus Budleigh Book, Dawlish Water, West Lyn River and the Bray. Drinking water from these areas is abstracted from the River Exe and treated at two water treatment works; Allers WTW located upstream of Tiverton and Pynes WTW located upstream of Exeter (SWW, 2019). Potential drinking water pollutants requiring monitoring, management/treatment are listed in **Appendix 1 Table 3** and include a wide range of agents including faecal bacteria (*E. coli* and Enterococci), nitrate, heavy metals, pesticides and aromatic hydrocarbons.

An additional area of 402 km^2 (61.4%) of the Exe Estuary catchment is covered by a Surface Water Safeguard Zone (SWSGZ5012) (DEFRA, 2021a). Safeguard zones are non-statutory areas identified for safeguarding 'at risk' abstractions where land use management practices and other activities can affect the quality of the untreated water. There are also a number of Ground Water Safeguard Zones in the catchment (Environment Agency, 2021c).

1.7: Nutrient sensitive areas (Nitrate Vulnerable Zones)

Nitrate Vulnerable Zones (NVZs) are defined within the Nitrates Directive (91 / 676 /EEC) and Nitrate Pollution Prevention Regulations 2015 (SI: 2015/668) as areas of land that drain into nitrate polluted waters and contributes to the pollution of those waters. Such waters i) Contain or could contain, if preventative action is not taken, nitrate concentrations > 50 mg/l; ii) are eutrophic, or become eutrophic, if preventative action is not taken. NVZs are designated by the Secretary of State under the Nitrate Regulations (England) and maps indicating the extent of these zones are compiled by the Environment Agency (2021b). There are four Nitrate Vulnerable Zones (NVZs) in the Exe main catchment, which are highlighted as being at risk from agricultural nitrate pollution: Aylesbeare stream NVZ (S535); Clyst NVZ (S536); River Weaver NVZ (S537); Mid Devon NVZ including Yeo/Creedy (S538) (**Section 4.7**).

1.8: Nature conservation protected areas

The Exe Estuary and Lyme Bay contain a number of designated shellfish production sites and European Marine Sites/ Natura 2000 Sites recognised as having international conservation importance under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and international Conventions such as the Ramsar Convention on wetlands. These sites, collectively known as Marine Protected Areas (MPAs), have the objectives of achieving 'Maximum ecological potential (in the case of the Exe Estuary, which is heavily modified) and 'High' ecological potential (in the case of unmodified water bodies, including Lyme Bay). Currently the Exe Estuary and Lyme Bay (West) are classified as having only 'Moderate' ecological potential and 'Moderate' ecological status, respectively (**Sections 4.1 and 4.2**).

Appendix 1 Table 3: Drinking Water Protected Area water quality standards

Table A

Microbiological parameters

Part I: Directive requirements

(1)	*(2)*	*(3)*	*(4)*	*(5)*
Item	*Parameters*	*Concentration or value (maximum)*	*Units of measurement*	*Point of compliance*
1.	*Enterococci*	0	number/100ml	Consumers' taps
2.	*Escherichia coli (E. coli)*	0	number/100ml	Consumers' taps

Part II: National requirements

(1)	*(2)*	*(3)*	*(4)*	*(5)*
Item	*Parameters*	*Concentration or value (maximum)*	*Units of measurement*	*Point of compliance*
1.	Coliform bacteria	0	number/100ml	Service reservoirs(*) and water treatment works
2.	*Escherichia coli (E. coli)*	0	number/100ml	Service reservoirs and water treatment works

(*) Compliance required as to 95% of samples from each service reservoir (regulation 4(6)).

Table B

Chemical parameters

Part I: Directive requirements

(1)	*(2)*	*(3)*	*(4)*	*(5)*
Item	*Parameters*	*Concentration or value (maximum)*	*Units of measurement*	*Point of compliance*
1.	Acrylamide	0.10	µg/1	(i)
2.	Antimony	5.0	µgSb/1	Consumers' taps
3.	Arsenic	10	µgAs/1	Consumers' taps
4.	Benzene	1.0	µg/1	Consumers' taps
5.	Benzo(a)pyrene	0.010	µg/1	Consumers' taps
6.	Boron	1.0	mgB/1	Consumers' taps
7.	Bromate	10	µgBrO3/1	Consumers' taps
8.	Cadmium	5.0	µgCd/1	Consumers' taps
9.	Chromium	50	µgCr/1	Consumers' taps
10.	Copper	2.0	mgCu/1	Consumers' taps

11.	Cyanide	50	µgCN/1	Consumers' taps
12.	1, 2 dichloroethane	3.0	µg/1	Consumers' taps
13.	Epichlorohydrin	0.10	µg/1	(i)
14.	Fluoride	1.5	mgF/1	Consumers' taps
15.	Lead	10	µgPb/1	Consumers' taps
16.	Mercury	1.0	µgHg/1	Consumers' taps
17.	Nickel	20	µgNi/1	Consumers' taps
18.	Nitrate(ii)	50	mgNO3/1	Consumers' taps
19.	Nitrite(ii)	0.50	mgNO2/1	Consumers' taps
		0.10		Treatment works
20.	Pesticides(iii) (iv)	0.030	µg/1	Consumers' taps
	Aldrin Dieldrin Heptachlor Heptachlor epoxide	0.030	µg1	Consumer's taps
	Other pesticides	0.10	µg/l	Consumers' taps
21.	Pesticides: total(v)	0.50	µg/1	Consumers' taps
22.	Polycyclic aromatic hydrocarbon(vi)	0.10	µg/1	Consumers' taps
23.	Selenium	10	µgSe/1	Consumers' taps
24.	Tetrachloroethene and Trichloroethene(vii)	10	µg/l	Consumers' taps
25.	Trihalomethanes: Total(viii)	100	µg/1	Consumers' taps
26.	Vinyl chloride	0.50	µg/1	(i)

(i) The parametric value refers to the residual monomer concentration in the water as calculated according to specifications of the maximum release from the corresponding polymer in contact with the water. This is controlled by product specification.

(ii) See also regulation 4(2)(d).

(iii) See the definition of "pesticides and related products" in regulation 2.

(iv) The parametric value applies to each individual pesticide.

(v) "Pesticides: total" means the sum of the concentrations of the individual pesticides detected and quantified in the monitoring procedure.

(vi) The specified compounds are—

- benzo(b)fluoranthene;
- benzo(k)fluoranthene;
- benzo(ghi)perylene;
- indeno(1,2,3-cd)pyrene.

The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

(vii) The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

(viii) The specified compounds are—

- chloroform;
- bromoform;
- dibromochloromethane;
- bromodichloromethane

Part II: National requirements

(1)	*(2)*	*(3)*	*(4)*	*(5)*
Item	*Parameters*	*Concentration or value (maximum)*	*Units of measurement*	*Point of compliance*
1.	Aluminium	200	µgA1/1	Consumers' taps
2.	Colour	20	mg/1 Pt/Co	Consumers' taps
3.	Iron	200	µgFe/1	Consumers' taps
4.	Manganese	50	µgMn/1	Consumers' taps
5.	Odour	Acceptable to consumers and no abnormal change		Consumers' taps
6.	Sodium	200	mgNa/1	Consumers' taps
7.	Taste	Acceptable to consumers and no abnormal change		Consumers' taps
8.	Tetrachloromethane	3	µg/1	Consumers' taps
9.	Turbidity	4	NTU	Consumers' taps

SCHEDULE 2

Regulation 2

Indicator parameters

(1)	*(2)*	*(3)*	*(4)*	*(5)*
Item	*Parameters*	*Specification concentration or value (maximum unless otherwise stated) or state*	*Units of measurement*	*Point of compliance*
1.	Ammonium	0.50	mgNH4/1	Consumers' taps
2.	Chloride[(i)]	250	mgC1/	Supply point[(*)]
3.	*Clostridium Perfringens (including spores)*	0	Number/100ml	Supply point[(*)]
4.	Coliform bacteria	0	Number/100ml	Consumers' taps
5.	Colony counts	No abnormal change	Number/1ml at 22°C	Consumers' taps, service reservoirs and treatment works
6.	Conductivity[(i)]	2500	µS/cm at 20°C	Supply point[(*)]
7.	Hydrogen ion	9.5 (maximum) 6.5 (minimum)	pH value	Consumers' taps
8.	Indicative dose[(ii)]	0.10	mSv	Supply point[(*)]
	(a) gross alpha	0.1	Bq/1	Supply point[(*)]
	(b) gross beta	1	Bq/1	Supply point[(*)]
9.	Radon[(iii)]	100	Bq/1	Supply point

11.	Total organic carbon (TOC)	No abnormal change	mgC/l	Supply point
12.	Tritium (for radioactivity)[iv]	100	Bq/l	Supply point[*]
13.	Turbidity	1	NTU	Treatment works

[i] The water should not be aggressive.

[ii] Where treatment to reduce the level of radionuclides in water intended for human consumption has been taken, monitoring must be carried out to ensure the continued efficacy of the treatment.

[iii] Remedial action may be taken by the Secretary of State on radiological protection grounds without further consideration and deemed to be justified where radon concentrates exceed 1,000 Bq/1.

[iv] If tritium concentration exceeds its parametric value, an investigation (which may include analysis) of the presence of artificial radionuclides is required.

[*] May be monitored from samples of water leaving treatment works or other supply point, as no significant change during distribution.

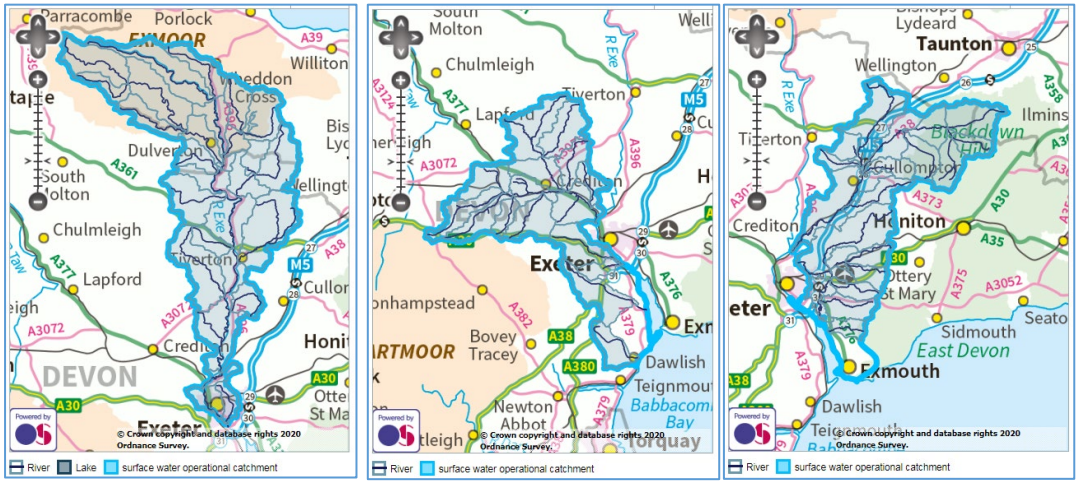
2 Wetland types and areas in the Exe Estuary

Data from JNCC (2008).

Code	Wetland	Area (%)	Area (km2)
F	Estuary water (low tide)	32.5	7.62
G	Intertidal sand/mudflats	32.5	7.62
Tp	Freshwater marsh/pools	10	2.35
E	Sand/shingle shores/dunes	10	2.35
9	Canals and drainage channels	5	1.17
H	Saltmarsh	5	1.17
B	Intertidal seagrass	5	1.17

3 WFD operational catchments and water bodies in the Exe Estuary catchment

Exe Main catchment **West Exe catchment** **Clyst and Culm catchment**



Waterbodies

Exe Main	**Creedy and West Exe**	**Clyst and Culm**
Ben Brook	Alphin Brook	Aylesbeare Stream
Brockey River	Colebrook	Bolham River
Burn (Exe)	Culvery River	Ford Stream (EXE)
Calverleigh Stream	Dawlish Water	Fulford Water
Danes Brook	Ford Brook (EXE)	Grindle Brook
Dart (Exe)	Holly Water	Halberton Stream
Exe (Barle to Culm)	Jackmoor Brook	Ken Stream
Exe (Creedy to Estuary)	Kenn	Lower Clyst
Exe (Culm to Creedy)	Lower Creedy	Lower Cranny Brook
Exe (Haddeo to Barle)	Lower Yeo (Creedy)	Lower Culm
Exe (Quarme to Haddeo)	Matford Brook	Madford River
Exe (Source to Quarme)	Middle Creedy	Middle Culm
Iron Mill Stream	Shobrooke Lake	Polly Brook
Lower Barle	Troney	Sheldon Stream
Lower Batherm	Upper Creedy	Spratford Stream
Lower River Haddeo	Upper Yeo (Creedy)	Upper Clyst
Lowman		Upper Cranny Brook
Middle Barle		Upper Culm
North Brook (East Devon)		Weaver
Pinkery Pond		
Pulham		
Quarme		
Sherdon Water		
Upper Barle		
Upper Batherm		
Upper River Haddeo		
Wimbleball Lake		

4 Water courses entering the Exe Estuary and Lyme Bay West

Unconstrained confluences with the Exe Estuary

• Withycombe Brook (Exe (tidal) GB108045008950) – terminating in a heavily engineered open-topped concrete culvert structure located in Exmouth.

• Polly Brook (GB108045008980) - Confluence is at Exton, where the river passes in two channels, one through a bridge structure and one through a culvert.

• Grindle Brook (GB108045008710) – Confluence with the Clyst in Clyst St Mary.

• North Brook (GB108045009050) – Confluence with the Exe at Countess Wear.

Tidally regulated confluences with the Exe Estuary

• River Exe – confluence at Tews Weir.

• Wotton Brook (Exe (tidal) GB108045008960) – Confluence with the Exe Estuary at Lympstone.

• Exe (GB108045009040) – Flows over St James Weir between Countess Wear and Exminster Marshes and Powderham Banks.

• Alphin Brook (GB108045009020) – Enters the Exe Estuary between Exminster Marshes and Powderham Banks via a siphon under the Exeter Ship Canal which takes all flow under nonflood conditions. Under flood flows, an overflow weir spills into a flood storage area associated with Exminster Marshes.

• Exeter Ship Canal (GB70810015) – Connects with the Exe Estuary at Turf locks between Exminster Marshes and Powderham Bank. The canal is part of the Exe Estuary SSSI designation, including habitats within and outwith the embankments.

• Berry Brook and Main Drain drainage system (GB108045008990) - Enters the Exe Estuary at Turf locks between Exminster Marshes and Powderham Banks, via an undershot sluice adjacent to the entrance to the ship canal.

• River Kenn ((Exe (tidal) - rises in the Haldon Hills and enters the estuary through a tidal gate between Starcross and Powderham.

• Staplake Brook (Exe (tidal) GB108045008930) - Enters the Exe Estuary at Starcross via a flapped outfall on a culvert under the coast road and railway.

• Cockwood Marsh (Exe (tidal) GB108045008920) – Enters the Exe Estuary at Starcross.

The river water body is regulated by a tidal flap under Church Lane on the western side of the harbour.

• Shutterton Brook (Exe (tidal) GB108045008900) – Confluence is with the Exe Estuary at Dawlish Warren.

5 WFD classification

5.1: Classification of surface water bodies in the South West River Basin District (14 September 2021)
https://environment.data.gov.uk/catchment-planning/RiverBasinDistrict/8/objectives
Results for WFD tranche 3 (2027) are not yet available, data in grey are predicted data.

WFD tranches	Ecological status/potential of water bodies (WBs)					
	Bad	Poor	Moderate	Good	High	Total WBs
1) WBs by 2015	5	8	62	160	2	237
2) WBs by 2021	0	0	10	44	0	54
3) WBs by 2027	0	1	13	392	0	406
Total WBs	5	9	85	596	2	697

5.2: Classification of ecological status of surface water bodies in operational catchments (associated with the Exe Estuary) in the East Devon Management Catchment (14 September 2021)
https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3033
Note *Exe main operational catchment includes 26 river reaches and Wimbleball Lake.
Several water bodies in the Exe Estuary catchment, are heavily modified (hyro-morphologically) and must fulfil 'Good ecological potential'. The Exe Estuary is also heavily modified, and as a European Marine Site/ Natura 2000 Site of conservation importance, it must achieve 'Maximum ecological potential'

Operational catchment	Ecological status/potential of water bodies (WBs)					
	Bad	Poor	Moderate	Good	High	Total WBs
Clyst & Culm	1	6	12	0	0	19
Creedy & West Exe	1	5	8	2	0	16
Exe main*	0	1	16	10	0	27
Exe Estuary	0	0	1	0	0	1
Lyme Bay (West)	0	0	1	0	0	1

5.3) Classification of chemical quality status of surface water bodies in operational catchments (associated with the Exe Estuary) in the East Devon Management Catchment (14 September 2021)
https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3033

Operational catchment	Chemical status of water bodies (WBs)				
	Fail	Good	Common RNAG	Additional RNAG	Total WBs
Clyst & Culm	19	0	a, b		19
Creedy & West Exe	16	0	a, b		16
Exe main	27	0	a, b	c	27
Exe Estuary	1	0	a, b	c	1
Lyme Bay (West)	1	0	a, b		1

Reasons for not achieving good (RNAG) chemical status include: exceedance of Environmental Quality Standards (EQS_{biota}) for: a) poly-brominated diphenyl ethers (PBDEs) EQS_{biota} = 0.0085 µg/kg; b)

mercury and its compounds EQS_{biota} = 20 μg/kg. Chemicals a) and b) have recently been detected up to 2500× the EQS_{biota} for PBDEs and up to 10× the EQS_{biota} in signal crayfish (*Pacifastacus leniusculus*) in freshwaters and/or blue mussels (*Mytilus edulis*) in transitional and coastal waters in the UK (Environment Agency, 2019a; 2019b; 2021a). Sources of these chemicals are largely atmospheric pollution. Additional reasons for not achieving good (RNAG) chemical status, for named water bodies in the Exe Estuary catchment include: c) Benzo(g-h-i)perylene (in Lower Batherm in Exe Main catchment and Exe Estuary). These chemicals a, b and c are priority hazardous substances listed under the WFD (Environment Agency, 2021b).

6 Marine Strategy Framework Directive qualitative descriptors of Good Environmental Status (GES)

Descriptors (water quality related descriptors are underlined)

Descriptor 1. Biodiversity is maintained

Descriptor 2. Non-indigenous species do not adversely alter the ecosystem

Descriptor 3. The population of commercial fish species is healthy

Descriptor 4. Elements of food webs ensure long-term abundance and reproduction

Descriptor 5. Eutrophication is minimised

Descriptor 6. The sea floor integrity ensures functioning of the ecosystem

Descriptor 7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem

Descriptor 8. Concentrations of contaminants give no effects

Descriptor 9. Contaminants in seafood are below safe levels

Descriptor 10. Marine litter does not cause harm

Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

Contaminant concentrations:

Environmental Assessment Criteria are stipulated by the Oslo Paris Commission (OSPAR); Maximum Permitted Levels of specified contaminants in fish and other seafood caught or harvested for human consumption are stipulated by Regulation (EC) No 1881/2006.

- Metals in biota
- Metals in sediment
- Poly Chlorinated Biphenyls (PCBs) in biota
- PCBs in Sediment
- Poly Aromatic Hydrocarbons (PAH) in biota
- PAH in sediment
- Poly Brominated Diphenyl Ethers (PBDEs) in biota
- PBDEs in sediment
- Radionuclides
- Metals from water and air
- contaminants in coastal waters
- specific pollutants

Biological effects

- Imposex in dogwhelks
- Micronucleus test
- EROD activity
- Bile metabolites
- Liver neoplasm
- Fish disease

7 Assessment criteria for PAHs, PCBs and trace metals in mussels and oysters

From OSPAR (2009):

For poly- chlorinated biphenyls (poly- CBs), OSPAR Environmental Assessment Criteria (EACs - intended to provide the green/red transition point) were estimated from sediment EACs and biota sediment accumulation factors (BSAF). Purple shaded cell are where EACs were not recommended for use by ICES (CBs) or are below the Low Concentration (LC). EC - Commission Regulation No 1881/2006 sets maximum concentration for contaminants in foodstuffs to protect public health. EACpassive - calculated on the basis of BSAFs and sediment EACs.

Compound	LC (µg/kg dry weight)	BAC (µg/kg dry weight) (T_0)	EAC (µg/kg dry weight) (T_1)	EC (µg/kg dry weight) (T_1)	$EAC^{passive}$ (µg/kg dry weight) (T_1)
PAHs					
Naphthalene		81.2[b]	340		
Phenanthrene	4.0[a]	12.6[b]	1700		
Anthracene		2.7[b]	290		
Fluoranthene	5.5[a]	11.2[b]	110		
Pyrene	4.0[a]	10.1[b]	100		
Benzo[*bj*]fluoranthene	3.0[a]	[b]			
Benzo[*k*]fluoranthene	1.0[a]	[b]	260		
Benzo[*a*]anthracene	1.0[a]	3.6[b]	80		
Chrysene	4.0[a]	21.8[b]			
Benzo[*e*]pyrene	2.5[a]	[b]			
Benzo[*a*]pyrene	0.5[a]	2.1[b]	600	50 (10 ww[h] X 5)	
Benzo[*ghi*]perylene	1.5[a]	7.2[b]	110		
Indeno[*1,2,3-cd*]pyrene	1.0[a]	5.5[b]			
C1-Phenanthrene/ Anthracene	7.0[a]	[b]			
C2-Phenanthrene/ Anthracene	7.0[a]	[b]			
C3-Phenanthrene/ Anthracene	6.5[a]	[b]			
C1-DBT	1.0[a]	[b]			
C2-DBT	3.5[a]	[b]			
C3-DBT	3.5[a]	[b]			
Total PAH (11 Parent PAH)	28.0[c]	[b]			
Total PAH (11 Parent + alkylated PAH with LCs)	56.5[d]	[b]			

CBs					
Compound	**LC (µg/kg dry weight)**	**BAC (µg/kg dry weight) (T_0)**	**EAC (µg/kg dry weight)**	**EC (µg/kg dry weight) (T_1)**	**$EAC^{passive}$ (µg/kg dry weight) (T_1)**
CB28	0.25[e]	[b]	13.5		3.2
CB52	0.25[e]	[b]	80		5.4
CB101	0.25[e]	[b]	5.0		6.0
CB118	0.25[e]	[b]	1.0		1.2
CB138	0.25[e]	[b]	100		15.8
CB153	0.25[e]	1.1[b]	1790		80
CB180	0.25[e]	[b]	26.5		24
ΣICES7CBs	1.0[f]	4.6[b]			
Trace metals (µg/kg dry weight) – mussels					
Determinand	**LC (µg/kg dry weight)**	**BAC (µg/kg dry weight) (T_0)**	**EAC (µg/kg dry weight)**	**EC (µg/kg dry weight) (T_1)**	**$EAC^{passive}$ (µg/kg dry weight) (T_1)**
Hg	50[g]	140[h]	10	2,500 (500 ww[i] x 5)	
Cd	600[g]	1,940[h]	280	5000 (1,000 ww[i] x 5)	
Pb	800[g]	1,520[h]	8,500	7,500 (1,500 ww[i] x 5)	
Trace metals (µg/kg dry weight) – oysters					
Hg	100[j]	[k]		2,500	
Cd	1,800[j]	[k]		5,000	
PB	800[j]	[k]		7,500	

[a]low concentrations (LC) proposed at MCWG 2008 from the 10th percentile of datasets (Scotland, Spain and France)

[b]Background Assessment Concentrations (BACs) used in the 2005/6 MON assessment to be defined/re-defined for updated BCs or LCs

[c]includes 8 of the 9 parent CEMP PAHs, benzo[*bj*]fluoranthene, benzo[*k*]fluoranthene and benzo[*e*]pyrene.

[d]includes 11 parent PAHs and selected alkylated PAHs. LCs were not proposed for anthracene or naphthalene nor for the alkylated naphthalenes due to a high proportion of samples in the datasets for which the values were below the limits of quantification for these PAHs

[e]LC = 2 x QUASIMEME constant error

[f]LC = 8 x QUASIMEME constant error

[g]low concentrations (LC) proposed at ICES MCWG 2008, median of regional medians

[h]BACs used in 2006/7 MON assessment to be redefined for new LCs

[i] ww, wet weight

[j]calculated using conversion factors proposed at ASMO 08 by France(3)

[k]To be calculated

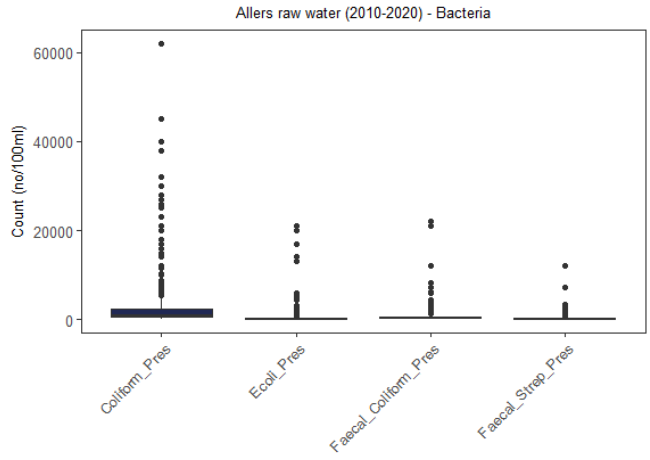
8 Pesticides highlighted to present a risk to the Exe catchment Surface Water Safeguard Zone

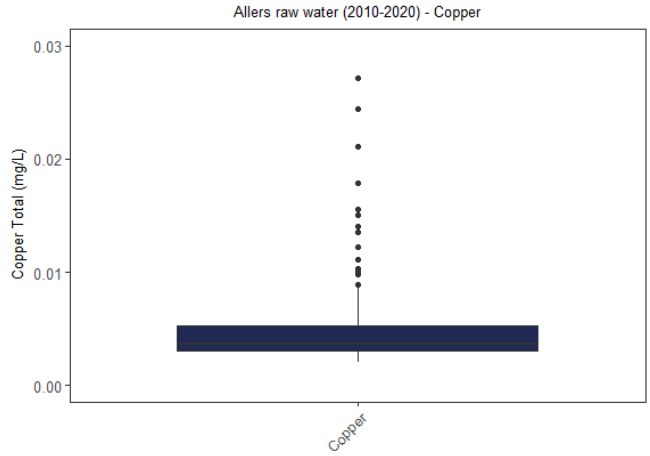
and physical-chemical properties underlying their potential to leach from agricultural land

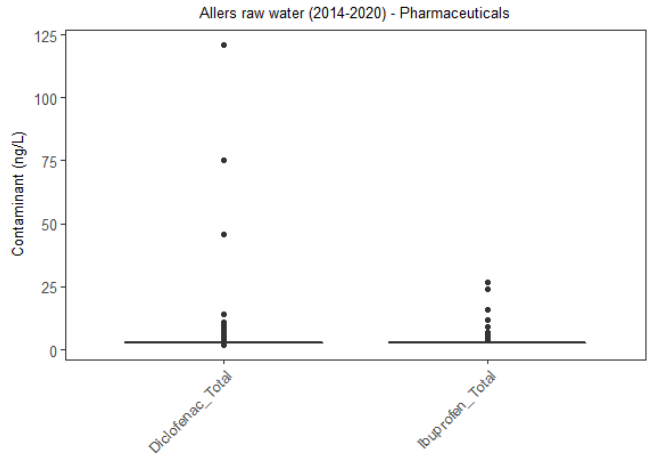
Soil adsorption coefficient (K_f) is the ratio between the amount of pesticide which is adsorbed (bound) to soil particles divided by the amount which is dissolved and mobile in soil pore water.
EC50 is effective concentration causing 50% reduction in growth of freshwater algae (sensitive species)
** EC50 for invertebrates for the slug killer metaldehyde is >78.4 µg/L*
The maximum allowable concentration for Mecoprop in saltwater is 1.7 µg/L (Environmental Quality Standard based on saltwater algae).
LC50 is lethal concentration (oral dose) causing 50% mortality in mammals (indication of human toxicity)

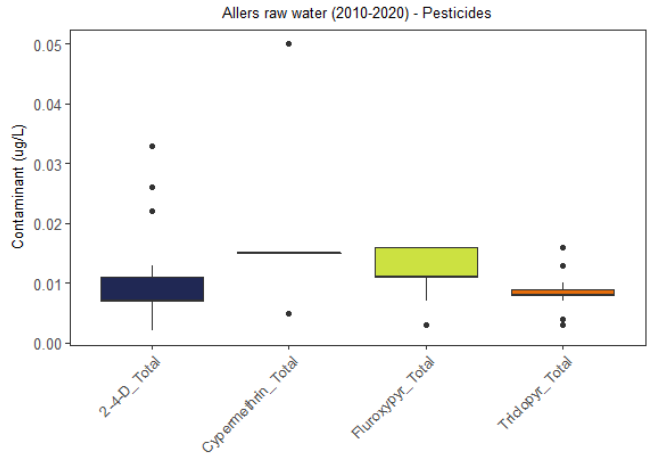
Pesticide	Type	Water solubility @ 20 °C (mg/L)	Soil adsorption coefficient (K_f)	Degradability (half-life in field soil in days)	Toxicity to freshwater algae (EC50 in µg/L)	Toxicity to mammals (LC50 in µg/L)
Chlorotoluron	Herbicide	76	1.3	12.5	82	>10000
MCPA	Herbicide	29390	0.94	25	79.8	962
Mecoprop	Herbicide	250000	1.54	21	16.2	431
Triclopyr	Herbicide	8100	1.02	30	181	630
Metaldehyde	Molluscicide	188	0.69	5.1	75.9*	283

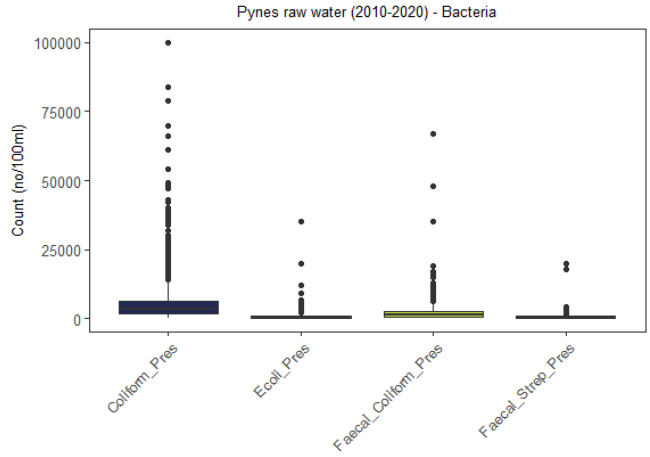
9 South West Water monitoring data indicating the quality of raw water taken in at Allers and Pynes Water Treatment Works (2010-2020)

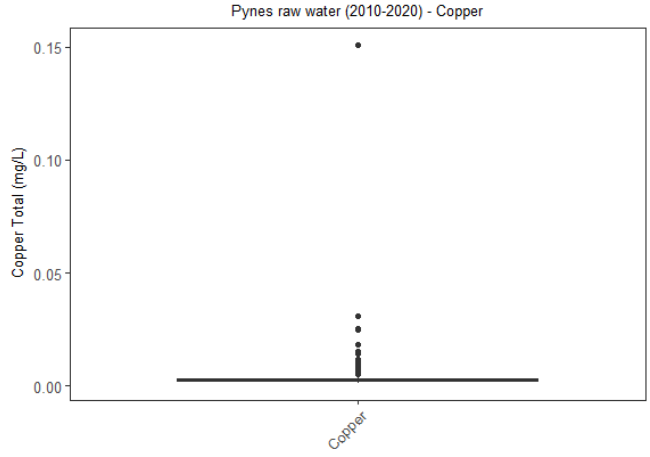


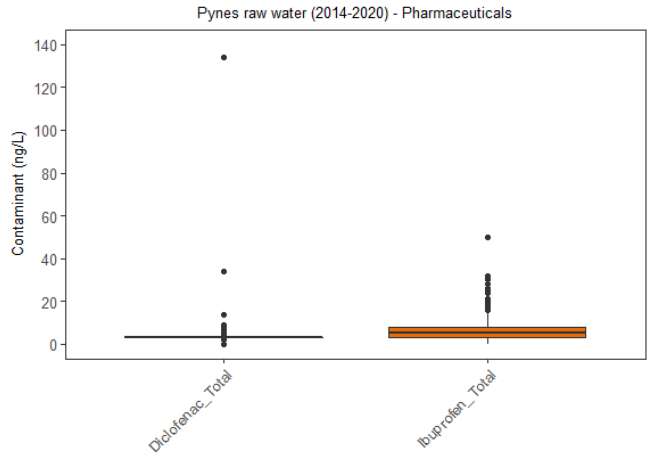


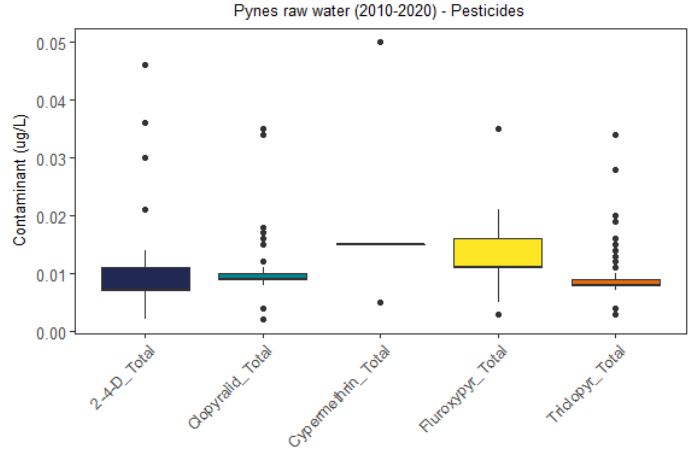



Allers raw water (2010-2020) - Pesticides
Contaminant (ug/L)
0.05
0.04
0.03
0.02
0.01
0.00
2-4-D_Total
Cypermethrin_Total
Fluroxypyr_Total
Triclopyr_Total


Pynes raw water (2010-2020) - Bacteria
Count (no/100ml)
100000
75000
50000
25000
0
Coliform_Pres
Ecoli_Pres
Faecal_Coliform_Pres
Faecal_Strep_Pres


Pynes raw water (2010-2020) - Copper
Copper Total (mg/L)
0.15
0.10
0.05
0.00
Copper


Pynes raw water (2014-2020) - Pharmaceuticals
Contaminant (ng/L)
140
120
100
80
60
40
20
0
Diclofenac_Total
Ibuprofen_Total


Pynes raw water (2010-2020) - Pesticides
Contaminant (ug/L)
0.05
0.04
0.03
0.02
0.01
0.00
2-4-D_Total
Clopyralid_Total
Cypermethrin_Total
Fluroxypyr_Total
Triclopyr_Total

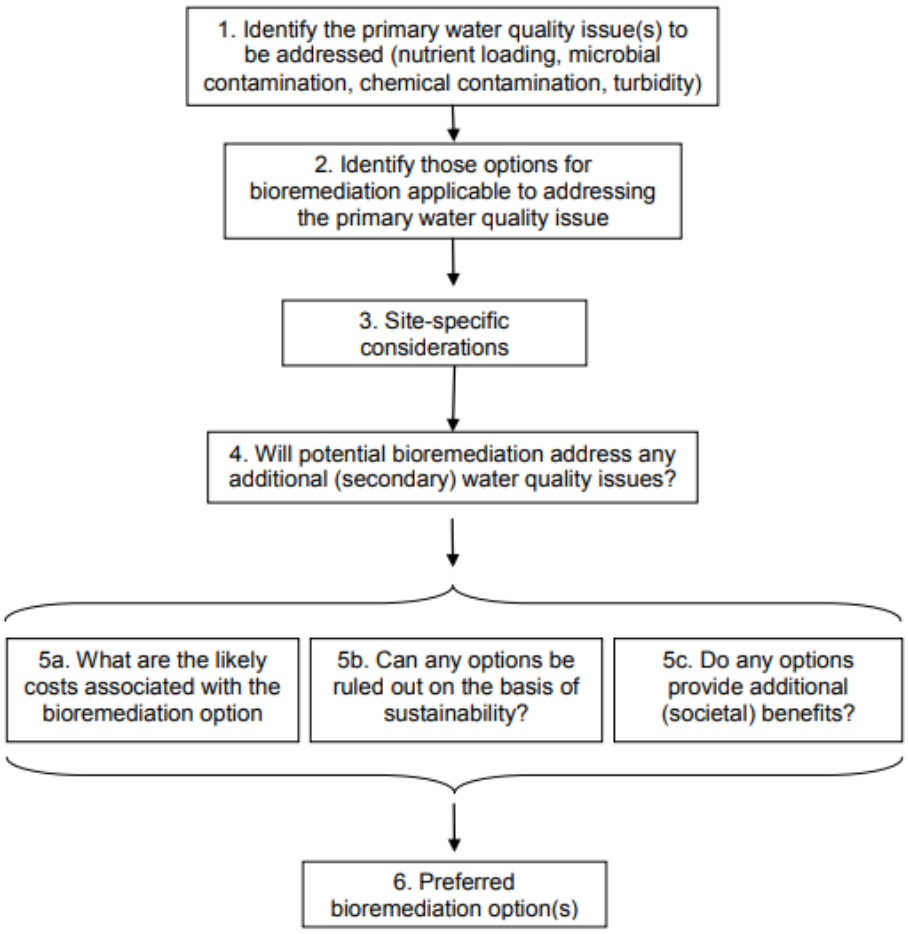
10 The use of bivalve shellfish to bio-remediate water quality in the Exe Estuary

– worked example from MMO Project No: 1105 on Environmental remediation in South Marine Plan Areas (MMO, 2016)

The Exe Estuary has multiple water quality issues:

- The Exe estuary has a well-documented problem with microbial contamination of shellfish.
- The estuary also fails to meet Water Framework Directive standards based on chemical status.
- The catchment area is a Nitrate Vulnerable Zone, and although not a designated eutrophication sensitive area, inorganic nutrient concentrations are too high at present to allow a good status classification under the WFD. A rapidly increasing human population in the catchment could further increase nutrient inputs in the next 20 years.
- High turbidity (as well as nutrient concentrations) is also a potential threat to health of existing intertidal and subtidal seagrass populations. However, it is of note that turbidity may be a limiting factor on the use of the nutrients by the phytoplankton and reducing it may increase the sensitivity of the waters to further eutrophic symptoms.
- Water quality managers have to be aware of potentially conflicting issues, so that solving one problem does not increase another.

The process of selecting the most suitable bioremediation option for a given site follows the steps outlined in the figure below.



Step 1: The Exe requires bioremediation for all of the main water quality issues highlighted (bulleted) above, but the primary issue of concern is judged to be microbial contamination due to the economic value of the shellfish industry at this location. Limiting factors in the Exe estuary for remediation techniques are the lack of available space (< 20 km2) and multiple uses by other sectors such as recreation (Exe Estuary Management Partnership, 2014b). However, paradoxically the remediation of the microbial contamination would increase that recreation use. Identification of microbial contamination input sources followed by hydrodynamic modelling would be necessary to identify the best possible locations for a bioremediation facility to be installed.

Step 2: South marine plan policies give clear guidance that proposals or activities which can deliver an improvement to estuarine water quality (policy S-WQ3b) will be supported by marine planning. Policy S-BIO-7c is more specific and indicates that water filtration, nutrient reduction and chemical sequestration ecosystem service will be supported. Following this direction, the Exe Estuary Management Partnership and all relevant agencies would review the most suitable bioremediation technology. The most effective reduction in microbial loading is via bio-filtration, with rope-grown mussels (*Mytilus edulis*) having the highest efficiency (and therefore requiring least area).

Step 3: Rope-grown mussels would also have the secondary effect of reducing the nutrient load of the Exe Estuary and surrounding waters (noting that locally, in the vicinity of the farm, that metabolically-released ammonia may cause seawater concentrations to be elevated to levels above ambient). It is possible that the chemicals in breach of Environmental Quality Standards may also be removed by bioaccumulation in mussel tissue; this would require further research and modelling of contaminant sources with respect to water flows. Turbidity would probably be reduced in the vicinity of the farm due to phytoplankton consumption and trapping of sediment particles in pseudofaeces. However, rope-grown systems require a water depth of more than 10 m, and this condition severely limits the number of suitable locations in the Exe itself. The next most suitable bioremediation option could be the bottom culture of mussels or oysters (*Ostrea edulis* or *Magallana gigas*, which although less efficient than a rope-grown system, would still have significant biofiltration capacity.

Step 4: The suitability of establishing bottom cultures of bivalves can then be compared with the other drivers: cost, sustainability, societal benefits and conflicts with other marine policies. Draft marine policies have been proposed to regulate the interaction of static objects in the water with recreational boating (S-TR-2c), and to avoid adversely influencing tourism or recreational activities (S-TR-2d). The relative weighting of each driver would become apparent during, for example, stakeholder consultation meetings. Bottom cultivation of all three species is rated as low-to-moderately expensive, with native oyster (*Ostrea edulis*) cultivation scoring high for sustainability, and equal with mussels for additional societal benefits. In this case, the selection of a bioremediation option which, after GIS mapping of constraints in the estuary, could offer a sustainable solution and a wide range of additional benefits to society (e.g. reef-forming habitat, fish nursery function and waste burial).

11 Consented continuous sewage discharges contained within the Exe Estuary catchment, Exe Estuary and Lyme Bay West

Treatment works	NGR	Treatment	Dry weather flow (m3 day-1)
ALLER GROVE STW	SY0529096950	BIOLOGICAL FILTRATION	9
ASHILL STW	ST0860011900	Unspecified	Unspecified
AYLESBEARE STW	SY0358091860	BIOLOGICAL FILTRATION	103
BAMPTON WWTW	SS9541021790	BIOLOGICAL FILTRATION	230
BICKLEIGH STW	SS9385007300	Unspecified	Unspecified
BRAMPFORD SPEKE STW	SX9314097070	BIOLOGICAL FILTRATION	104.54
BRIDGETOWN WWTW	SS9230033230	BIOLOGICAL FILTRATION	Unspecified
BROMPTON REGIS STW	SS9553031200	Unspecified	Unspecified
BRUSHFORD WWTW	SS9267025860	BIOLOGICAL FILTRATION	124
BUCKLAND STW	SX9606071430	BIOLOGICAL FILTRATION	21818
BURLESCOMBE WWTW	ST0653016970	BIOLOGICAL FILTRATION	155
BUTTERLEIGH STW	SS9740007750	Unspecified	Unspecified
CADBURY CROSS STW	SS9065005050	Unspecified	Unspecified
CADELEIGH STW	SS9153008120	Unspecified	Unspecified
CHERITON BISHOP STW	SX7757093550	BIOLOGICAL FILTRATION	144
CHERITON FITZPAINE WWTW	SS8576006130	BIOLOGICAL FILTRATION	115
CLYST HYDON STW	ST0367001620	BIOLOGICAL FILTRATION	7.13
COWLEY BRIDGE STW	SX9064095420	Unspecified	Unspecified
CULLOMPTON WWTW	ST0216006080	BIOLOGICAL FILTRATION	2955
CULMSTOCK STW	ST0992013680	BIOLOGICAL FILTRATION	118
DAWLISH STW	SX9742076470	UV DISINFECTION	4856
DULFORD STW	ST0685005950	Unspecified	Unspecified
DULVERTON SEPTIC TANK	SS9133027640	SEPTIC TANK	Unspecified
DULVERTON WWTW	SS9172027190	BIOLOGICAL FILTRATION	468
DUNKESWELL STW	ST1519008580	BIOLOGICAL FILTRATION/ REED BED	314
EXETER COUNTESS WEIR STW	SX9497089050	UV DISINFECTION	40486
EXFORD STW	SS8567038160	BIOLOGICAL FILTRATION	120
EXMOUTH STW	SY0379079190	UV DISINFECTION	11825
FORETOWN STW	ST0315000010	BIOLOGICAL FILTRATION	4.8
HALBERTON STW	ST0113012320	BIOLOGICAL FILTRATION	208
HELE WHITEWAYS STW	SS9955002050	Unspecified	Unspecified
HELE VILLAGE STW	SS9935002350	Unspecified	Unspecified
HEMYOCK WWTW	ST1339013880	ACTIVATED SLUDGE	446
HOCKWORTHY STW	ST0290020270	BIOLOGICAL FILTRATION	Unspecified
HOLCOMBE ROGUS WWTW	ST0639017980	BIOLOGICAL FILTRATION	119
HUNTSHAM STW	ST0045020350	Unspecified	Unspecified
KENN & KENNFORD STW	SX9276085270	BIOLOGICAL FILTRATION	262
KENTON & STARCROSS	SX9748283180	UV DISINFECTION	1750
KERSWELL STW	ST0782006330	BIOLOGICAL FILTRATION	Unspecified

Treatment works	NGR	Treatment	Dry weather flow (m3 day-1)
KNOWLE STW	SS7831001590	Unspecified	Unspecified
LORDS MEADOW WWTW	SX8572099120	CHEMICAL-PHOSPHATE STRIPPING	4100
MAMHEAD STW	SX9340080350	Unspecified	Unspecified
MARSH GREEN WWTW	SY0419093810	REEDBED	28
MOREBATH STW	SS9535024770	Unspecified	Unspecified
NEWBUILDINGS STW	SS7950003500	Unspecified	Unspecified
NEWTON ST CYRES STW	SX8885098140	ACTIVATED SLUDGE	300
NORTH BOVEY STW	SX7452093750	Unspecified	Unspecified
OAKFORD STW	SS9113021420	Unspecified	Unspecified
OAKLEIGH WWTW	ST1209008480	BIOLOGICAL FILTRATION	Unspecified
OLDWAY END STW	SS8690024950	Unspecified	Unspecified
OTTERTON STW	SY0923084090	UV DISINFECTION	1643
PENNYMOOR STW	SS8646011670	BIOLOGICAL FILTRATION	34
PLYMTREE STW	ST0406003960	BIOLOGICAL FILTRATION	96.8
PORT ROAD WWTW	SX9486079650	BIOLOGICAL FILTRATION	3.6
POUGHILL STW	SS8653008290	PACKAGE TREATMENT PLANT	Unspecified
PUDDINGTON STW	SS8360010730	Unspecified	Unspecified
REWE WWTW	SX9455098840	TREATMENT	429
SAMPFORD PEVERELL WWTW	ST0387013360	WWTW	296
SANDFORD WWTW	SS8339002240	TREATMENT	118
SHILLINGFORD ABBOT STW	SX9135088650	Unspecified	Unspecified
SHILLINGFORD ST GEORGE WWTW	SX9075088050	Unspecified	Unspecified
SHILLINGFORD STW	SS9794023780	Unspecified	Unspecified
SHUTE WWTW	SS8954000080	BIOLOGICAL FILTRATION	12.3
SIDELING CLOSE STW	SX8823087870	PACKAGE TREATMENT PLANT	13.5
SILVERTON WWTW	SS9712001420	ACTIVATED SLUDGE	563.64
SPREYTON STW	SX6987097530	BIOLOGICAL FILTRATION	34
STOODLEIGH STW	SS9250019000	Unspecified	Unspecified
TEDBURN ST MARY STW	SX8248093950	BIOLOGICAL FILTRATION	383
THORVERTON WWTW	SS9359001680	BIOLOGICAL FILTRATION	309
TIVERTON STW	SS9530010300	BIO-FILTRATION & CHEMICAL-PHOSPHATE STRIPPING	6900
UFFCULME WWTW	ST0622011860	BIOLOGICAL FILTRATION	564
UPLOWMAN STW	ST0132015270	BIOLOGICAL FILTRATION	42
WASHFIELD STW	SS9360015300	Unspecified	Unspecified
WHIDDON DOWN STW	SX6929092440	BIOLOGICAL FILTRATION	41
WILLAND WWTW	ST0420010160	TREATMENT	613
WIMBLEBALL RESERVOIR WWTW	SS9640031000	SEPTIC TANK	6.3
WINSFORD STW	SS9110034630	BIOLOGICAL FILTRATION	84
WOODBURY WWTW	SX9979086780	BIOLOGICAL FILTRATION	408
BRADNINCH WWTW	ST0057003310	PRIMARY SETTLEMENT	404
YEOFORD WWTW	SX7894098740	BIOLOGICAL FILTRATION	493
OLD WOODBURY SALTERTON STW	SY0128089340	BIOLOGICAL FILTRATION	201

12 Consented intermittent sewage discharges contained within the Exe Estuary catchment, Exe Estuary and Lyme Bay West

Name	Receiving Environment	NGR	Treatment (if applicable)
121A ST. KATHERINES ROAD CSO	MINCINGLAKE STREAM	SX9419093870	SCREENING
14 CLIFTON ROAD CSO	RIVER EXE VIA SWS	SX9223091880	NONE
15 HAMLIN LANE CSO	NORTH BROOK	SX9417093410	NONE
19 HEAVITREE ROAD CSO	RIVER EXE VIA SWS	SX9223091880	NONE
2 DRYDEN ROAD CSO	NORTH BROOK VIA SWS	SX9430091240	NONE
21 LOWER TOWN CSO	TRIBUTARY OF SPRATFORD STREAM	ST0328014230	NONE
21 WONFORD STREET CSO	NORTHBROOK VIA SWS	SX9429091240	NONE
23 KING EDWARD STREET CSO	RIVER EXE VIA SWS	SX9109093800	NONE
28 CLIFTON ROAD CSO	RIVER EXE VIA SWS	SX9224091880	NONE
34 CLIFTON ROAD CSO	RIVER EXE VIA SWS	SX9224091890	NONE
49 EXETER ROAD CSO	ENGLISH CHANNEL VIA SWS	SX9679077050	SCREENING
50 CASTLE PARK CSO	STREAM (S)	ST1361413585	NONE
ARGYLL ROAD PUMPING STATION	TRIBUTARY OF DURYARD STREAM	SX9212094980	FLOTATION
ASH GROVE CSO	A TRIBUTARY OF THE EXE ESTUARY	SY0003083070	NONE
AYLESBEARE STW	AYLESBEARE BROOK	SY0358091860	SCREENING
BAMPTON STREET CSO	RIVER EXE	SS9535012800	NONE
BAMPTON WWTW	RIVER BATHERM	SS9541021790	SCREENING
BARNHILL PUMPING STATION	GROUNDWATER VIA INFILT SYSTEM	SX9273098460	NONE
BARRINGTON STREET CSO	RIVER LOWMAN	SS9577012580	SCREENING
BARTON HILL/BRUNSWICK CSO	DAWLISH WATER (S)	SX9591076670	SCREENING
BATHILL PSEO	STREAM (S)	ST0361107084	NONE
BELLE PARADE CSO	STREAM (S)	SS8448600412	NONE
BESSOM BRIDGE PUMPING STATION	WIMBLEBALL LAKE	SS9740031871	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN

Name	Receiving Environment	NGR	Treatment (if applicable)
BICKLEIGH STW	TRIB OF RIVER EXE	SS9401007000	NONE
BLUE BALL PUMPING STATION	TRIB OF RIVER CLYST	SX9686090930	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
BONHAY PARK CSO	RIVER EXE	SX9140092310	SCREENING
BONHAY ROAD CSO	TIDAL RIVER EXE(E)	SX9783081900	SCREENING
BOOBERY ROAD COMBINED SEWER OVERFLO	TRIB OF SPRATFORD STREAM	ST0303014370	NONE
BRAMPFORD SPEKE LAKE BRIDGE PSEO	STREAM (S)	SX9275097812	NONE
BRIDGE HOUSE CSO	RIVER EXE	SS9532012540	NONE
BRIDGETOWN WWTW PS	RIVER EXE	SS9233033200	UNSPECIFIED
BRITTON STREET PSEO	RIVER BATHERN	SS9593022131	UNSPECIFIED
BROADCLYST (SIDE) PUMPING STATION	RIVER CLYST VALLEY VIA SWS	SX9851097400	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
BROMPTON REGIS STW	PULHAM RIVER(S)	SS9553031200	UNSPECIFIED
BROOK COTTAGE PUMPING STATION	NADDER BROOK	SX8911093440	SCREENING
BROOK HOUSE SSO	DAWLISH WATER (S)	SX9544076790	SCREENING
BRUSHFORD WWTW	RIVER BARLE	SS9264025890	SCREENING
BUCKLAND WASTEWATER TREATMENT WORKS	ENGLISH CHANNEL (COASTAL)	SX9606071430	SCREENING
BUDDLE LANE CSO	RIVER EXE VIA SWS	SX9300090670	NONE
BULLEN STREET COMBINED SEWER OF	TRIB OF THE RIVER EXE VIA SWS	SS9259002110	NONE
BULLER ROAD CSO	STREAM (S)	SS8448600412	NONE
BURLESCOMBE WWTW	FENACRE WATER	ST0653016980	SCREENING
BURNTHOUSE LANE CSO	NORTHBROOK VIA SWS	SX9429091240	SCREENING
CADELEIGH STW	UNNAMED WATERCOURSE(S)	SS9153008120	UNSPECIFIED
CENTRAL STATION YARD CSO	HIGHER LEAT VIA SWS	SX9147092500	SCREENING
CHERITON BISHOP PSCSO/EO	FORD BROOK (S)	SX7730093000	NONE
CHERITON BISHOP STW	FORD BROOK(S)	SX7757093550	SCREENING
CHERITON FITZPAINE WWTW	TRIBUTARY OF HOLLY WATER	SS8580006150	SCREENING
CHURCH LANE COMBINED SEWER OVERFLOW	TRIB OF RIVER CREEDY VIA SWS	SS8448000410	NONE
CHURCH ROAD CSO	ALPHIN BROOK	SX9176090270	SCREENING
CHURCH ROAD CSO	COFTON STREAM(S)	SX9718280629	SCREENING
CHURCH ROAD CSO	CRANNY BROOK	SY0416097130	SCREENING
CHURCH ROAD JCT OF CECIL ROAD CSO	RIVER EXE VIA SWS	SX9299090670	NONE
CHURCH STREET COMBINED SEWER OVERFLOW	TRIB OF RIVER CREEDY (SWS)	SS8448000410	NONE

Name	Receiving Environment	NGR	Treatment (if applicable)
CHUTE STREET CSO	RIVER EXE VIA SWS	SX9223091890	NONE
CLIFTON ROAD/JCT ALBERT ROAD CSO	RIVER EXE VIA SWS	SX9223091880	NONE
CLYST HONITON PUMPING STATION	RIVER CLYST	SX9865093690	SCREENING
COACH ROAD CSO	STREAM (S)	SS9586402917	NONE
COCKWOOD PSEO	COFTON STREAM(S)	SX9756680731	SCREENING
COFTON PSCSO/EO	COFTON STREAM(S)	SX9711880605	SCREENING
COLLETON GROVE CSO	RIVER EXE VIA SWS	SX9223091890	NONE
CORNER LANE PUMPING STATION	TRIBUTARY OF SPRATFORD STREAM	ST0074012820	SCREENING
COUNCIL YARD PSCSO/EO	TRIB RIVER CREEDY (S)	SS8447000390	NONE
COWLEYMOOR ESTATE CSO	TRIB OF RIVER LOWMAN VIA SWS	SS9610012990	NONE
CULMSTOCK SEWAGE TREATMENT WORKS	RIVER CULM	ST0992013680	SCREENING
DAWLISH (ROYAL HOTEL) PS	DAWLISH WATER(C)	SX9636076620	NONE
DAWLISH BREAKWATER SSO	LYME BAY (C)	SX9648076510	SCREENING
DAWLISH SSO (BROOK STREET)	DAWLISH WATER(S)	SX9567076740	SCREENING
DAWLISH WARREN ROAD PS	SHUTTERTON BROOK(S)	SX9760478924	SCREENING
DAWLISH WARREN ROAD PS	SHUTTERTON BROOK(S)	SX9760678925	SCREENING
DIX'S FIELD CSO	RIVER EXE VIA SW SEWER	SX9224091880	NONE
DUKE STREET PUMPING STATION	CULLOMPTON MILL LEAT	ST0238006730	SCREENING
DULFORD PSCSO/EO	WEAVER (S)	ST0697005960	NONE
DULVERTON WWTW	RIVER BARLE	SS9158027280	SCREENING
DUNKESWELL PS	DUNKESWELL STREAM(S)	ST1426007700	SCREENING
DUNKESWELL STW	RIVER MADFORD (S)	ST1519008580	SCREENING
DUNSFORD ROAD CSO	RIVER EXE VIA SWS	SX9299090670	NONE
EBFORD PUMPING STATION	RIVER CLYST (ESTUARINE)	SX9758087940	SCREENING
ELM GROVE CSO	LYME BAY (C)	SX9679077050	SCREENING
EXE BRIDGE PS	RIVER EXE(S)	SS9296024420	NONE
EXE STREET CSO	HIGHER LEAT	SX9146092510	SCREENING
EXELEIGH PSEO	RIVER EXE (E)	SX9756082430	NONE
EXETER (COUNTESS WEAR) SSO	RIVER EXE ESTUARY(E)	SX9479089240	SCREENING
EXETER (COUNTESS WEAR) SSO	RIVER EXE ESTUARY(E)	SX9497089050	SCREENING
EXETER BOWLING CLUB CSO	RIVER EXE VIA SWS	SX9223091890	NONE
EXETER COLLEGE CSO	HIGHER LEAT VIA SW SEWER	SX9147092500	SCREENING
EXETER ROAD CSO - EXMOUTH	WITHYCOMBE BROOK	SX9997082010	SCREENING

Name	Receiving Environment	NGR	Treatment (if applicable)
EXETER ROAD PUMPING STATION	COTTEY BROOK	SS9492011640	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
EXFORD STW	RIVER EXE	SS8567038160	
EXFORD STW PSEO	RIVER EXE (S)	SS8567038160	NONE
EXMOUTH SEWAGE TREATMENT WORKS	LYME BAY(C)	SY0379079190	SCREENING
EXTON NORTH PS	RIVER CLYST (ESTUARINE)	SX9769086890	SCREENING
EXTON SOUTH PUMPING STATION	WOODBURY BROOK (ESTUARINE)	SX9809086240	SCREENING
FERRY ROAD PUMPING STATION	RIVER EXE	SX9623088140	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
FIRST AVENUE SERVICE LANE CSO	NORTH BROOK VIA SWS	SX9480092300	NONE
FOLLET ROAD CSO	RIVER EXE (E)	SX9622088140	SCREENING
FORD BARTON PSEO	STREAM (S)	SS9132318219	NONE
FORE STREET CSO	KNOWLE STREAM	SY0649081880	NONE
FORGE WAY CAR PARK CSO	MILL STREAM (S)	ST0227907436	NONE
GENERALS LANE PUMPING STATION	S/WATER SYSTEM TO EXE ESTUARY	SX9766081850	SCREENING
GOLD STREET CSO	RIVER LOWMAN	SS9576012560	NONE
GRANARY LANE (NORTH) CSO	KERSBROOK CHANNEL	SY0711082740	SCREENING
GRANARY LANE CSO	TRIB OF RIVER OTTER (S)	SY0718082270	NONE
HAM LANE CSO	WOODBURY BROOK	SY0074086930	SCREENING
HAREWOOD PSEO	SURFACE (S)	SS9680030120	NONE
HARTOPP ROAD CSO	EXE ESTUARY	SX9996081460	SCREENING
HAWKINGS WAY CREDITION CSO	TRIB OF RIVER CREEDY VIA SWS	SS8448000410	NONE
HEATH CROSS PUMPING STATION	TRIB OF RIVER CLYST	SX9882096880	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
HEAVITREE PLEASURE GROUND CSO	NORTH BROOK VIA SWS	SX9479092290	NONE
HEMYOCK PSCSO/EO	RIVER CULM (S)	ST1384013930	NONE
HEMYOCK STW PSEO	RIVER CULM (S)	ST1384013940	NONE
HEMYOCK WASTEWATER TREATMENT WORKS	RIVER CULM	ST1339013880	SCREENING
HESCANE PARK CSO	YEO(S)	SX7742493169	NONE
HIGH MARSH PSEO (HALF MOON VILLAGE)	RIVER CREEDY(S)	SX8967097460	SCREENING
HOLCOMBE PUMPING STATION	SHELL COVE, LYME BAY(C)	SX9608075340	SCREENING
OLCOMBE ROGUS WWTW	TRIB OF RIVER LYNER	ST0580018240	PRIMARY SETTLEMENT
HOLLOWAY STREET	RIVER EXE VIA SWS	SX9223091880	NONE
HOWELL ROAD CSO	HIGHER LEAT VIA SWS	SX9146092500	SCREENING
HUNTSHAM STW	TRIBUTARY OF RIVER LOWMAN(S)	ST0052020230	UNSPECIFIED

Name	Receiving Environment	NGR	Treatment (if applicable)
IMPERIAL ROAD TANK CSO	EXE ESTUARY	SX9986081110	SCREENING
IN FIELD R/0 11 GRANTLANDS	MILL BROOK (S)	ST0653212323	NONE
JEWSONS YARD CSO	RIVER YEO (S)	SX8474699207	NONE
JOCKEY HILL CSO	TRIBUTARY OF IVER CREEDY	SS8448000410	NONE
KENN AND KENNFORD PUMPING STATION	RIVER KENN	SX9275085270	SCREENING
LANGATON LANE CSO	PIN BROOK	SX9731094130	NONE
LARKBEARE HOUSE CSO	RIVER EXE VIA SWS	SX9223091890	NONE
LIME KILN PSEO	KERSBROOK CHANNEL	SY0722082100	SCREENING
LIME KILN TANK CSO	ENGLISH CHANNEL	SY0794081920	SCREENING
LITTLE KNOWLE CSO	KNOWLE STREAM	SY0535082260	NONE
LITTLE SILVER PUMPING STATION	RIVER LOWMAN	SS9534011980	SCREENING
LITTLE SILVER PUMPING STATION	RIVER LOWMAN	SS9544012080	SCREENING
LORDS MEADOW WWTW	RIVER YEO/RIVER CREEDY	SS8488000620	SCREENING
LORDS MEADOW WWTW	RIVER YEO	SX8475099210	
LOWER AVENUE CSO	NORTH BROOK VIA SWS	SX9479092290	NONE
LOWER MILL COMBINED SEWER OVERFLOW	RIVER BARLE	SS9125027720	NONE
LOWER NORTH STREET CSO	HIGHER LEAT VIA SW SEWER	SX9147092500	SCREENING
LYMPSTONE OUTFALL PUMPING STATION	RIVER EXE ESTUARY	SX9874083860	SCREENING
MAER PUMPING STATION & TANK CSO	ENGLISH CHANNEL	SY0111079660	SCREENING
MAER ROAD CSO EXMOUTH	LITTLEHAM BROOK	SY0107080060	SCREENING
MAGDALEN ROAD CSO	RIVER EXE VIA SWS	SX9223091880	NONE
MAGELAKE PS	RIVER CULM(S)	ST0703812505	NONE
MAIN ROAD CSO	BERRY BROOK	SX9456087320	NONE
MARINA PSEO	DAWLISH (C)	SX9712277366	NONE
MARINE PARADE CSO	KNOWLE STREAM	SY0664081860	SCREENING
MARSH GREEN WASTEWATER TRTMNT WORKS	FORD STREAM (S)	SY0419093810	SCREENING
MEADOW ROAD TANK CSO	KNOWLE STREAM	SY0597082060	SCREENING
MIDDLE MILL LANE CSO	MILL LEAT	ST0228007350	SCREENING
MILBURY LANE PUMPING STATION	TRIB OF THE BERRY BROOK	SX9483087970	SCREENING
MILBURY LANE PUMPING STATION	TRIB OF THE BERRY BROOK	SX9500088340	SCREENING
MILL RACE COMBINED SEWER OVERFLOW	MILL RACE, RIVER EXE	SX9341090620	NONE
MILL ROAD PUMPING STATION	RIVER EXE (ESTUARINE)	SX9397090120	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
MILL STREET COMBINED SEWER OVERFLOW	TRIB RIVER CREEDY (S)	SS8418900304	NONE
MILL STREET COMBINED SEWER OVERFLOW	TRIB OF RIVER CREEDY VIA SWS	SS8419000300	NONE

Name	Receiving Environment	NGR	Treatment (if applicable)
MILLMOOR CSO	RIVER CULM(S)	ST1007513766	NONE
MONKERTON PUMPING STATION	PIN BROOK	SX9671093970	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
MOOR LANE PSCSO/EO	STREAM (S)	SX9645097062	NONE
MOREBATH STW	SHUTTERN BROOK (S)	SS9535024770	UNSPECIFIED
NEWPORT PARK PUMPING STATION	TRIB OF RIVER EXE (ESTUARINE)	SX9541088990	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
NEWTON ST CYRES STW	(S) RIVER CREEDY	SX8885098140	SCREENING
NORTH LAWN COURT CSO	NORTH BROOK VIA SWS	SX9479092300	NONE
NORTH STREET CAR PARK CSO	TRIB OF RIVER CREEDY VIA SWS	SS8448600412	NONE
NORTHBROOK GOLF COURSE LOWER CSO	NORTHBROOK	SX9382090390	SCREENING
NORTHBROOK PARK GOLF CRSE UPPER CSO	NORTHBROOK	SX9383090400	SCREENING
O/S 25 OAK CRESCENT PSEO	TRIB OF CULM (S)	ST0310010480	NONE
O/S HONITON INN	RIVER EXE (S)	SX9254792833	NONE
OAKFORD STW	TRIB OF IRON MILL STREAM (S)	SS9115021420	UNSPECIFIED
OAKLANDS PSEO	COASTAL (C)	SX9610475854	NONE
OKEHAMPTON ROAD CSO	RIVER EXE VIA SWS	SX9299090670	NONE
OLD TIVERTON ROAD CSO	STREAM(S)	SS8448600412	NONE
OLD WOODBURY SALTERTON STW CSO	TRIB OF GRINDLE BROOK VIA SWS	SY0128089340	SCREENING
PARKLAND DRIVE PUMPING STATION	NORTHBROOK VIA SWS	SX9430091240	NONE
PATHFINDER TERMINAL PS	LILLY BROOK(S)	SX8248093950	SCREENING
PENCEPOOL FARM PUMPING STATION	TRIBUTARY OF RIVER CLYST (S)	ST0522003090	SCREENING
PENNSYLVANIA ROAD CSO	HIGHER LEAST VIA SW SEWER	SX9147092500	SCREENING
PENNYMOOR SEWAGE TREATMENT WORKS	A TRIBUTARY OF BINNEFORD WATER	SS8645011630	SCREENING
PHEAR PARK PSEO/CSO	EXE ESTUARY	SX9996081460	SCREENING
PLYMTREE STW	RIVER WEAVER	ST0406003960	PRIMARY SETTLEMENT
PLYMTREE STW	AN UNNAMED TRIB-RIVER CLYST	ST0491002790	SCREENING
POUNDSHILL PSCO/EO	STREAM	ST0606418853	NONE
PUDDINGTON STW	RIVER CREEDY	SS8360010730	NONE
QUAY HILL COMBINED SEWER OVERFLOW	HIGHER LEAT	SX9192092170	NONE
QUAY HILL CSO	HIGHER LEAT VIA SW SEWER	SX9194092150	SCREENING
R/O 13 WEST STREET CSO	RIVER BATHERN (S)	SS9546622016	NONE
R/O IMPERIAL HOTEL CSO	TADDIFORDE BROOK	SX9141093490	NONE
RAGSFIELD PSEO	TRIB OF R. CREEDY	SS8442300595	NONE
REWE WASTEWATER TREATMENT WORKS	RIVER CULM	SX9455098840	SCREENING
ROSE COTTAGE CSO	LILLY BROOK (S)	SX8228894125	NONE

Name	Receiving Environment	NGR	Treatment (if applicable)
SAMPFORD PEVERELL WWTW	SPRATFORD STREAM	ST0387013360	SCREENING
SANDFORD PUMPING STATION	THE SANDFORD STREAM (S)	SS8309502203	NONE
SANDFORD ROSE & CROWN CSO	THE SANDFORD STREAM (S)	SS8275102304	SCREENING
SANDFORD WASTEWATER TREATMENT WORKS	TRIBUTARY OF RIVER CREEDY	SS8339002240	SCREENING
SANDY BAY HOLIDAY PARK PSEO	STRAIGHT POINT (C)	SY0398079190	NONE
SANDY LANE PUMPING STATION	LYME BAY (COASTAL)	SX9736076490	SCREENING
SANDY LANE PUMPING STATION	LYME BAY (C)	SX9742076470	SCREENING
SEA LAWNS OUTFALL CSO, DAWLISH	LYME BAY(C)	SX9679077050	NONE
SEA LAWNS PUMPING STATION	LYME BAY	SX9679077050	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
SEARLE STREET CSO	STREAM (S)	SS8448600412	NONE
SHILLINGFORD ST GEORGE WWTW CSO	ALPHIN BROOK	SX9073087980	
SHIP INN CSO	COFTON STREAM(S)	SX9752580690	SCREENING
SHOBROOKE PS	SHOBROOKE LAKE	SS8712001320	SCREENING
SHUTE WWTW	TRIB OF RIVER CREEDY	SS8954000080	SCREENING
SHUTTERTON BRIDGE PS	SHUTTERTON BROOK(S)	SX9658078540	SCREENING
SILVERTON PUMPING STATION	SILVERTON STREAM VIA SWS	SS9527003010	SCREENING
SILVERTON WWTW	HEAL-EYE STREAM	SS9712001420	SCREENING
SLITTERCOMBE LANE PSCSO/EO	RIVER KENN(S)	SX9613083470	SCREENING
SMUGGLERS LANE PSEO	BABBACOMBE BAY(C)	SX9568074640	SCREENING
SOWDEN LANE PUMPING STATION	TRIBUTARY OF EXE ESTUARY (S)	SX9912083670	SCREENING
SPREYTON STW	COOMBE STREAM(S)	SX6985097520	SCREENING
ST MARTINS LANE CSO	STREAM (S)	SS8448500412	NONE
ST NICHOLAS CHURCH PSEO	BROCKERY RIVER (S)	SS9189725652	NONE
ST SIDWELLS SCHOOL CSO	HIGHER LEAT VIA SW SEWER	SX9147092500	SCREENING
STATION ROAD PSCSO/EO WILLAND	SPRATFORD STREAM	ST0332111417	
STATION ROAD PSEO	RIVER CREEDY(S)	SX8810098560	SCREENING
STOKE CANON PSEO	R CULM (S)	SX9371097598	SCREENING
STOKE MEADOW CLOSE PUMPING STATION	MINCINGLAKE STREAM VIA SWS	SX9330094620	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
STONEYFORD PSCSO/EO	RIVER CULM (S)	ST0287607453	SCREENING
STOODLEIGH STW	STOODLEIGH STREAM	SS9243018980	

Name	Receiving Environment	NGR	Treatment (if applicable)
SWEETBRIER LANE CSO	NORTHBROOK	SX9481092600	SCREENING
SWEETHAM SEWAGE PUMPING STATION	RIVER CREEDY(S)	SX8813098580	SCREENING
TALATON PSCSO/EO	STREAM (S)	SY0685699822	NONE
TAN LANE PUMPING STATION	TRIB OF THE ALPHIN BROOK	SX9204091350	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
TEDBURN ST MARY STW	LILLY BROOK(S)	SX8248093950	SCREENING
TEDBURN ST MARY STW	LILLY BROOK(S)	SX8250093940	SCREENING
TEMPLE ROAD CSO	RIVER EXE VIA SWS	SX9223091880	NONE
THE COLLEGE IDE CSO	FORDLAND BROOK	SX9001090600	SCREENING
THE GREEN TANK CSO	KNOWLE STREAM	SY0617081990	SCREENING
THE WALRONDS CSO	RIVER EXE	SS9526011910	NONE
THORNTON HILL CSO	HIGHER LEAT VIA SWS	SX9147092500	NONE
THORVERTON WWTW	(S) RIVER EXE	SS9359001680	SCREENING
TIVERTON STW	RIVER EXE	SS9530010300	SCREENING
TOPSHAM ROAD JCT ROBERS ROAD CSO	RIVER EXE VIA SWS	SX9223091890	NONE
TURLAKE SPS	TRIB OF R EXE	SX9049296109	
UFFCULME PUMPING STATION	RIVER CULM	ST0632011960	SCREENING
UFFCULME WWTW	RIVER CULM	ST0622011860	SCREENING
UPLOWMAN STW	UPLOWMAN STREAM	ST0132015270	SCREENING
VIADUCT HIGH LEVEL STORM TANK CSO	DAWLISH WATER(C)	SX9630076660	SCREENING
WAR MEMORIAL CSO	RIVER CULM (S)	ST0973713696	NONE
WASHFIELD STW	TRIBUTARY OF RIVER EXE(S)	SS9353015050	UNSPECIFIED
WEAVER CRESCENT CSO	RIVER EXE	SS9481013410	SCREENING
WELL STREET CSO	HIGHER LEAT VIA SW SEWER	SX9147092500	SCREENING
WEST CLIFF COMBINED SEWER OVERFLOW	DAWLISH WATER	SX9569076710	SCREENING
WESTEXE PUMPING STATION	RIVER EXE	SS9532012010	SCREENING
WESTWOOD PSEO	TRIB RIVER YEO (S)	SS8225800129	NONE
WHIDDON DOWN STW	FINGLE BROOK(S)	SX6929092440	SCREENING
WILLAND WASTEWATER TREATMENT WORKS	TRIB OF RIVER CULM	ST0419010600	SCREENING
WILLAND WASTEWATER TREATMENT WORKS	TRIB OF RIVER CULM	ST0420010160	SCREENING
WINSFORD PSCSO/EO	RIVER EXE(S)	SS9072034830	SCREENING
WITHYBRIDGE PUMPING STATION	RIVER CLYST	SX9747095730	NO TREATMENT REQUIRED - GOOD ENGINEERING DESIGN
WOODBURY WWTW	WOODBURY BROOK	SX9979086780	SCREENING
WOODLAND AVE CSO	STREAM DIS TO LYME BAY (S)	SX9509074280	SCREENING
WWTW AT BRADNINCH	RIVER CULM	ST0057003310	SCREENING
YEOFORD WASTEWATER TREATMENT WORKS	RIVER YEO	SX7894098740	SCREENING

13 Spill frequencies and durations for intermittent discharges into the Exe Estuary and Lyme Bay West in 2020

Intermittent discharge	Permit Number	Spill Frequency Threshold	Spill Frequency (>threshold)	Total spill duration (hrs)	Action
Sandy Lane Lf Spst_pscsoeo_dawlish	201966	5	**56**	63	SOAF investigation in 2023
Viaduct Sps_pscsoeo_dawlish	200824/PC/01	5	**20**	38	-
Cofton Sps_pscsoeo_dawlish	202627	14	**45**	384	SOAF investigation in 2023
Ship Inn_cso_cockwood	202630	14	11	1	-
Warren Road Sps_pscsoeo_dawlish	202631	14	**54**	71	SOAF investigation in 2022
Bonhay Rd_cso_starcross	202625	14	**20**	129	-
Slittercombe Spst_pscsoeo_kenton	202626	14	11	55	-
Exminster Spst_pscsoeo_exminster	201580	40	**47**	155	-
Church Road_cso_alphington	201933	40	23	6	-
Holloway St_cso_exeter	201925	40	**74**	127	-
Lwr North St I_cso_exeter	201373	40	**70**	141	-
Dunsford Rd_cso_exeter	201932	40	32	43	-
Mill Race/river Exe_cso_exeter	201896	40	33	85	-
Northbrook Golf Course Upper_cso_exeter	201914	40	20	23	-
Countess Wear Stw_so_exeter	202475	40	23	66	-
Countess Wear Stw_sso_exeter	202475	40	**65**	202	UV treatment in 2018
Follet Rd_cso_exeter	201636/CS/01	40	28	14	-
Odams Wharf Sps_pscsoeo_ebford	202365	40	**164**	404	SOAF investigation in 2021
Exton North Sps_pscsoeo_exmouth	203229	40	**146**	2003	SOAF investigation in 2022
Ham Ln_cso_woodbury	201815	40	**53**	97	SOAF investigation in 2021
Exton South Sps_pscsoeo_exmouth	203230	40	**47**	451	SOAF investigation in 2022
Lympstone Outfall Sps_pscso_lympstone	202165	14	**24**	22	SOAF investigation in 2021
Exeter Rd_cso_exmouth	200128/CS/01	14	**66**	56	SOAF investigation in 2023
Hartop Road_pscsoeo_exmouth	200122/CS/01	14	**38**	81	SOAF investigation in 2023

Spill frequency (SF) trigger permit (spills per year as 10 year averages: 40 spills for water bodies; 14 spills for shellfish waters; 5 spills for bathing waters - per bathing season) (SWW, 2021a).

Intermittent discharge	Permit Number	Spill Frequency Threshold	Spill Frequency (>threshold)	Total spill duration (hrs)	Action
Imperial Rd - Tank_cso_exmouth	200123/CS/01	5	**14**	103	-
Maer Rd Sps_cso_exmouth	200125/CS/01	5	**62**	858	Investigation in 2021 for amp7 improvements
Royal Hotel Sps_pseo_dawlish	201450	5	1	1	-
Piermont Pl/jubilee Bridge_cso_dawlish	201449	5	**7**	3	-
Barton Hill/brunswick Pl_cso_dawlish	200823/CS/01	5	**25**	14	SOAF investigation in 2023
Brook St Manor Gardens_cso_dawlish	200821/CS/01	5	**33**	11	AMP7 -reduction to 2 significant spills scheme in 2021
Brook House_cso_dawlish	200820/CS/01	5	1	2	-
Teignmouth Road_pscsoeo_holcombe	202110	5	**56**	703	NOT designed to meet bw Directive.
Smugglers Lane Sps_pscsoeo_dawlish	203688	5	**57**	200	SOAF investigation in 2023
Woodland Av_cso_holcombe	202488	5	**33**	54	-
Railway Station Car Park_cso_teignmouth	203349	5	**8**	13	-
Ilsham Valley Spst_pscsoeo_torquay	200977	5	**123**	1706	SOAF investigation in 2022 Hopes Nose

Spill frequency (SF) trigger permit (spills per year as 10 year averages: 40 spills for water bodies; 14 spills for shellfish waters; 5 spills for bathing waters - per bathing season) (SWW, 2021a).

14 Estimated mean levels of pathogens in fresh farmyard manure and slurry

Pathogen name	Maximum Levels of pathogens in fresh FYM&S			Unit[a]	Country	Reference
	Cattle	Pig	Sheep			
Cryptosporidium parvum	2.7×10^2 to 3.5×10^3	3×10^2 to 3.6×10^3	5.3×10^1 to 2.5×10^2	Oocysts g^{-1}	UK	(Hutchison et al., 2004)[b]
Mycobacterium bovis	6.5×10^3			CFU ml^{-1}	Ireland	(Scanlon and Quinn, 2000)
MAP	3×10^5			CFU g^{-1}	USA	(Bonhotal et al., 2011)
Salmonella spp.	3.9×10^4 to 5.8×10^5	9.6×10^3 to 7.8×10^4	1.1×10^3 to 2×10^3	CFU g^{-1}	UK	(Hutchison et al., 2004)[b]
Listeria monocytogenes	1.5×10^4 to 4.2×10^5	4.6×10^4 to 9.7×10^5	4.5×10^2 to 1.7×10^3	CFU g^{-1}	UK	(Hutchison et al., 2004)[b]
Clostridium spp.	$10^{4.95}$	$10^{5.28}$		CFU g^{-1}	Italy	(Costa et al., 2017)
		1.0×10^5 to $1.0 \times 10^{5.5}$		CFU g^{-1}	Ireland	(Mccarthy et al., 2013)
	1.0×10^4 to $1.0 \times 10^{4.6}$			CFU g^{-1}	Sweden	(Bagge et al., 2005)
Clostridium spp. (combined)	1.0×10^4 to $1.0 \times 10^{4.95}$	1.0×10^5 to $1.0 \times 10^{5.5}$		CFU g^{-1}		
E. coli	$5.1 \times 10^4 \pm 4.5 \times 10^4$	$3 \times 10^4 \pm 7.1 \times 10^3$		CFU g^{-1}	France	(Jaffrezic et al., 2011)
		$1.0 \times 10^{3.8}$ to $1.0 \times 10^{5.5}$		CFU g^{-1}	Ireland	(Mccarthy et al., 2013)
E. coli (combined)	0.6×10^4 to 9.6×10^4	$1.0 \times 10^{3.8}$ to $1.0 \times 10^{5.5}$		CFU g^{-1}		
E. coli O157	2.9×10^6 to 2.6×10^8	6.9×10^4 to 7.5×10^5	1.1×10^4 to 4.9×10^4	CFU g^{-1}	UK	(Hutchison et al., 2004)[b]

Pathogen name	Maximum Levels of pathogens in fresh FYM&S			Unit[a]	Country	Reference
	Cattle	Pig	Sheep			
Campylobacter spp.	7.6×10^3 to 1.5×10^5	1.9×10^3 to 1.5×10^4	8.6×10^2 to 2.1×10^3	CFU g^{-1}	UK	(Hutchison et al., 2004)[b]

15 The Storm Overflow Assessment Framework (SOAF)

Stage 1 – Spills are counted using Event Duration Monitoring (EDM) and above a threshold spill number (e.g. 60 per year) an outfall is highlighted as needing investigation. If the reporting period included exceptional rainfall, then data from more typical years are sought. Subsequent investigations check for possible blockages or leaks and whether the hydraulic capacity of the system is sufficient for heavy (storm-related) rainfall.

Stage 2 – The environmental and aesthetic impact of the outfall is determined. The aesthetic assessment covers visibility and prevalence of sewage litter and sewage fungus. The environmental assessment compares the classification of aquatic invertebrates gathered upstream and downstream from the outfall (classification is performed using the River Invertebrate Classification Tool) (WFD UKTAG, 2008). If no invertebrate monitoring data are available, water quality modelling is used for environmental assessment.

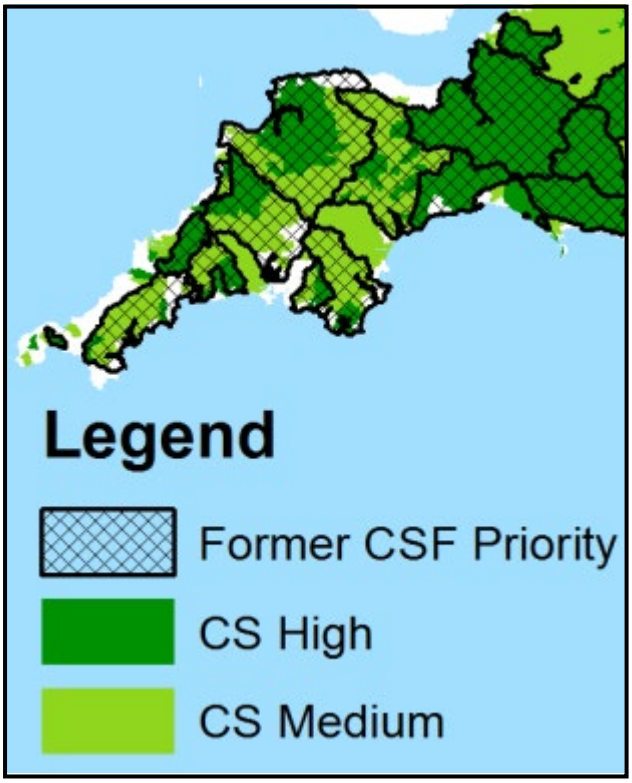
Stage 3 – Assess improvement options including a cost benefit analysis. If any of the methods applied in Stage 2 show an environmental impact, or if the outfall is situated in an urban area, then an economic assessment is made of overflow improvement.

Stage 4 – A decision is made based on the cost benefit results, with no further action being taken if the cost is disproportionate compared to the environmental benefits.

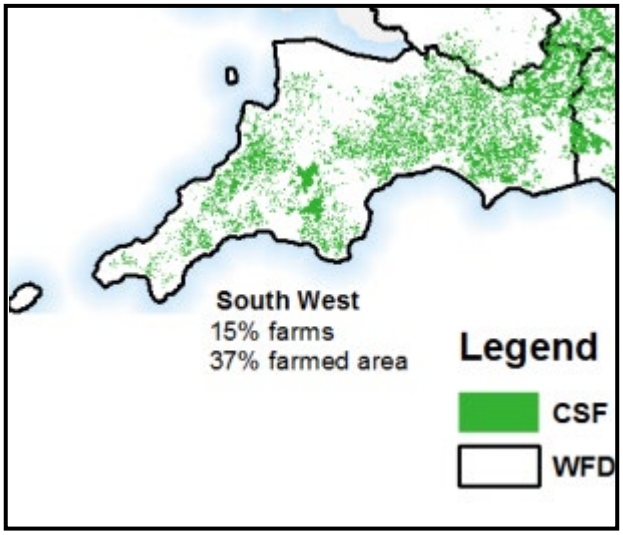
Stage 5 – The most cost beneficial solution is delivered to reduce environmental impact and/or reduce the frequency of discharges.

16 Catchment Sensitive Farming (CSF) Priority Catchments in SW England

Appendix 11.1: Extent of Countryside Stewardship High and Medium Priority Areas for Water and former CSF Priority Catchments in SW England



Appendix 11.2: Extent of CSF engagement across WFD River Basin Districts, expressed in terms of total farm numbers and total farmed area in SW England



17 Twenty most heavily applied pesticides in the South West Water Ltd. region in 2011

(from Townsend et al., 2018)

Ranking	Pesticide	Category	Tonnes applied
1	Glyphosate	Herbicide	66.7
2	MCPA	Herbicide	59.3
3	Chlormequat	Crop growth promotor	47.7
4	Mecoprop/Mecoprop-P	Herbicide	29.2
5	Chlorothalonil	Fungicide	27.5
6	Pendimethalin	Herbicide	26.9
7	Prosulfocarb	Herbicide	23.4
8	Triclopyr	Herbicide	17.2
9	MCPB	Herbicide	14.9
10	Chlorotoluron	Herbicide	12.6
11	Prothioconazole	Fungicide	10.1
12	Asulam	Herbicide	9.4
13	2,4-D	Herbicide	8.3
14	Fluroxypyr	Herbicide	7.1
15	Propamocarb Hydrochloride	Fungicide	7.1
16	Clopyralid	Propamocarb	5.7
17	Mancozeb	Fungicide	5.5
18	Spiroxamine	Fungicide	5.0
19	Epoxyconazole	Fungicide	4.4
20	Flufenacet	Herbicide	4.4

18 Dissolved oxygen standards required by the EC Shellfish and Bathing Water Directives

EC Directive	DO Standard	Compliance statistic
Shellfish Waters Directive	70%	Mean, Imperative (I) standard
	60%	Minimum, Imperative (I) standard
	80%	5%ile, Guide (*G*) value
Bathing Water Directive	80–120%	10%ile, Guide (*G*) value
Urban Waste Water Treatment Directive (CSTT guidelines)	7.0 mg l^{-1}	Median (in coastal waters a change of <0.5 mg l^{-1} assumed to have no adverse effect. In estuaries a change of <1.0 mg l^{-1} assumed to have no adverse effect

19 Guidance: Sewage sludge in agriculture: code of practice for England, Wales and Northern Ireland

Guidance on Potentially Toxic Elements (PTE) in arable soil

	Max permissible conc. in soil at set pH (mg/kg dry solids)				Max permissible annual rate of PTE addition over 10 years (kg/ha)
pH	5<5.5	5.5<6.0	6.0-7.0	>7.0	
Zinc	200	200	200	300	15
Copper	80	100	135	200	7.5
Nickel	50	60	75	110	3

	Max permissible conc. in soil at set pH (mg/kg dry solids)	Max permissible annual rate of PTE addition over 10 years (kg/ha)
pH	≥5	
Cadmium	3	0.15
Lead	300	15
Mercury	1	0.1
Chromium	400	15
Molybdenum	4	0.2
Selenium	3	0.15
Arsenic	50	0.7
Fluoride	500	20

Guidance on Potentially Toxic Elements (PTE) limits in soil used as grassland

	Maximum permissible concentration of PTE in soil (mg/kg dry solids)			
pH	5<5.5	5.5<6.0	6.0-7.0	>7.0
Zinc	200	200	200	300
Copper	130	170	225	330
Nickel	80	100	125	180

	Maximum permissible concentration of PTE in soil (mg/kg dry solids)
pH	≥5
Cadmium	3
Lead	300
Mercury	1.5
Chromium	600
Molybdenum	4
Selenium	5
Arsenic	50
Fluoride	500

For lead, cadmium and fluoride, you can apply no more than 3 times the average annual limit of PTE in a single year. This is to control how much of these elements your livestock can ingest.

Guidance on when you can use treated sludge:

On growing crops	**Restrictions**
• Cereals, oil seed rape	No restrictions
• Grass	No grazing or harvesting within 3 weeks of use
• Turf	Not less than 3 months before harvest
• Fruit trees	Not less than 10 months before harvest

Before planting crops	**Restrictions**
• Cereals, grass, fodder, sugar beet, oilseed rape, fruit trees	No restrictions
• Soft fruit and vegetables	Not less than 10 months before harvest
• Potatoes	Not less than 10 months before harvest.
• Nursery stock	Not on land that's used for a cropping rotation

Guidance on protecting water

- Prevent run off if the soil is dry, or if clay soils are at, or close to field capacity.
- Prevent liquid sludge from leaching through permeable soils and polluting groundwater and land drains.
- Don't store or apply sludge close to water supply sources.
- Use good farming practices to reduce the risks of water pollution. For example, you can reduce the risk of nitrogen getting into water supplies by adjusting the timing and rates of application according to the demands of the crop.

20 Pharmaceutical concentrations in μg/L in effluent from Countess Weir Sewage Treatment Works in 2010/11

Pharmaceutical	01/06/2010	07/07/2010	12/08/2010	28/09/2010	17/10/2010	24/11/2010	09/12/2010	25/01/2011	04/02/2011	17/03/2011	27/04/2011	18/05/2011	20/06/2011	13/07/201
Non Steroidal Anti-Inlfammatory Drugs (NSAIDS)														
Ibuprofen	0.0770	0.0270	0.0180	0.0100	0.0650	0.1750	0.2010	0.1770	0.1150	0.2530	0.0100	0.0100	0.0170	0.0100
Diclofenac												0.1300	0.0640	
Antibiotics														
Erythromycin	0.9150	0.7790	0.1510	0.4270	0.4810	0.2170	1.0700	0.6240	0.4790	0.2490	0.1700	0.4400	0.2100	0.1300
Ofloxacin	0.0600	0.1080	0.0800	0.0440	0.0370	0.0150	0.0950	0.0490	0.0340	0.0430	0.0510	0.1200	0.0510	0.0340
Oxytetracycline	0.5360	6.0000	0.4660	0.3150	0.2630	0.1750	0.5350	0.4560	0.3350	0.5760	0.3000	0.2200	0.2700	0.2700
Anti-Tension/Depression														
Propranolol	0.1140	0.1860	0.1990	0.1090	0.1270	0.0350	0.1350	0.0750	0.0750	0.1570	0.0800	0.1200	0.0720	0.2000
Fluoxetine	0.0640	0.0470	0.0510	0.0100	0.0240	0.0160	0.0300	0.0180	0.0280	0.0350	0.0210	0.0360	0.0330	0.0370
Hormones														
Salicylic Acid	0.4300	0.2770	0.2310	0.2410	0.4790	0.2120	0.3540	0.7300	0.1190	0.5800	0.0690	0.2100		0.2200
Estrone	0.002	0.002	0.002	0.0057	0.0046	0.0034	0.0045	0.0051	0.0022	0.0055	0.0004	0.0016	0.0064	0.0020
Estradiol		0.000	0.002	0.0026	0.0003	0.0011	0.0008	0.0013	0.0005	0.0007	0.0002	0.0007	0.0008	0.0002
Ethynylestradiol	0.001	0.001	0.001	0.0004	0.0002	0.0012	0.0014	0.0018	0.0018	0.0008	0.0005	0.0037	0.0014	0.0001

21 Pharmaceutical, veterinary medicine (and other contaminant) concentrations in ng/L in the River Exe and Exe Estuary in June 2020

Mean river flow upstream of Station 7 Trews Weir (taken from Thorverton Weir Station 3) = 16.125 m^3/sec; Mean river flow downstream of Trews Weir = 25 m^3/sec.
River flow was normal in the Exe despite heavy rainfall in the previous week
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895422/Rainfall_and_river_flow_summary_17_to_23_June_2020.pdf
Tidal stations 8 to 10 were sampled on the ebb tide i.e. 2 to 3 hours after high water.#

Site	Site description	17a-Ethinylestradiol	Amitriptyline	Atenolol	Azlocillin	Bentazone	Bis (2-ethylhexyl) phthalate (DEHP)	Bisphenol-S	Butyl Phthalate (DBP)	Carbamazepine	Caffeine	Cefazolin	Ceterizine	Cimetidine	Ciprofloxacin	Citalopram	Clarithromycin
1	100 m upstream of Tiverton WWTP	ND	ND	21.08	ND	ND	ND	ND	ND	51.15	404.1	ND	70.5	ND	ND	5.416	5.416
2	100 m downstream of Tiverton WWTP	ND	1.56	23	ND	ND	ND	ND	ND	55.43	271	ND	79.44	ND	ND	7.912	7.912
3	Upstream of Thorverton Weir	ND	ND	6.271	ND	ND	ND	ND	ND	15.38	132.2	ND	18.69	ND	ND	2.59	ND
4	Furze Park, upstream of Culm confluence	ND	ND	23.46	ND	ND	ND	ND	ND	55.37	376.6	ND	79.73	ND	ND	2.53	2.53
5	Furze Park, downstream of Culm confluence	ND	ND	36.56	ND	ND	ND	ND	ND	64.45	428.9	ND	88.49	ND	ND	14.98	14.98
6	Cowley Bridge	ND	ND	ND	ND	ND	ND	ND	ND	ND	277.6	ND	ND	ND	ND	ND	ND
7	Trews Weir	ND	ND	ND	ND	ND	ND	ND	ND	5.426	420	ND	2.593	ND	ND	1.316	ND
8	Countess Weir upstream of WWTP	ND	ND	17.96	ND	ND	ND	ND	ND	11.32	956.3	ND	6.593	ND	ND	5.402	ND
9	Countess Weir downstream of WWTP	ND	ND	5.02	ND	ND	ND	ND	ND	11.83	205.9	ND	5.993	ND	ND	3.274	ND
10	Starcross	ND	2.81	21.56	ND	ND	ND	ND	ND	59.95	457.4	ND	94.6	ND	ND	7.124	7.124

Site	Site description	Cotinine	Desvenlafaxine	Diazepam	Diclofenac	Diltiazem	Enrofloxacin	Erythromycin	Fexofenadine	Fluoxetine	Gabapentin	Hydrocodone	Imazalil	Ketoconazole	Ketotifen	Lidocaine	Lincomycin
1	100 m upstream of Tiverton WWTP	48.42	97.04	ND	ND	2.788	ND	22.67	199.2	ND	998.4	4.605	ND	ND	ND	15.48	ND
2	100 m downstream of Tiverton WWTP	40.42	99.21	ND	ND	3.29	ND	21.49	199.2	ND	864.4	ND	ND	ND	ND	15.28	ND
3	Upstream of Thorverton Weir	14.98	29.7	ND	ND	1.749	ND	12.53	34.75	ND	190.6	ND	ND	ND	ND	4.2	ND
4	Furze Park, upstream of Culm confluence	41.24	114.2	ND	ND	3.385	ND	27.99	194.2	ND	1045	9.567	ND	ND	ND	14.9	ND
5	Furze Park, downstream of Culm confluence	47.42	131.5	ND	ND	5.461	ND	35.9	246.7	ND	1317	11.05	ND	ND	ND	19.7	ND
6	Cowley Bridge	13.35	ND	ND	ND	2.127	ND	ND	5.37	ND	ND	ND	ND	ND	ND	ND	ND
7	Trews Weir	25.42	ND	ND	ND	ND	ND	ND	6.146	ND	31.29	8.511	ND	ND	ND	ND	ND
8	Countess Weir upstream of WWTP	38.93	13.37	ND	ND	ND	ND	ND	27.75	ND	245.5	6.935	ND	ND	ND	ND	ND
9	Countess Weir downstream of WWTP	7.238	16.45	ND	ND	ND	ND	ND	17.11	ND	126.2	5.301	ND	ND	ND	5.117	ND
10	Starcross	50.51	109.2	ND	ND	3.484	ND	27.15	220.5	ND	1779	6.458	ND	ND	ND	17.25	ND

22 Prioritisation of veterinary medicines – compounds considered to have the greatest potential for environmental impact (Group 1)

Table adapted from Boxall et al. (2002)
Priority class abbreviations: HP-CIA = Highest Priority Critically Important Antibiotics (VMD, 2020); PS = Priority Substance (2008/105/EC).
Target group abbreviations: H = herd animals; I = individual food production animals; A = aquaculture; C = companion animals; n/a = not applicable.

Rank (use)	Veterinary medicine	Category	Priority class	Target animals	Data gap - further data required			
					Use	Metabol	Aquatic	Terrestrial
1	Oxytetracycline	Antibiotic		H, A				✓
2	Chlortetracycline	Antibiotic		H			✓	✓
3	Tetracycline	Antibiotic		H			✓	✓
4	Sulphadiazine	Antibiotic		A			✓	✓
5	Trimethoprim	Antibiotic		A			✓	✓
6	Baquiloprim	Antibiotic		H		✓	✓	✓
7	Amprolium	Coccidiostat		H	✓		✓	✓
8	Clopidol	Coccidiostat		H	✓	✓	✓	✓
9	Lasalocid Sodium	Antibiotic		H	✓	✓	✓	✓
10	Maduramicin	Antibiotic	HP-CIA	H	✓		✓	✓
11	Nicarbazin	Coccidiostat		H	✓	✓	✓	✓
12	Robenidine Hydrochloride	Coccidiostat		H	✓	✓	✓	✓
13	Amoxicillin	Antibiotic		H		✓	✓	✓
14	Procaine Penicillin	Antibiotic		H		✓	✓	✓
15	Procaine Benzylpenicillin	Antibiotic		H		✓	✓	✓
16	Clavulanic Acid	Antibiotic		H		✓	✓	✓
17	Diazinon	Insecticide	Banned	H		n/a	✓	✓
18	Tylosin	Antibiotic		H			✓	✓
19	Monensin	Antibiotic		H	✓	✓	✓	✓
20	Salinomycin Sodium	Coccidiostat		H	✓		✓	✓
21	Flavophospolipol	Antibiotic		H	✓	✓	✓	✓
22	Dihydrostreptomycin	Antibiotic		H			✓	✓
23	Neomycin	Antibiotic	HP-CIA	H, C			✓	✓
24	Apramycin	Antibiotic	HP-CIA	H			✓	✓
25	Flavomycin	Antibiotic	HP-CIA	H		✓	✓	✓
26	Morantel	Anthelmintic		H	✓		✓	✓
27	Cypermethrin	Insecticide	PS	H		n/a	✓	✓
28	Flumethrin	Insecticide		H		n/a	✓	✓
29	Triclabendazole	Fungicide		H	✓		✓	✓
30	Fenbendazole	Fungicide		H	✓	✓	✓	✓
31	Levamisole	Anthelmintic		H	✓	✓	✓	✓
32	Ivermectin	Insecticide		H	✓	✓		✓
33	Cephalexin	Antibiotic		H	✓	✓	✓	✓
34	Florfenicol	Antibiotic		A	✓	n/a	✓	
35	Tilmicosin	Antibiotic		H	✓		✓	✓
36	Oxolinic Acid	Antibiotic		H	✓	n/a	✓	✓
37	Lido/Lignocaine Hydrochloride	Anaesthetic		H	✓	✓	✓	✓
38	Tiamulin	Antibiotic		H	✓	✓		✓

39	Lincomycin	Antibiotic	HP-CIA	H			✓	✓
40	Clindamycin	Antibiotic	HP-CIA	H			✓	✓
41	Nitroxynil	Anthelmintic		H	✓	✓	✓	✓
42	Enrofloxacin	Antibiotic	HP-CIA	H			✓	✓
43	Sarafloxacin	Antibiotic	HP-CIA	A		n/a	✓	
44	Dimethicone	Skin barrier		H	✓	✓	✓	✓
45	Poloxalene	Anti-bloat		H	✓	✓	✓	✓
46	Toltrazuril	Coccidiostat		H	✓	✓	✓	✓
47	Decoquinate	Coccidiostat		H	✓	✓	✓	✓
48	Diclazuril	Coccidiostat		H	✓	✓	✓	✓
49	Phosmet	Insecticide		H	✓	n/a	✓	✓
50	Piperonyl Butoxide	Anti-fly		C	✓	n/a	✓	✓
51	Amitraz	Acaricide and Insecticide		H	✓	n/a		✓
52	Deltamethrin	Insecticide		H	✓	n/a	✓	✓
53	Cypromazine	Insecticide		H	✓	n/a	✓	✓
54	Emamectin Benzoate	Insecticide		A	✓	n/a	✓	✓?
55	Antiseptics	Antiseptics		C, I	✓	✓	✓	✓
56	Immunological products	Immuno-logical		C, H	✓	✓	✓	✓