AMP7 Bathing Water Ambition Investigations Programme

Mothecombe

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South West Water

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Executive Summary

Mothecombe is one of 25 Bathing Waters (BW) at which DEFRA (Department for Environment, Food & Rural Affairs) have required South West Water (SWW) to do an investigation into the feasibility of achieving 'Good' and/or 'Excellent' bathing water quality.

This report reviews and builds on the current understanding of water quality issues at Mothecombe. It also quantifies what changes need to be affected on bathing water quality to achieve at least 80% confidence of 'Good' or 'Excellent' compliance. Also, what proportion of FIO (Faecal Indicator Organisms) contamination could be reasonably attributed to SWW assets and potential possible storm overflow discharge frequency criteria or treatment options for significant SWW assets that would markedly improve water quality classification.

Figure 1: Mothecombe Bathing Water at the mouth of the Erme Estuary

Mothecombe Bathing Water is a small sandy beach at the mouth of the Erme Estuary on the south Devon coast. The main freshwater input to the Erme Estuary is the River Erme, while there are nine other streams which flow into the Estuary. Oceanographic studies and salinity analysis demonstrate the importance of freshwater inputs on the bathing water quality at Mothecombe. Local freshwater inputs include the Mothecombe Stream and Wonwell Stream and the other freshwater inputs up the Erme Estuary. It was determined that the River Erme is the most significant freshwater input in terms of flow, followed by the Sheepham Brook. There are four sewage treatment works (STW) in the Mothecombe catchment, these are Ermington STW, Holbeton STW, Ivybridge STW and Modbury STW which all discharge to the Erme or associated tributaries. The final effluent from Holbeton STW, Ivybridge STW received ultraviolet (UV) disinfection. There are several intermittent discharges further upstream to the Erme estuary and its respective streams. These include Storm Overflows (SO) from the STWs (e.g. Modbury STW SSO and Holbeton STW SSO) and combined sewer overflows (CSO) (e.g. Poundwell Meadow CSO).

To understand the required level of change needed to achieve the desired classification, Planning Classification data for Mothecombe was examined.

- **Mothecombe has had a 'Good' Bathing Water classification since 2016.**
- **The Planning Classification has also been 'Good' since 2016, although this decreased to 'Sufficient' in 2021, with a 90% risk of failing to reach Good and 100% risk of failing to reach 'Excellent'.**

At Mothecombe Intestinal enterococci (IE) is the main FIO parameter that determines planning class for the most recent planning data sets. *E. coli* (EC) was the FIO that determined class in earlier data sets. Statistical analysis in Section 3 demonstrated 6 of the 28 EC elevated above the 95 percentile EC limit of 250 cfu/100ml would need to be replaced with 'Excellent' water quality to achieve a robust 'Good' classification 2012 to 2019. For IE 2 of the 30 IE elevated above the 100 cfu/100ml threshold needed to be replaced with 'Excellent' water quality to achieve robust 'Good' classification. For the time frame looked at, it was not seen to be possible to achieve a robust 'Excellent' water quality.

Faecal pollution can come from an abundance of sources, many of which can be unrelated to human waste and its treatment, a prime example is land runoff from livestock. Microbial source tracking (MST) analysis carried out by SWW on 2021 bathing season samples collected by Nijhuis showed that sources at the BW were predominantly ruminant although human sources were also present. The Erme Estuary samples were also predominantly ruminant with nearly equal presence of human, and one occasion with a signal from canine sources. The only substantial source found in the Mothecombe Stream was human.

Routine Environment Agency (EA) data between 2012 and 2019 was examined to better establish the conditions that lead to elevated FIO events The EA pollution risk forecasting (PRF) model uses Flow 12 hours average as the most important factor for predicting poor water quality. River flow clearly plays a large role in BW quality where the model also selected for 72 hours average flow as well. Analysis suggested that increased flow had a greater relationship with EC levels than IE. The PRF also selected for 24 hours antecedent rainfall for the whole catchment. This was seen to have good relationship with both FIO. Time and day where also selected for. Time was seen to be a possible artifact from the data where samples are largely collected at one of two times of day. Day was seen to have a limited relation with the different FIO appearing to respond differently. The PRF selected 15 hours average Wind onshore component. Elevated samples tended to occur in the presence of positive onshore wind component. The same was seen for alongshore, but this is likely down to it being the predominant wind direction. Finally absolute hours relative to high water was also selected for with elevated events tending to occur around low tide.

- **Freshwater analysis revealed little relationship between the BW and Mothecombe Stream.**
- **The BW water was seen to have a better relationship with the river Erme (at mouth).**
- **This relationship was significantly stronger once the data set was sorted into tide state with the flood tide seen to have the strongest relationship.**

Considering the tendency for elevated counts around low water, it is likely that on the ebb tide the river can discharge past the bay without impacting on quality whereas on the flood tide this gets pushed back into the bay. It was also observed that at low tide the BW transect is no longer sheltered in the bay but almost on the river mouth itself.

Nijhuis data for 2019 and 2021 came to similar conclusions although Mothecombe Stream was seen to have a slightly more significant relationship. Wonwell Stream was also seen to have a degree of correlation with poor quality coinciding with that at the BW. Nijhuis 2021 survey looked at freshwater tributaries on the River Erme. Of these Sheepham Brook and Oldaport Stream were seen to have the strongest relationship with the BW. Flete Stream had the best relationship with water quality at the river mouth.

Asset performance and freshwater loading assessment for 2012 to 2019 were scrutinized to inform options available to improve bathing water (BW) quality. 11 of 33 elevated FIO scenarios coincided with a storm overflow discharge event from either Holbeton STW SO, Holbeton STW SSO, Ivybridge STW SSO, Poundwell Meadow CSO, Modbury STW SSO, Town Hill CSO The most frequent storm overflow discharge was Holbeton STW SO.

Loadings assessment showed the bulk of the pollution is likely sourced on the River Erme upstream of Sequers Bridge. Oldaport Stream was also seen to be a significant cause of loadings for the BW. Based on our assessment, the largest continuous discharges are Modbury STW and Ermington STW. These contribute to the high loads seen in the Oldaport stream and River Erme respectively. Given the importance of the freshwater component in the elevated bathing water samples, as demonstrated throughout this report, contributions from these STW are assessed as being significant.

- **We therefore propose that both Modbury STW and Ermington STW have effective biological treatment with ultraviolet (UV) disinfection.**

A review of EDM data and assessment of loads show that Holbeton STW SSO and SO may be impacting on water quality more frequently than other intermittents discharge and water quality at the bathing water would benefit from a reduction in storm overflow discharges.

- **Due to this we propose that the discharges be improved to a design standard of 2 significant (greater than 50m^3) storm overflow discharges per bathing season (aggregated).**

Glossary

BRAVA	Baseline Risk and Vulnerability Assessment
BS	Bathing Season
BW	Bathing Water
BWMP	Bathing Water Monitoring Point
cfu	Coliform Forming Unit
CSO	Combined Sewer Overflow
DEFRA	Department for Environment, Food & Rural Affairs
EA	Environment Agency
EC	E. coli
EDM	Event Duration Monitoring
FIO	Faecal Indicator Organisms
HW	High Water
IE	Intestinal Enterococci
LW	Low Water
MCERTs	Monitoring Certification Scheme (EA)
MSF	Measure Specification Form
MST	Microbial Source Tracking
NGR	National Grid Reference
OS	Ordnance Survey
PC	Planning Class
PRF	Pollution Risk Forecasting
SO	Storm Overflow
SPS	Sewage Pumping Station
SSO	Settled Storm Overflow
STW	Sewage Treatment Works
SWW	South West Water
UV	Ultra-Violet
WINEP	Water Industry National Environment Programme

1. Introduction

South West Water (SWW) had an obligation to deliver a total of 25 bathing water ambition investigations under the terms of the Water Industry National Environment Programme (WINEP) by September 30th, 2021. On 30th March the EA wrote to all water company regulatory contacts to communicate a deadline extension to September 30th, 2022. These investigations are required to understand what water company action would be needed to achieve a robust classification of 'Good' and/or 'Excellent'.

Mothecombe WINEP scope:

Investigation part 1. Catchment investigation to understand what water company action would be needed to achieve a robust classification of Good (less than 20% risk of failing planning class of Good).

Investigation part 2. Catchment investigation to understand what water company action would be needed to achieve a robust classification of Excellent (less than 20% risk of failing planning class of Excellent).

Full scope and objectives for the investigation are shown in the Measure Specification Form given in Appendix A. The intention of this final report is to identify possible storm overflow discharge frequency criteria or treatment options for significant SWW assets that would markedly improve water quality classification. Also, to assess the confidence that these interventions would deliver improved water quality in isolation from non-SWW asset interventions.

This report reviews and builds on the current understanding of water quality issues at Mothecombe. It quantifies what faecal indicator organism (FIO) parameter determines planning class, and what proportion of its loading at the bathing water monitoring point (BWMP) could be reasonably attributed to SWW assets. Determination of source apportionment for bathing water samples elevated above 95 percentile classification thresholds between 2012 and 2019 will allow SWW-asset and non-SWW-asset loads to be ranked and assessed for benefits of source removal or reduction.

2. Summary of the Nature of the Bathing Water and Local Oceanography.

In this section the geographic and oceanographic nature of Mothecombe bathing water (BW) will be explored. The nature of the bay and freshwater inputs is defined along with relevant geographic features that have a bearing on the BW. Admiralty maps in conjunction with any site-specific modelling or analysis conducted is assessed to establish how the tidal currents influence freshwater sources and whether they are of relevant to the BW quality.

2.1 Nature of the Bathing Water

Mothecombe Bathing Water is a small sandy beach at the mouth of the Erme Estuary on the south Devon coast (Figure 2.1).

Figure 2.1 Mothecombe Bathing Water at the mouth of the Erme Estuary (Source: Grid Reference Finder).

The beach is about 200 m alongshore and is backed by low dunes and a field. It is flanked by rocks; to the west these extend south west for about 1 km to Battisburgh Island. The beach is exposed to the south-to-south west.

The Erme Estuary effectively dries out on spring and neap tides, so that the water quality at the Bathing Water is strongly affected by the brackish water outflow from the Estuary.

The main freshwater input to the Erme Estuary is the River Erme, while there are nine other streams which flow into the Estuary (see Figure 2.2).

Figure 2.2 Freshwater Inputs to the Erme Estuary (Source: Grid Reference Finder)

The average daily flows during the bathing season for each of these freshwater inputs is shown in Table 2.1.

Table 2.1 Average Daily Flows for the Freshwater Inputs to the Erme Estuary (Source: 'Results based upon Qube methodology and data, Wallingford HydroSolutions Ltd, 2022').

River or Stream	Average Daily Flow over Bathing Season m^3/s
River Erme	1.168
Sheepham Brook at Goutsford Bridge	0.128
Flete Stream	0.021
Ford Stream	0.019
Holbeton Stream	0.010
Oldaport Stream	0.086
Clyng Mill Stream	0.021
Pamflete Stream	0.004
Wonwell Stream	0.004
Mothecombe Stream	0.003

Based on these data, the River Erme is the most significant freshwater, followed by the Sheepham Brook. All other freshwater inputs are small in terms of flow.

The freshwater catchment draining to the Erme Estuary is about 10, 500 ha. The catchment is mostly agricultural, although the River Erme rises in moorland (EA Bathing Water Profile 2022). There are various settlements in the freshwater catchment, including Ivybridge, Modbury, Ermington, and Holbeton.

There are no SWW assets discharging directly to the Erme Estuary. There are, however, various SWW assets discharging to the freshwater catchments draining to the Erme Estuary. These SWW assets are discussed in Section 4.

2.2 Local Oceanography

The mean tidal range at the mouth of the Erme Estuary is 4.7 m for spring tides and 2.2 m for neap tides (ATT 2010).

There are no freshwater inputs or SWW assets immediately seaward of the mouth of the Erme Estuary, so that the water quality at Mothecombe Bathing Water is dominated by the local freshwater inputs of Mothecombe Stream and Wonwell Stream and the other freshwater inputs up the Erme Estuary.

The significance of the freshwater inputs to the bacterial water quality at Mothecombe is shown by the median salinity and freshwater percentage of all bathing water samples between 2000 and 2019 compared with the same data for the samples with elevated bacterial levels between 2012 and 2019. These are shown in Table 2.2 below.

Table 2.2 Median Salinity and Percentage of Freshwater in All BW Samples (2000 to 2019) and Elevated Bacterial Samples (2012 to 2019) at Mothecombe

Medians	All BW Samples 2000 to 2019	Elevated Bacterial Samples 2012 to 2019
Salinity	33.73	26.60
Percentage of Freshwater	4.96	25.05

The Erme Estuary is about 5 km long and almost dries out at low water spring tides. The residence time at spring tides is about one day or two tidal cycles. Most freshwater inputs below the tidal limit are likely to reach the Bathing Water in one tical cycle, although those at the head of the Estuary will be longer, unless river flows are very high.

Given the significance of the freshwater inputs to the bacterial water quality at Mothecombe Bathing Water, the relative significance of SWW assets has been assessed using relative bacterial loadings data for both continuous and intermittent discharges, together with storm overflow discharge frequency and duration data for the intermittent discharges. This is discussed further in Section 6.

2.3. Nature of bathing water and local oceanography conclusions

Mothecombe BW is situated at the mouth of the Erme Estuary. The main source to the estuary is the River Erme, as well as nine other streams. Oceanographic studies and salinity analysis demonstrate the importance of freshwater inputs on the bathing water quality at Mothecombe. Local freshwater inputs include the Mothecombe Stream and Wonwell Stream and the other freshwater inputs up the Erme Estuary. It was determined that the River Erme is the most significant freshwater input in terms of flow, followed by the Sheepham Brook.

3. Bathing water status

This section describes recent bathing water (BW) compliance. It identifies what faecal indicator organism (FIO) parameter determines planning class and quantifies how many elevated BW samples need to be replaced to ensure robust Good and Excellent classification in each 4-year compliance period dataset.

3.1. Recent Classification

Since 2015, Mothecombe Bathing Water has achieved either 'Good' or 'Sufficient' status (Table 3.1). For Mothecombe Pollution Risk Forecasting (PRF) is forecast daily and signage displayed (details of PRF are given in Section 5). At times of poor water quality, if an 'advice against bathing' warning has been issued, then the BW sample is able to be discounted from the dataset. Because of this, the BW class is calculated using the discounted dataset and it is this classification that is presented to the public. Classification for 2020 was not undertaken due to A reduced monitoring programme during the Covid-19 pandemic.

Table 3.1. Bathing water (BW) classification from 2015-2020, S = Sufficient, G = Good. / = data not available.

	2021	2020	2019	2018	2017	2016	2015
BW classification	G	/	G	G	G	G	S

3.2. Risk of failing Planning Class

Planning class is calculated using the full dataset including discounted and catch-up samples. It is this classification that is used for prioritising interventions. The Planning Class for Mothecombe has been 'Good' since 2016 (Table 3.2.). In 2021 it was Good, with a 90% risk of failing to reach 'Good' status, and a 100% risk of failing to reach 'Excellent' status.

Table 3.2. Planning Class (PC) and probability of achieving class. S = Sufficient, G = Good, / = data not available.

	2021	2020	2019	2018	2017	2016	2015
Planning Class	S	/	G	G	G	G	/
Risk of failing E	100%	/	100%	100%	100%	95%	/
Risk of failing G	90%	/	13%	33%	32%	0%	/

The WINEP scope states that the investigation is to understand what water company action would be needed to achieve a robust (less than 20% risk of failing) Planning class of both Good and Excellent. The 2019 statistics (2016-2019 dataset) have been recalculated for both Intestinal Enterococci (IE) and *E.coli* (EC) and are shown in Tables 3.3 and 3.4 respectively. All data and values used in the calculations are transformed to Log10, on the basis that the bacterial data have a normal distribution after a Log10 transformation. The value of z in Tables 3.3 and 3.4 is the proportion of the Normal Distribution Curve defined by the calculated statistical 90% or 95%ile compared with the BW Directive threshold value. The zed value is then transformed into the cumulative probability (P) under the normal distribution curve, and (1-P) gives the probability of exceeding the threshold value, i.e., the risk of failing the BW Directive Class. The percentage risk of IE and or EC not achieving planning class from Table 3.3 accords with the EA figures in Table 3.2. The data from Tables 3.3 and 3.4 also show that IE is the most sensitive parameter at Mothecombe in the 2019 data set, but *E. coli* still present a significant risk.

Table 3.3. Intestinal Enterococci – 2016-2019 statistics for classification risk.

Class	Threshold Percentile	Threshold	Log Threshold	Value of z	Cumulative probability related to z	Percentage risk of not achieving class.
Excellent	95%ile	100	2.00	-3.93	0	1.0E+02
Good	95%ile	200	2.30	1.11	1	13.40
Sufficient	90%ile	185	2.27	3.91	1	0.004

Table 3.4. E. coli – 2016-2019 statistics for classification risk.

Class	Threshold Percentile	Threshold	Log Threshold	Value of z	Cumulative probability related to z	Percentage risk of not achieving class.
Excellent	95%ile	250	2.40	-2.14	0	98.38
Good	95%ile	500	2.70	2.27	1	1.15
Sufficient	90%ile	500	2.70	5.65	1	8.23E-07

3.3. Confidence of Good/Excellent.

To lower the risk of failing classifications to 20% or below, it was decided to test how many top-ranked IE or EC sample results would need to be replaced with the 95th percentile threshold (100 or 250 cfu/100ml respectively) from each yearly rolling-4-year-planning-dataset before risk was at or below 20%. The FIO value paired with the replaced value would also be replaced with the Excellent Threshold if above it. Table 3.5 shows the number of replacements required for each compliance dataset to achieve robust classifications of Excellent, Good or Sufficient.

Table 3.5. Number of sample replacements required to achieve robust Excellent, Good or Sufficient classification at Mothecombe, 4-year rolling datasets 2015 to 2019. Orange cells indicate the Risk of not achieving the EC Class is greater and blue cells that the Risk of not achieving the IE Class is greater.

4-Year planning dataset	Planning Class	Risk of not achieving Class			Samples replaced for robust Sufficient Classification	Samples replaced for robust Good Classification	Samples replaced for robust Excellent Classification
		Excellent	Good	Sufficient			
19,18,17,16	Good	100% IE, 98.4%EC	13.4% IE, 1.2% EC	0.0%	0	0	10(EC), 11(IE)
18,17,16,15	Good	100% both	33.1% IE, 18.8% EC	0.0%	0	0(EC), 1(IE)	Not Possible (EC), 12(IE)
17,16,15,14	Good	100% both	32.2% EC, 9.1% IE	0.0%	0	1(EC), 0(IE)	Not Possible (EC), 10(IE)
16,15,14,13	Good	94.8% EC, 67.7% IE	0.2% EC	0.0%	0	0	9/10(EC), 2(IE)
15,14,13,12	Sufficient	100% both	98.5% EC, 61.4% IE	11.2% EC, 0.2% IE	0	6(EC), 1(IE)	Not Possible (EC) and (IE)

It should be noted that for the 4-year rolling datasets, each sample value could be replaced up to four times for the different dataset periods. For multiple years sets it was not seen as possible to achieve <20% risk of not achieving excellence. The total 35 IE replacements made to achieve Excellence classification equate to only 14 of the top-ranking samples. It should be noted that for the period 2012 to 2019, the total number of samples exceeding the relevant Excellent threshold value was in fact 30 for IE, and 28 for EC. Details of these samples in Table 3.6. show scenarios to be dominated by high freshwater percentage scenarios. The freshwater component was derived from BW sample salinity. Percentile flow derivation is explained in Section 5.3.

Class is very sensitive to these relatively few high sample results, it is the circumstances surrounding these poor water quality results that the authors believe gives the best opportunity to understand what interventions may have the greatest chance of bringing about a robust Excellent or Good classification at Mothecombe. A significant part of these investigations is to characterise these occurrences of poorer bathing water quality and to understand asset contribution in these scenarios. Asset contributions outside of these scenarios will also be considered to allow for a thorough understanding of potential asset impacts at Mothecombe

Table 3.6. Details of all 33 samples exceeding the Excellent threshold value of either IE (100cfu/100ml) or EC (250 cfu/100ml) (2012 to 2019) shown in red.

Date	EC/100 ml	IE/100 ml	Freshwater component at BW	Q River Erme at Sequers Bridge	Rain Radar (Whole Catch) 24hrs Sum
02-Jul-12	7800	1710	64%	0.1	18.3
24-Sep-12	2900	1300	16%	8	50.5
02-May-18	1600	827	49%	1	20.0
27-Jul-15	1500	720	23%	22	1.6
12-Sep-19	540	600	10%	55	0.0
06-Jul-12	1500	540	25%	0.1	16.0
05-Sep-17	900	486	24%	17	1.6
29-Jun-17	410	477	9%	19	15.1
15-Sep-15	600	360	36%	14	13.0
21-Aug-17	470	320	39%	30	1.4
15-Jul-15	310	320	31%	44	1.2
08-Jun-12	900	280	9%	5	28.0
04-Aug-17	1018	270	45%	21	0.6
22-Jun-16	230	250	23%	31	1.7
13-Sep-16	490	200	16%	45	7.2
12-Jul-12	630	172	16%	0.1	15.7
08-Jun-17	460	164	32%	1	10.7
23-May-17	640	155	27%	54	0.0
28-Aug-19	290	150	6%	78	1.7
22-Jun-12	650	136	17%	15	10.7
19-Sep-17	270	136	48%	30	0.3
28-Aug-15	470	127	41%	19	0.9
02-Sep-12	480	122	48%	21	0.0
18-Jun-19	36	120	15%	67	1.8
03-Jun-15	650	118	36%	31	0.3
31-Jul-12	210	118	33%	32	5.5
11-Jul-17	155	118	30%	12	9.5
31-May-18	27	118	1%	88	0.7
06-Aug-13	640	114	35%	50	0.8
19-Aug-13	330	100	9%	68	2.3
09-May-14	480	18	14%	4	0.2
06-Sep-13	400	64	19%	80	0.2
10-May-13	310	64	25%	21	5.7

In the Good assessment 7 replacements for EC relating to 6 separate samples are required to achieve a robust Good classification (for IE the 2 replacements relate to 2 samples). In these cases, the replacements for IE are not separate samples from those seen for EC. It should be noted that the replacement values used were the Excellent threshold values rather than the Good threshold values. The details of the samples which were replaced in the Good assessment would be a sub-set of those replaced for the Excellent assessment. The role of asset performance in these scenarios will be considered the same way as the Excellent assessment.

3.4 Rainfall Statistics in the South West 2000 to 2021

The rainfall statistics from 2000 to 2021 have been assessed to see whether the data sets which are being used for the bathing water statistics are representative. The rainfall anomalies for each bathing season from 2000 to 2021 are shown in Figure 3.1 below. The rainfall anomaly used here is the percentage of rainfall that is greater or less than the average over the 51 years between 1971 and 2021.

In the last 10 years there have been 5 years with rainfall more than 10% greater than the average, 3 years with more than 10% less than the average, and 2 years within +/- 10% of the average. 2012 was a particularly wet year being more than 50% above average. It was the 5th wettest bathing season since 1836. 2018 was relatively dry, being 29% below average, and it was the 14th driest bathing season since 1836. Overall, it is considered that the bathing seasons being assessed in the present investigation are not highly anomalous in terms of being very dry or very wet.

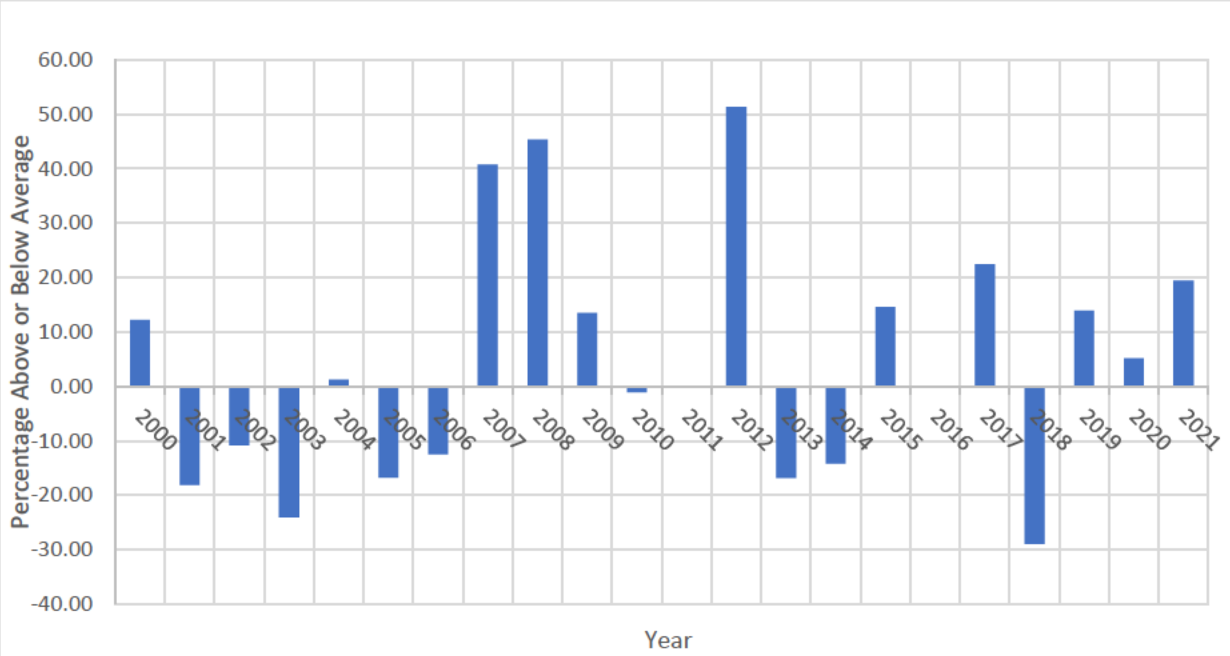


Figure 3.1. Rainfall Anomaly for the Bathing Season 2000 to 2021.

3.5. Bathing water status conclusion

Mothecombe has had a 'Good' Bathing Water classification since 2016. The Planning Classification has also been 'Good' since 2016, although this decreased to 'Sufficient' in 2021, with a 90% risk of failing to reach Good and 100% risk of failing to reach 'Excellent'. Intestinal enterococci (IE) is the main FIO parameter that determines planning class for the most recent planning data sets, however *E. coli* (EC) was the FIO that determined class in earlier data sets.

From 2012-2019, there were 28 samples elevated above the 95-percentile limit of 250 cfu/100ml for EC and 30 samples elevated above the 100 cfu/100ml threshold for IE. When looking at the number of elevated samples needing to be replaced by 'Excellent' water quality to achieve a robust 'Excellent' classification, statistical analysis determined that demonstrated 6 of the 28 EC elevated samples would need to be replaced with 'Excellent' water quality to achieve a robust 'Good' classification 2012 to 2019. For IE 2 of the 30 IE needed to be replaced with 'Excellent' water quality to achieve robust 'Good' classification. For the time frame looked at, it was not seen to be possible to achieve a robust 'Excellent' water quality.

Rainfall data suggest a high yearly variability in rainfall within the period covered by the data used for the statistics.

4. Summary of the Known and Potential Sources of FIO.

To better understand the cause of the bathing water (BW)'s elevated faecal indicator organism (FIO) scenarios, it is necessary to establish the possible sources of the faecal pollution. Theoretically faecal pollution will enter the BW from a freshwater source. This section will look at the responsible freshwater discharge, both South West Water (SWW) continuous and intermittent discharges, and any possible unknow sources identified by misconnections surveys or microbial source tracking (MST) results

Summary statistics of all routine FIO sampling data in Table 4.1. highlights that bathing water quality has a large proportion of 'less than' levels, and this is reflected in the geometric means (geomeans). Less than Good or Excellent classification appears to be an acute problem with occasionally very high values, suggesting a wet weather issue, related probably to both the urban catchment of Mothecombe and the agricultural catchment of the streams and rivers.

Table 4.1. Summary statistics for Mothecombe 2012 to 2019.

4-Year planning dataset	Sample Count	No. of EC Samples <10	No. of IE Samples <10	No. of Samples > EC Excellent Threshold of 250	No. of Samples >IE Excellent Threshold of 100	EC Geomean	EC Statistical 90%ile	EC Statistical 95%ile	IE Geomean	IE Statistical 90%ile	IE Statistical 95%ile
19,18,17,16	84	38	56	11	15	33	206	350	21	108	172
18,17,16,15	87	39	54	14	17	35	247	433	22	117	188
17,16,15,14	85	38	52	14	15	37	264	463	22	106	167
16,15,14,13	84	42	52	11	9	31	191	322	19	72	105
15,14,13,12	84	37	46	17	15	43	397	752	24	129	208

4.1. Summary of freshwater and asset discharges in the catchment in relation to the Bathing Water.

4.1.1. Freshwater discharges

It is evident from Table 3.6 that freshwater inputs represent a significant influence on bathing water quality during acute high FIO events. The Mothecombe stream enters the sea at Mothecombe Beach, in very close proximity bathing water monitoring point (BWMP) transect. Mothecombe is also located at the mouth of the Erme estuary which main freshwater input is from the River Erme but also has multiple freshwater inputs from smaller streams such as the Holbeton Stream, Oldaport Stream, Flete Stream, Wonwell Stream, Ford Stream, Clyng Mill stream, and others. Table 4.2 and 4.3 shows river/stream flow characteristics that were derived using Qube software (https://qube.hydrosolutions.co.uk/) for the bathing season (BS) for the Mothecombe Stream and River Erme.

Table 4.2. Derived flow statistics m^3s^{-1} for the River Erme at Sequers Bridge during the bathing season May-September.

River Erme at Sequers Bridge			
High flow Q5	Q10	Mean flow Q50	Low flow Q95
3.3446	2.3332	0.7402	0.298

Table 4.3. Derived flow statistics m^{3}s^{-1} for the River Erme at Mothecombe Stream during the bathing season May-September.

Mothecombe Stream			
High flow Q5	Q10	Mean flow Q50	Low flow Q95
0.00602	0.00456	0.00216	0.00114

4.1.2. SWW permitted discharges

There are four sewage treatment works (STW) in the Mothecombe catchment, these are Ermington STW, Holbeton STW, Ivybridge STW and Modbury STW which all discharge to the Erme or associated tributaries. The final effluent from Holbeton STW, Ivybridge STW received ultraviolet (UV) disinfection. There are several intermittently discharging assets further upstream to the Erme estuary and its respective streams. These include Storm Overflows (SO) from the STW (e.g., Modbury STW SSO and Holbeton STW SSO) and combined sewer overflows (CSO) (e.g., Poundwell Meadow CSO). Locations of these are given in Figure 4.1 and summarised in Table 4.4.

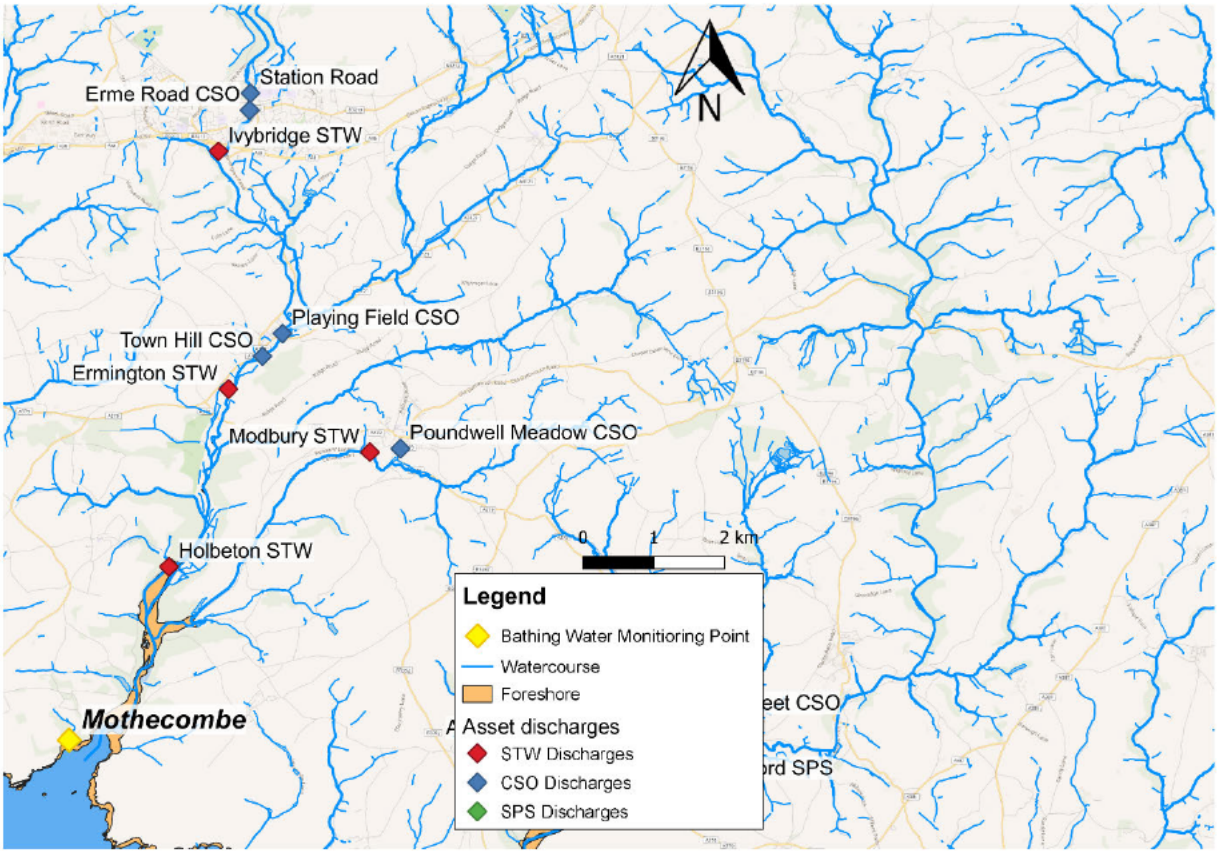


Figure 4.1. Map of SWW asset discharges locations in the Mothecombe catchment in relation to the bathing water monitoring point. Map produced in QGIS 3.4 using Wikimedia basemap and Ordnance Survey (OS) river data. STW = sewage treatment works, CSO = combined sewer overflow, SPS = sewage pumping station).

Table 4.4. Summary of South West Water (SWW) assets discharging in or close to the Mothecombe Catchment. (CSO = combined sewer overflow, SSO = sanitary sewer overflow, SPS = sewage pumping station, EO = emergency overflow, SO = storm overflow, STW = sewage treatment works).

Intermittent Site Name	Discharge type	CD number	Permit Number	Discharge outlet NGR	Receiving Water
Ho beton STW SSO	Intermittent	CD202400	202650	SX 6246 4979	Holbeton Stream
Ho beton STW SO	Intermittent	CD402400	202650	SX 6200 5021	Holbeton Stream
Ermington STW SO	Intermittent	CD201790	NRA-SW-1188	SX 6339 5237	River Erme
Ermington STW EO	Intermittent	CD301790	NRA-SW-1188	SX 6339 5237	River Erme
Town Hill CSO, Ermington	Intermittent	CD513420	201874	SX 6373 5282	River Erme
Modbury STW SSO	Intermittent	CD203370	SWWA 2259	SX 6537 5136	Oldaport Stream
Ermington Playing Field CSO, Ermington	Intermittent	CD513410	201875	SX 6406 5308	River Erme
Poundwell Meadow CSO, Modbury	Intermittent	CD509010	201962	SX 6573 5146	Tributary of Ayleston Brook
Ivybridge STW SO	Intermittent	CD202580	203299	SX 6316 5566	River Erme
Ivybridge STW SSO	Intermittent	CD202581	203299	SX 6316 5566	River Erme
Erme Road CSO, Ivybridge	Intermittent	CD513640	201862	SX 6360 5624	River Erme
Ermington STW	Continuous	CD101790	NRA-SW-0222	SX 6330 5230	River Erme
Ho beton STW	Continuous	CD102400	202413	SX 6246 4979	Holbeton Stream
Modbury STW	Continuous	CD103370	SWWA 2259	SX 6530 5141	Oldaport Stream
Ivybridge STW	Continuous	CD102580	203299	SX 6316 5566	River Erme

4.1.3. Other sources

Microbial source Tracing (MST) was performed on select elevated samples from the Nijhuis 2021 survey (more survey details in Section 5.5) from Erme Estuary at Mouth, Mothecombe BW Monitoring Point and Mothecombe Stream (Figure 4.2). Samples were analysed for the presence of human, ruminant, canine and sheep markers (table 4.5). MST at the BW was predominantly ruminant although human sources were present. The Erme Estuary samples were also predominantly ruminant with nearly equal presence of human, and one occasion with a signal from canine sources. The only substantial source found in the Mothecombe Stream was human.

Table 4.5. Results of SWW MST analysis on 5 Nijhuis survey samples taken during the 2021 bathing season.

Sample site	Date	Time	*E. coli* (cfu/100ml)	Intestinal Enterococci (cfu/100ml)	Bact Human Copy No	Bact Ruminant Copy No	Canine Mito Copy No	Sheep Mito Copy No
Erme Estuary at Mouth	05/08/2021	09:43	3500	610	3.4	4.5	<2	<2
Mothecombe BW Monitoring Point	05/08/2021	09:06	400	280	2.7	3.4	<2	<2
Erme Estuary at Mouth	09/09/2021	07:25	580	490	3.5	3.7	2.4	<2
Mothecombe BW Monitoring Point	09/09/2021	07:00	2000	1480	4.4	4.7	<2	<2
Mothecombe stream	09/09/2021	07:05	3100	1240	2.9	<2	<2	<2

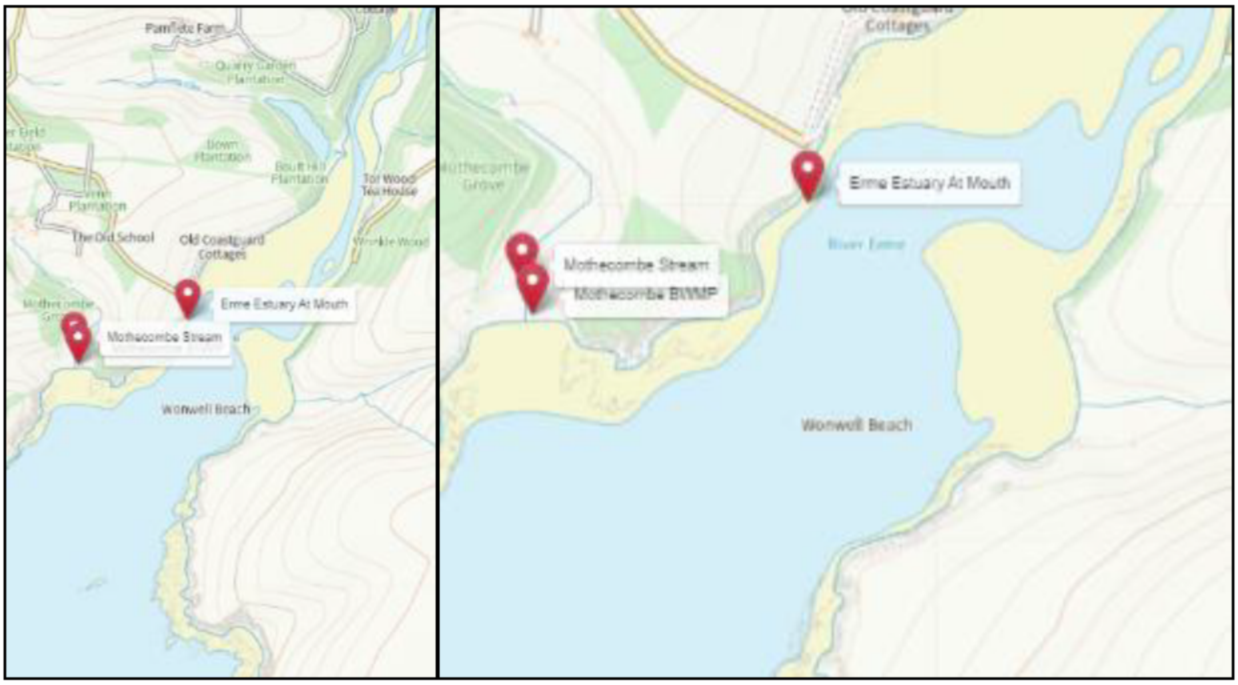


Figure 4.2. Locations of sampling points for Erme Estuary at Mouth, Mothecombe BW Monitoring Point and Mothecombe Stream where MST analysis was performed from the 2021 Nijhuis bathing season survey. (Source: Grid Reference Finder)

There is a seasonal dog ban in place on Mothecombe Beach from 1st May to 30th September.

4.2. Nature and timing of significant SWW asset improvements.

Table 4.6. Past improvements to South West Water assets within the Mothecombe catchment.

Year completed	Asset name	Improvement description
2002	Holbeton STW	The sewage treatment scheme for Holbeton was completed by South West Water Sewage receives secondary treatment with ultraviolet (UV) disinfection and discharges to the River Erme three kilometres from Mothecombe bathing water.
2015	Multiple CSOs and Ivybridge STW	Storm overflow event duration monitoring (EDM) and works to reduce the frequency of twelve CSOs discharging to the Erme estuary, together with the installation of UV disinfection at Ivybridge STW.
2015	CSOs	Work to reduce the frequency of discharges from CSOs in Modbury was completed

4.3. Sources of FIO conclusions

The Mothecombe stream enters the sea at Mothecombe Beach, in very close proximity bathing water monitoring point (BWMP) transect. Mothecombe is also located at the mouth of the Erme estuary which main freshwater input is from the River Erme but also has multiple freshwater inputs from 9 other smaller streams.

There are four sewage treatment works (STW) in the Mothecombe catchment which all discharge to the Erme or associated tributaries. The final effluent from Holbeton STW and Ivybridge STW are UV disinfected.

There are also a number of intermittent discharges from storm overflows further upstream to the Erme estuary and its respective streams.

MST analysis at the BW and Erme Estuary were predominantly ruminant, although human sources were present at both locations, as well as one occasion in the Erme Estuary with a signal from canine sources. The only substantial source found in the Mothecombe Stream was human.

5. Bacteriological data.

A range of Bacteriological data exist in connection to water quality at Mothecombe bathing water (BW). This section will look at the EA Pollution Risk Forecasting's (PRF) environment variables used to predict poor water quality and how this is reflected in the EA routine data. Freshwater inputs will also be assessed using the available data. Flow for these sources is determined, impact of water quality established, and a theoretical total faecal indicator organism (FIO) load calculated. Finally, data collected from Nijhuis BW surveys is evaluated to better inform the relationship of the BWs quality and freshwater sources.

5.1. Environment Agency PRF Multiple Linear Regression.

Environment Agency Intestinal enterococci pollution risk forecasting (PRF) is undertaken at qualifying bathing waters to provide information to public. The Short-Term Pollution provision of the bathing water legislation allows discounting if the public have been advised of a risk of poor water quality. The modelling that enables this forecasting is described by Tyrrell (2017).

In 2019, the EA Bathing Water Pollution Risk Forecasting equation was as follows:

Log10 Intestinal enterococci (no/100ml) = (Flow 12hr Ave x 0.055)+(Whole Catch 24hr Sum x 0.02)+(Wind On 15hr Ave x 0.055)+(Flow 72hr Ave x 0.077)+(Abs Hrs Rel to HW x 0.129)+(Day x 0.002)+(Time x -0.713)+0.862

This equation demonstrates that the average 12-hour preceding flow is the biggest factor is predicting poor water quality.

Figure 5.1. is a figure from the EA's BW Raintide database. It summarises water quality statistics from 1993 to 2019.

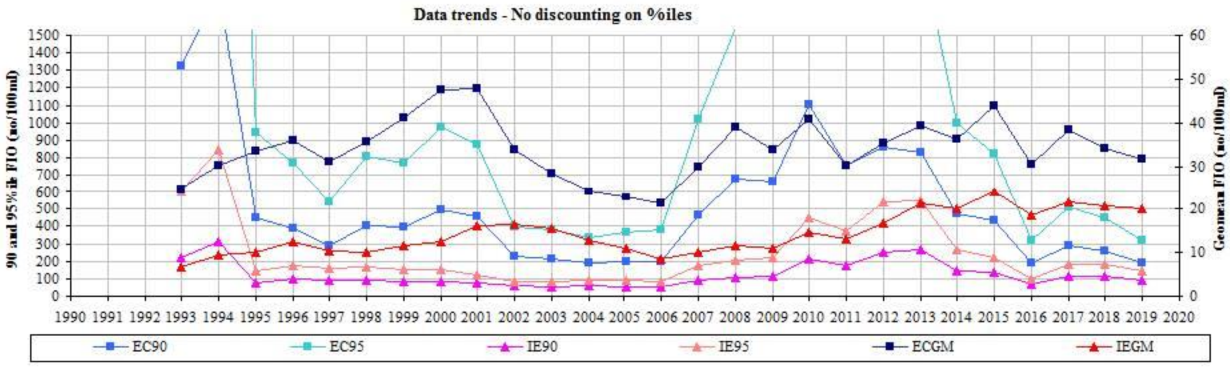


Figure 5.1. EA Graph summarising water quality from 1993 to 2019.

5.2. Environment Agency BW Monitoring Point Routine Data.

In the interim report, plots of all routine data 2000 to 2019 supported PRF modelling outputs, demonstrating that there is a rainfall component to FIO levels at the BW along with tide. The extent to which this is related to high season loadings, decreased UV from sunlight or increased rainfall is uncertain. However, trends based on the full dataset can mask acute pollution characteristics. In this Section we will look in more detail at environmental conditions around the 33 elevated FIO results that influence classification and summarise any conclusions relating to elevated FIO contamination scenarios.

The most significant variable for the PRF is the 12-hour average river flow. The EA data base for historic Ermington flow is recorded as daily averages (24hrs). Figure 5.2 shows the 24 hours average flow compared to BW quality. A degree of correlation is present suggesting greater FIO levels at higher flows, particularly for *E. Coli*. This relationship appears to flatten out for significantly higher flows, suggesting a nonlinear relationship. Where most of the data resides on the lower end of the scale, it is not possible to conclude the effects of extremely elevated flows. In figure 5.3, 72 hours average flow, another PRF variable, was compared to BW FIO levels. In this data set there was a more even spread of data and relationships were seen to be more linear. Once again, correlation was significantly stronger for *E. coli*. *E. coli* correlation was also seen to be stronger for the 72 hours average flow compared to 24-hour flows. This is implicit of a lag effect between increase flows and decline in the BW quality, possible indicative of both travel time and further lag caused by tide. IE's had little correlation in both time periods. The fact increased flow for this time scale do not correlate would BW quality for IE could suggest that sources of IE are closer to the BW and are impacted by a shorter time scale.

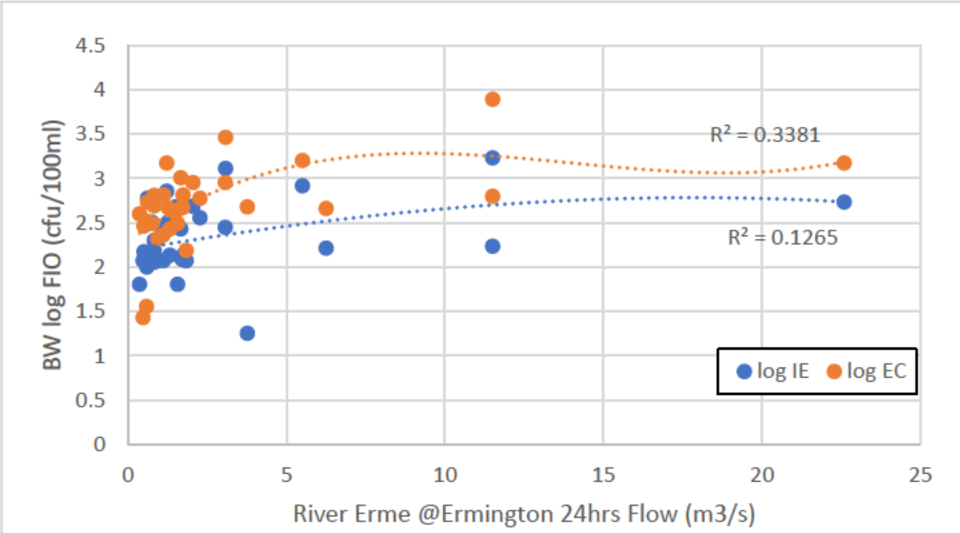


Figure 5.2. Elevated BW FIO level versus 24hr average flow at Ermington 2012 to 2019.

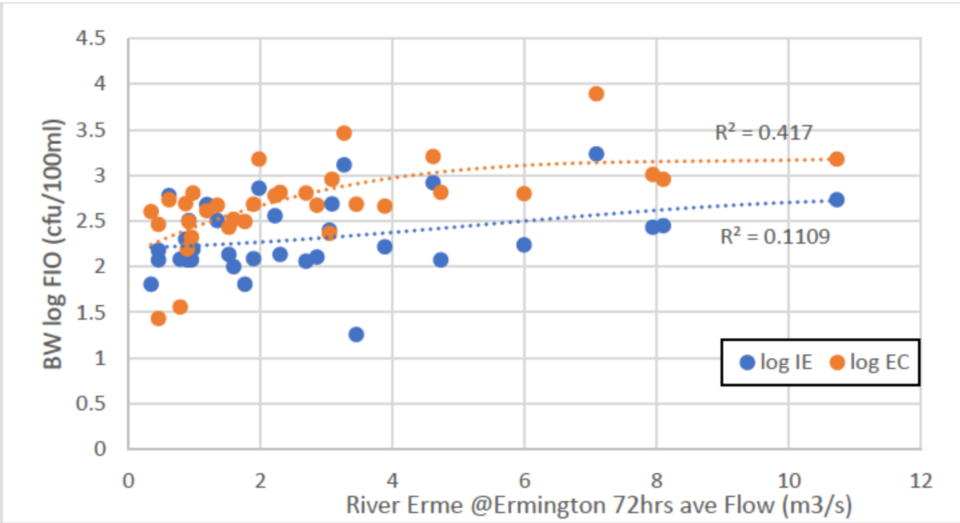


Figure 5.3. Elevated BW FIO level versus 72hr average flow at Ermington 2012 to 2019.

The PRF model selected 24-hours antecedent rainfall across the whole catchment as the most relevant rainfall variable. Figure 5.4 Shows this compared to BW quality. Although there is a degree of correlation this is significantly weakened by the fact many of the elevated sample occasions occurred with little or no rainfall. This implies although rainfall can exacerbate the FIO loading it doesn't drive failures. It is also worth observing that *E. coli* was seen to have a slightly stronger correlation with 24 hours rainfall over 5km, see figure 5.5. Although it might not be significantly different, it does imply a PRF model based on E. coli would select for slightly different variables.

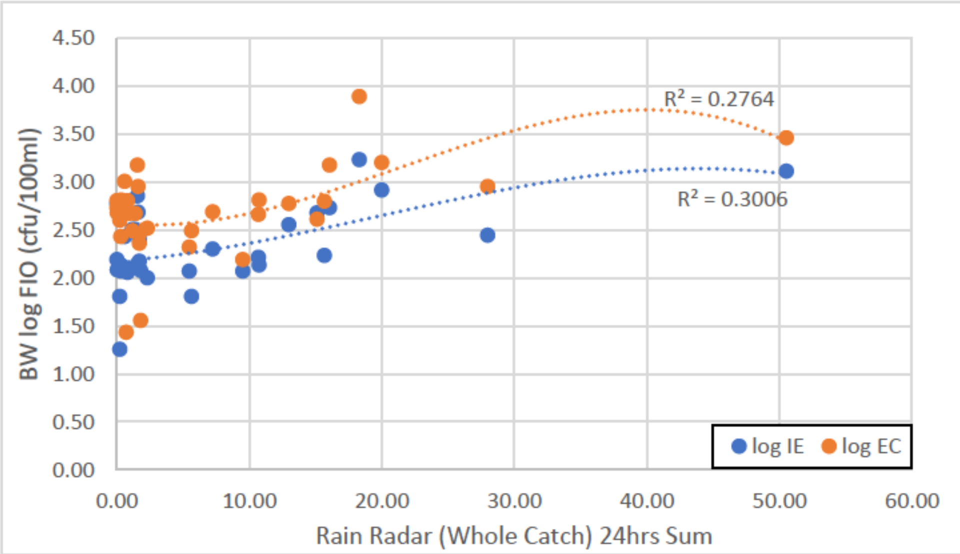


Figure 5.4. Elevated BW FIO level versus 24hr antecedent rainfall of the whole catchment 2012 to 2019.

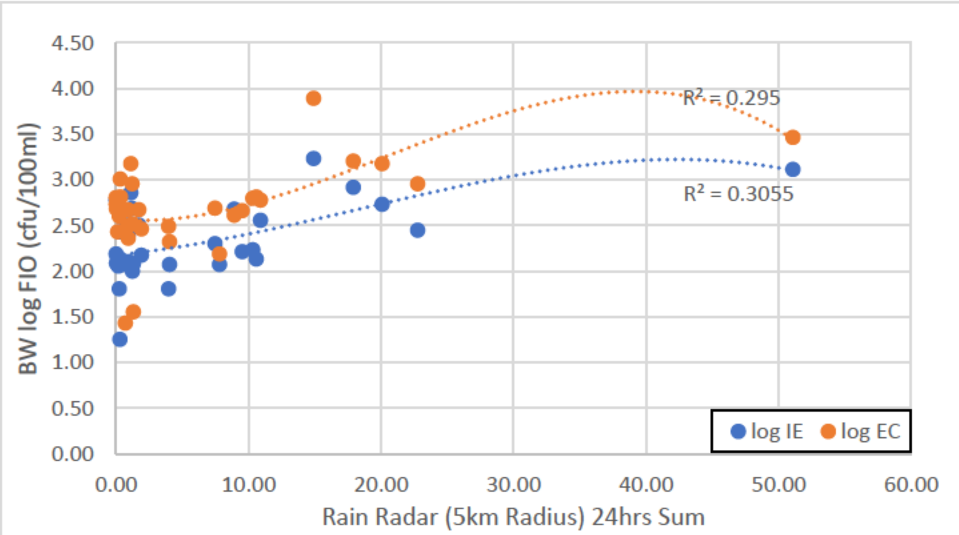


Figure 5.5. Elevated BW FIO level versus 24hr antecedent rainfall for 5km radius 2012 to 2019.

Where two flow parameters were selected for by the PRF, it is clear the river influences the BW. Figure 5.6. shows BW quality compared to freshwater %. For both FIO correlation was relatively low. This suggests not all freshwater sources negatively impact on the BW. Some of the elevated scenarios only had one elevated FIO (the paired non elevated FIO has been included in all plots). The fact that none of these occasions (at least for IE) occur above 30% freshwater illustrate the negative impact of freshwater. Finally, it is worth noting that all the elevated samples have relatively high levels of freshwater for a BW site. Freshwater sources will be explored more in the following section.

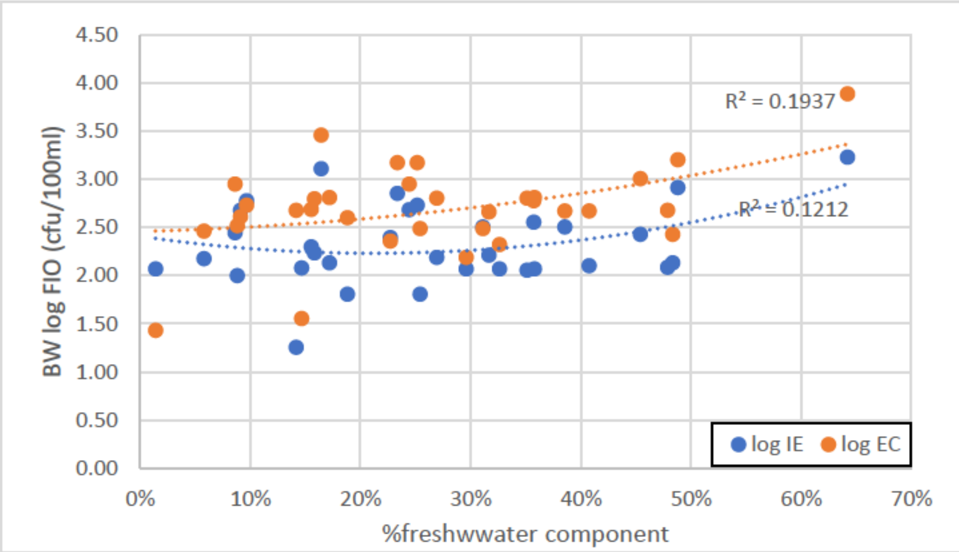


Figure 5.6. Elevated BW FIO level compared to freshwater component of sample 2012 to 2019.

The PRF also selected for 15-hour average onshore wind component. Figure 5.7 show this plotted against BW quality. Although correlation is relatively weak, it is worth observing only 6 elevated scenarios occurred with negative onshore wind compared to the 27 with positive onshore wind component. This suggest onshore wind is a key factor on whether elevated scenarios occur. A similar observation could be made about alongshore wind component where only 4 elevated scenarios occurred with negative alongshore wind, see figure 5.8. However, alongshore wind has a sample bias with on 43 samples with negative alongshore (compared to 124 with positive). No such bias is present for onshore wind. It is also worth observing positive alongshore will be associated with south westly wind patterns that stereotypically are associated with rainfall. This means any alongshore wind correlation is likely an artifact of this.

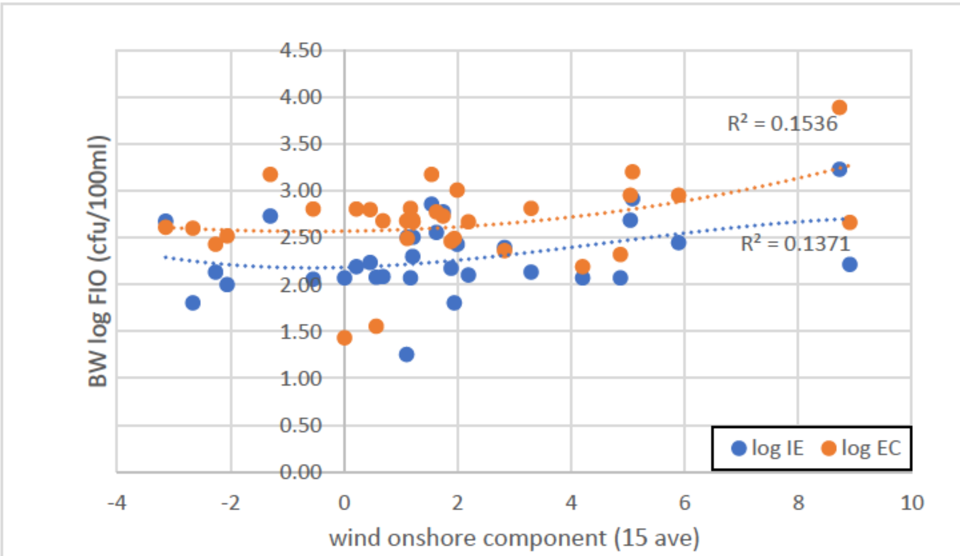


Figure 5.7. Elevated BW FIO level compared to wind onshore component 2012 to 2019.

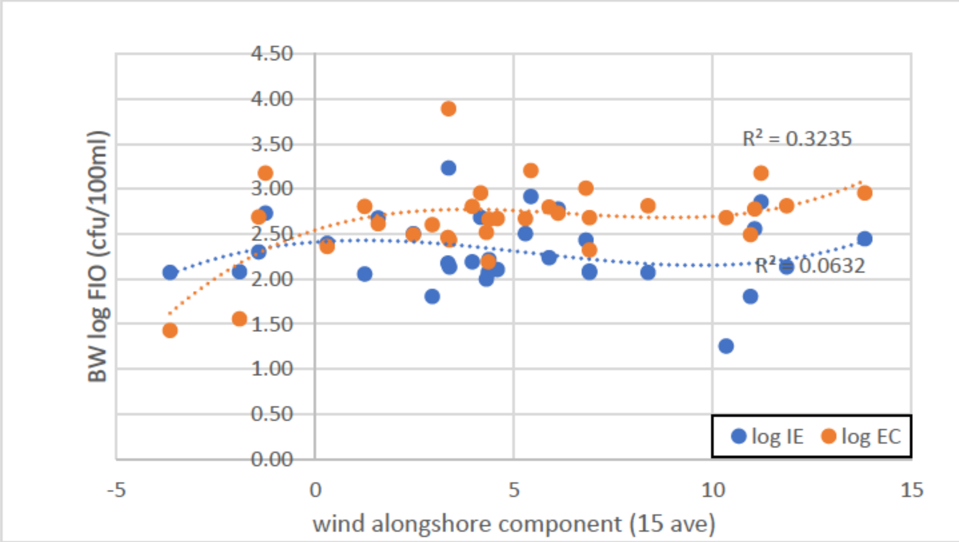


Figure 5.8. Elevated BW FIO level compared to wind alongshore component 2012 to 2019.

Absolute Hours Relative to HW was another PRF selected variable. When plotted against BW quality, as in figure 5.9, there is a clear tendency for elevated samples to occur around low tide. This could be indicative of hydrography of the river but might just be the shift in sample location as the tide goes out. Where the BW is a transect, at low tide Mothecombe BW point is no longer going to be in the protection of the bay and more under the influence of the River Erme, and closer to Wonwell Stream.

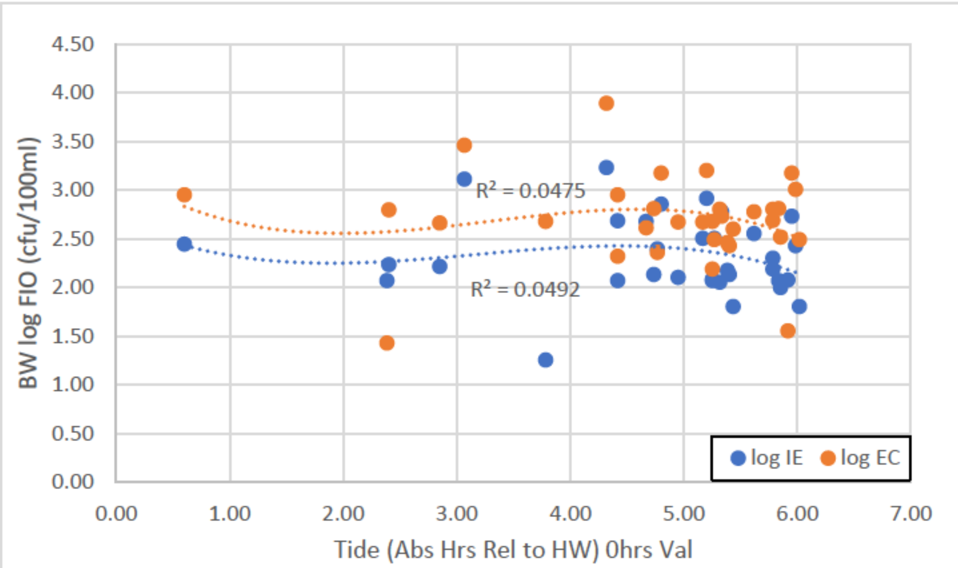


Figure 5.9. Elevated BW FIO level compared to absolute hours relative to HW 2012 to 2019.

Time has been selected as a relevant variable for the PRF model. In figure 5.10 no correlation is seen between time and BW quality. The only pattern to note is that almost all elevated samples occur in the hour between either 10:00-11:00 or 12:30-13:30. Upon further analysis it appears this is purely down to sample bias with just over 70% of samples being taken in one of these two time periods. It is possible the PRF model has included time as an artifact of this.

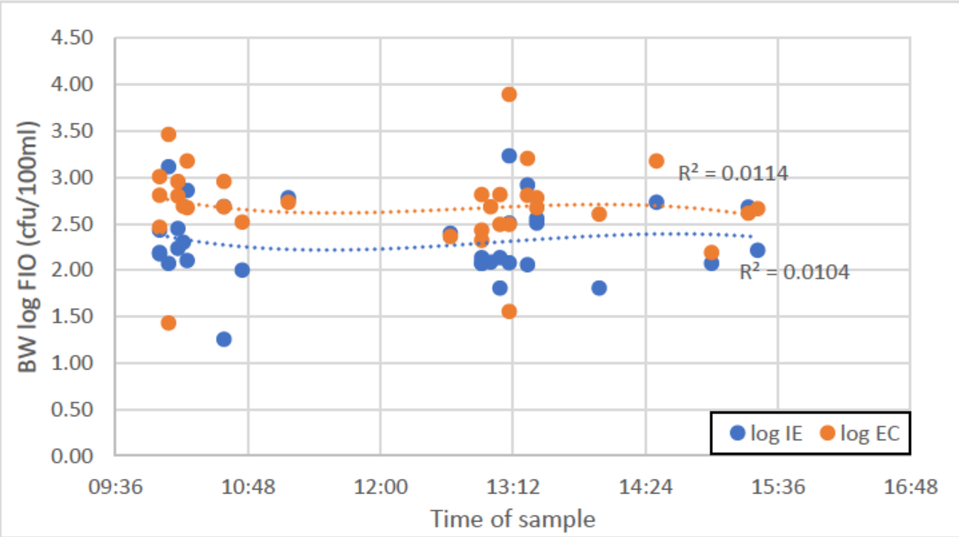


Figure 5.10. Elevated BW FIO level compared to time sample taken 2012 to 2019.

In figure 5.11. day, another variable selected by the PRF, has been plot against BW quality. Limited correlation is present. The relationship indicated by the trendlines for *E. coli* and IE are opposite in affliction. This mean a PRF model base on IE alone using this variable, potential suffers in accuracy for *E. coli.*

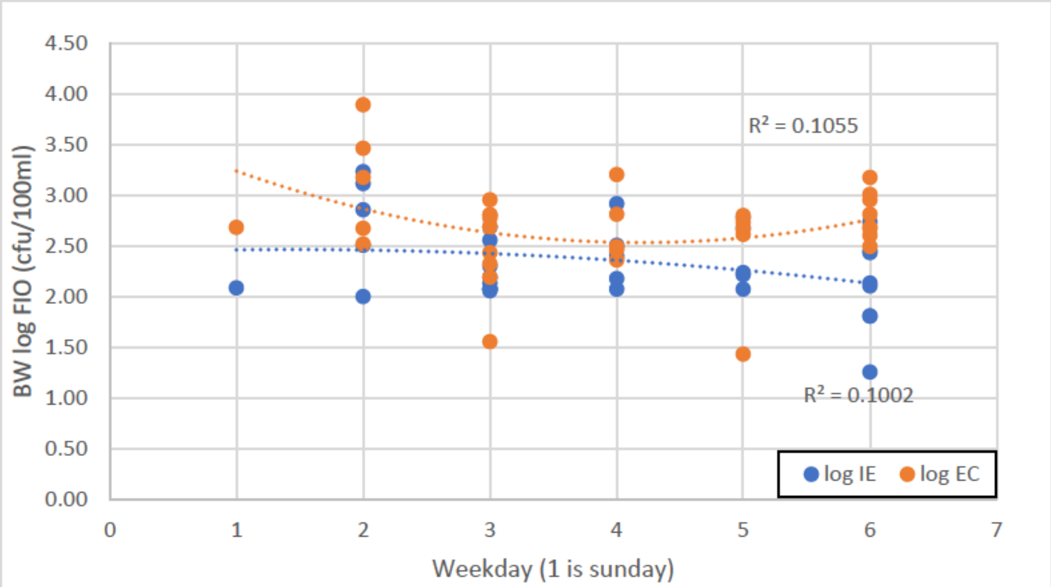


Figure 5.11. Elevated BW FIO level compared to the day of week, 1 being Sunday.

Where time-based components such as time and day were included in the PRF, decimal season was also considered in this report. In figure 5.12 little correlation was seen when comparing to BW FIO level. Cluster density appears to be greater near the end of the season. In figure 5.13. this was explored further by calculating average fortnightly FIO levels and Rainfall across the bathing season. Peak FIO levels were at the end of the bathing season, coinciding with peak tourism. Overall, there is a good correlation between rainfall and FIO levels. The only exception to this is when a spike in rainfall occurs in late August without similar IE spike. This would suggest some land use related practices influencing the BW quality e.g. Whether the cows are in one field or another when rainfall hits.

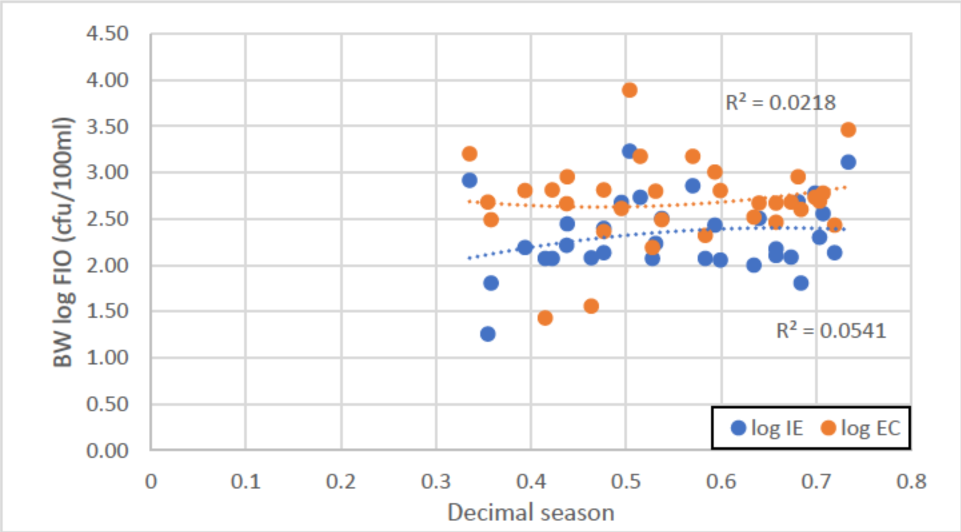


Figure 5.12. Elevated BW FIO level compared to decimal season 2012 to 2019.

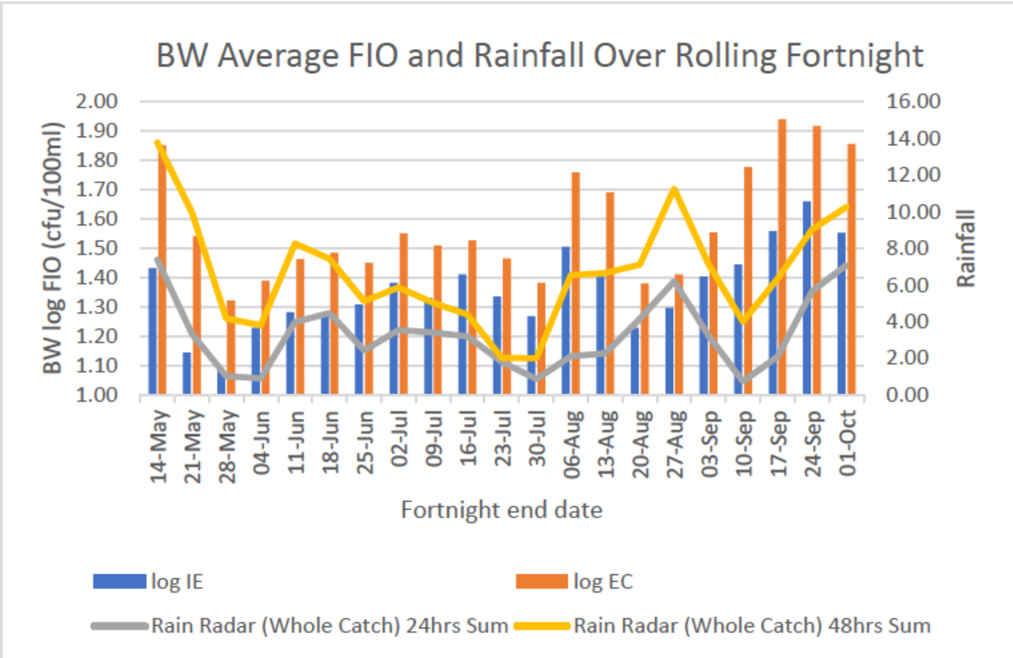
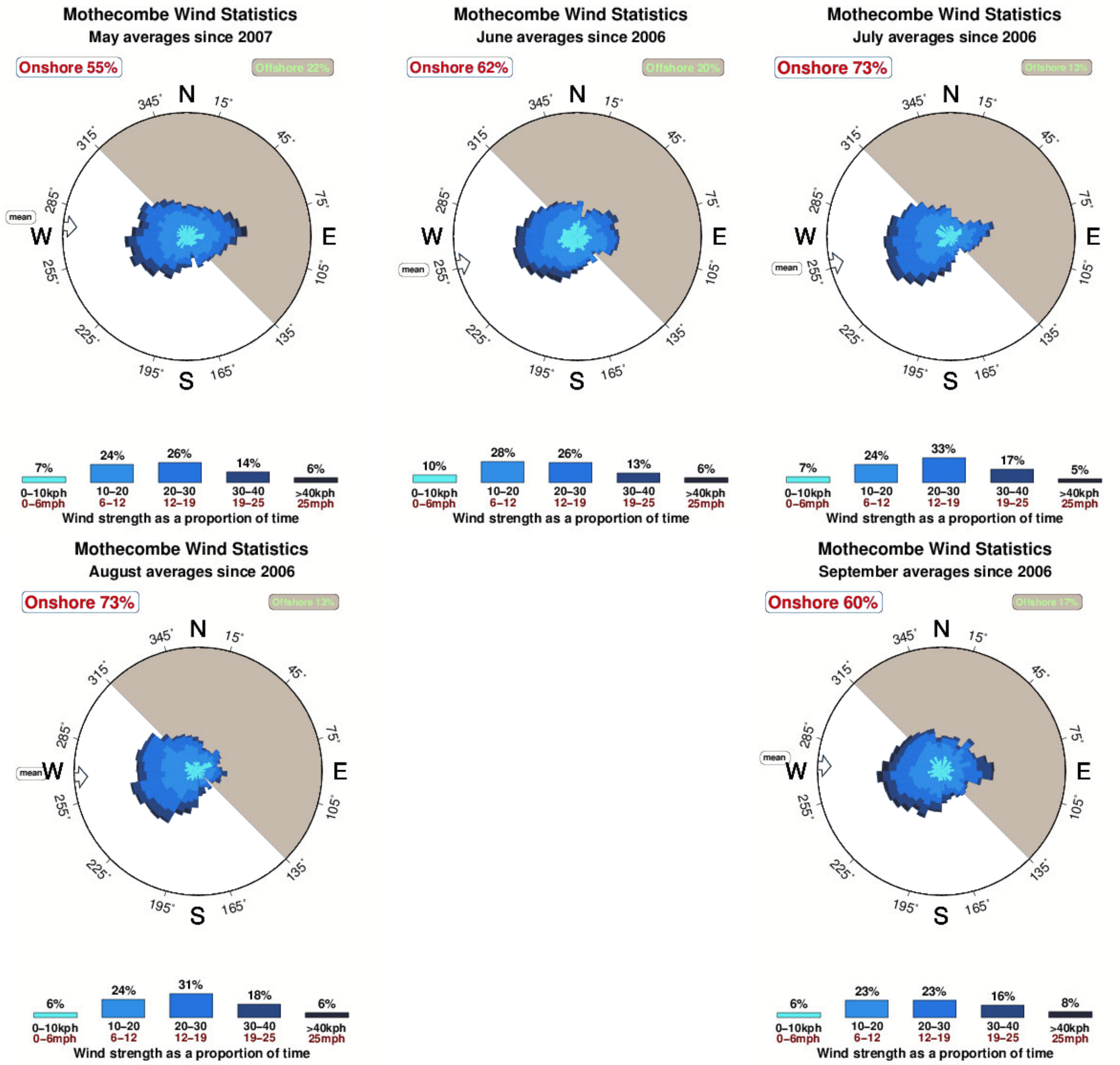


Figure 5.13. rolling fortnightly averages for BW FIO and rainfall over the bathing season.

Wind Roses shown in figure 5.14. show a predominance for westerly winds (hence the alongshore wind sampling bias). Whether this is a south westerly or North westly is going to play a large role in the BW quality.

South West Water

Figure 5.14. Wind Rose for Mothecombe.



https://www.surf-forecast.com/breaks/mothecombe/wind-stats

5.3. Environment Agency Stream Input Routine Data

There is freshwater data available for many sites in the Mothecombe catchment. Unfortunately, the dataset is too small and disjointed to give reliable resolution of likely FIO sources up-catchment. Data available will however, be used to characterise FIO loads entering the bathing water.

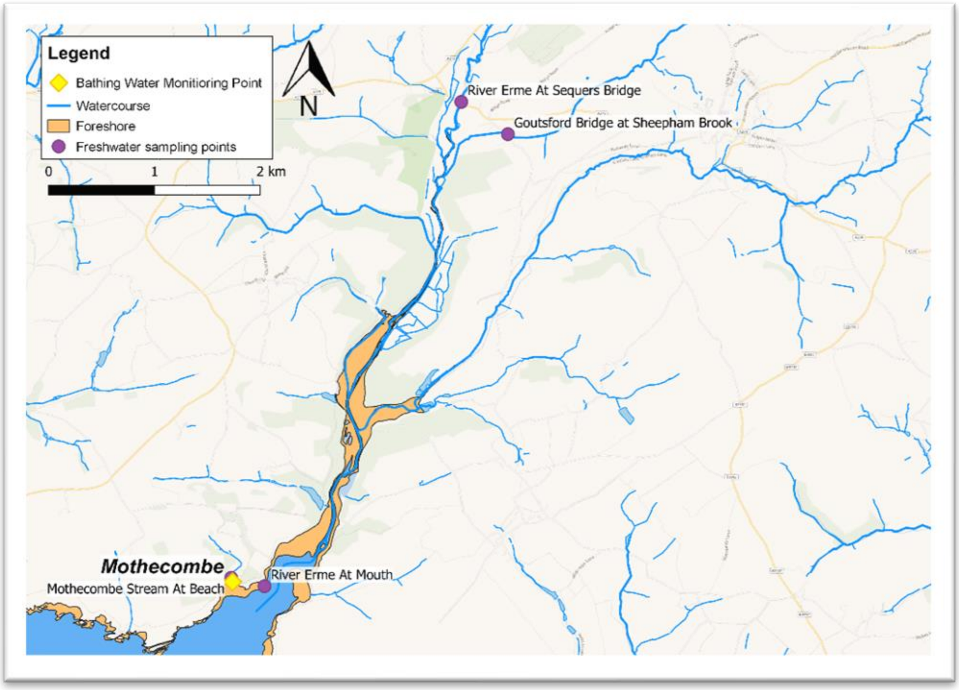


Figure 5.15. Map of freshwater inputs and sampling locations in the Mothecombe catchment in relation to the bathing water monitoring point. Map produced in QGIS 3.4 using Wikimedia basemap and Ordnance Survey (OS) river data.

5.3.1. River flow FIO characterisation.

In this section we use daily flow data downloaded from the Environment Agency's website https://environment.data.gov.uk/hydrology/explore. Where no data exists for the river/streams at the point at which it discharges to the Mothecombe BW or Erme River, daily flows were derived by bathing season comparison of Qube software (https://qube.hydrosolutions.co.uk/) flow estimates for the River/streams, with flow estimates for a gauged site in the most representative catchment in close proximity. For Mothecombe Ermington flows were used. A conversion factor (gauged to un-gauged) was calculated using the Qube flow estimates and applied to the gauged daily flows to derive the un-gauged flows for the site on sampling dates.

Figure 5.16 shows that the elevated FIO concentration at the BW tends to increase with flow, but correlation is poor. Flow was also compared to FIO in Mothecombe Stream itself and correlation was found to be even weaker, suggesting stream quality is not influence by flow and the BW quality is also independent from Mothecombe Streams flow.

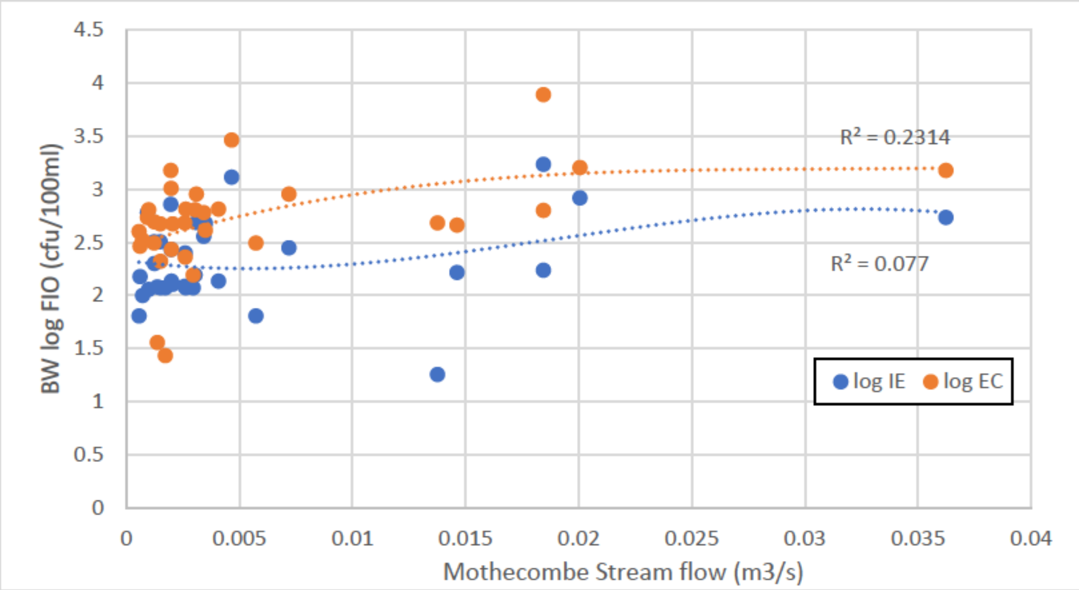


Figure 5.16. Plot of Mothecombe Stream daily flow versus FIO concentrations at the BW

Routine EA data between 2012 and 2014 included paired samples at Mothecombe Stream. Figure 5.17 shows very little correlation between the stream and BW FIO levels. From this data set it would appear Mothecombe Stream has little influence on BW quality. Some of the stream's most elevated samples have no elevation on BW samples and vice versa. Upon sorting the data by tidal state, correlation improved slightly but remained low (highest R2 0.24 for IE), with the strongest correlation not being linear in nature.

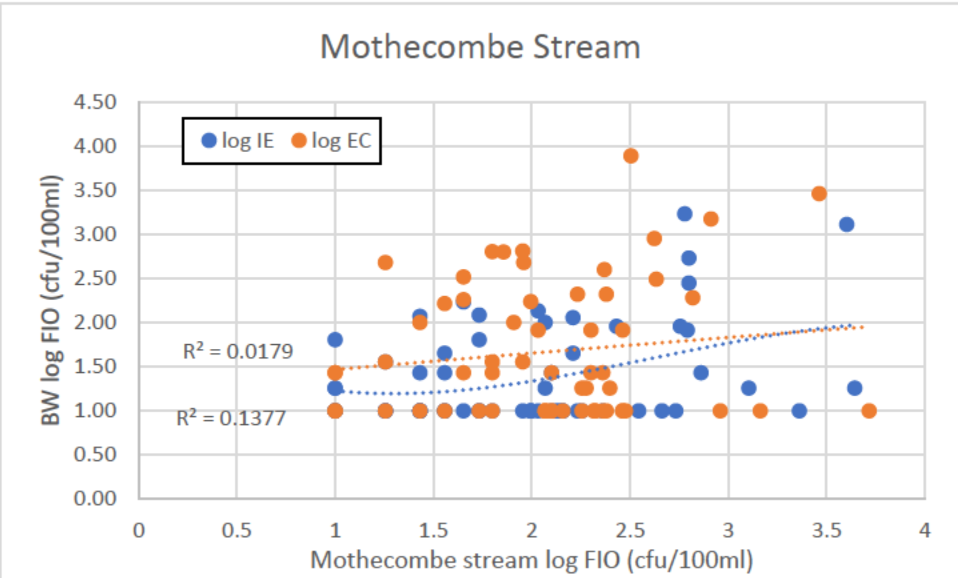


Figure 5.17. Mothecombe stream compared to BW FIO levels 2012-2014

In figure 5.18 Mothecombe Stream quality was used to predict BW quality working under the assumption that the freshwater component is all from one stream and that freshwater is the sole source of faecal pollution. Due to the immediate proximity of the stream to the BW, no decay or tidal factor was applied. This was then compared to the actual BW quality to illustrate how well the streams FIO levels explains the BW's. Mothecombe Stream theoretical BW levels was only able to explain 32-48% of the variation in the BW. Although on average theoretical levels account for 65-85% of the BW levels, this is largely down to over accounting for low level BW FIO occasions and accountability for elevated samples is much lower. Overall, Mothecombe stream can influence BW quality but is not likely to be the key driver in elevated BW scenarios.

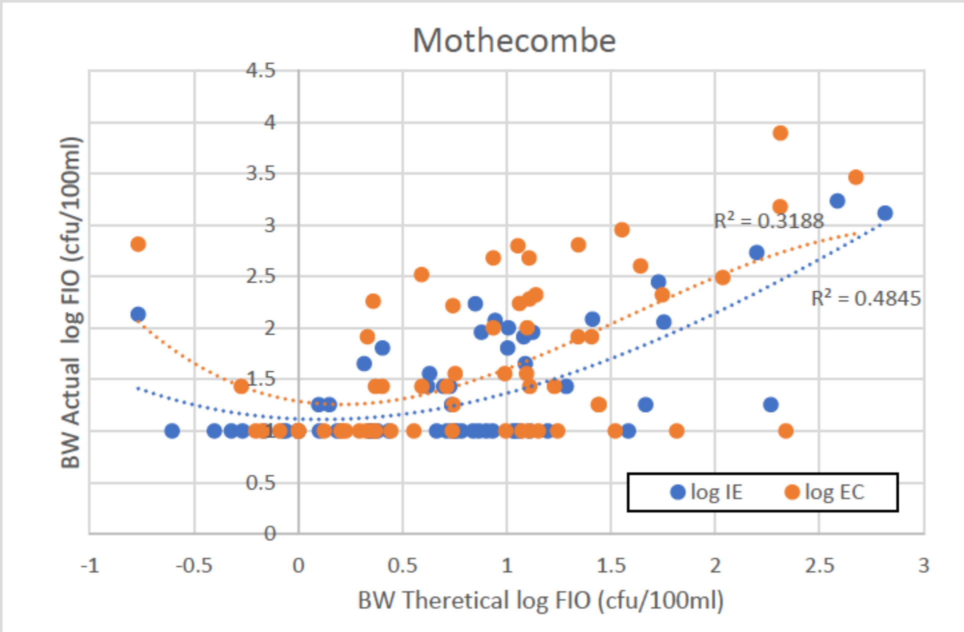


Figure 5.18. Theoretical BW FIO levels derived from Mothecombe Stream compared to actual BW FIO levels.

Flow data was also derived for the River Erme at Sequers Bridge from Ermington flow data. Although locations are close and only limited change in flow occurred from ratio occurred, the derived flow were seen to have a slightly better fit. In figure 5.19 River Erme's flow at Sequers Bridge was compared to BW quality. Despite the distance between here and the BW, correlation was stronger than that seen for Mothecombe Stream. River Erme's flow at Sequers Bridge was also compared to the FIO levels at the mouth of the River Erme. Correlation was seen to nearly double suggesting a good relationship between the upstream flow and final River quality. Conclusions on this are limited by the fact nearly two thirds of elevated BW samples have no paired samples at the river mouth. Figure 5.20 compared the Sequers Bridge flow to FIO level at the Sequers bridge sample point. Correlation was significantly stronger than in previous figure, with around 50% of the variation in both FIO levels explained by variation in flow. The fact increase flow is linked to increase FIO levels means that under high flow regimes the Rivers loading on the BW is going to increase in volume and concentration.

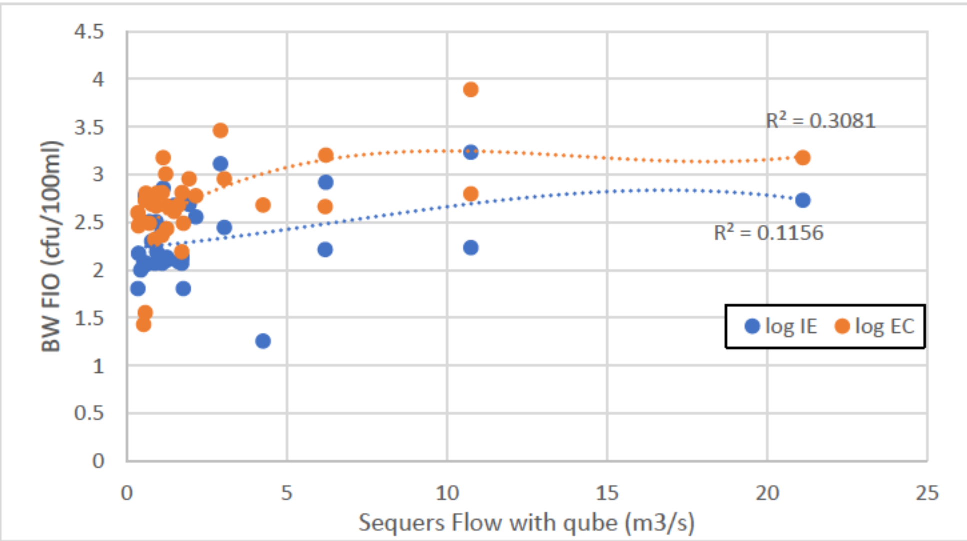


Figure 5.19. Plot of River Erme at Sequers Bridge daily flow versus FIO concentrations at the BW.

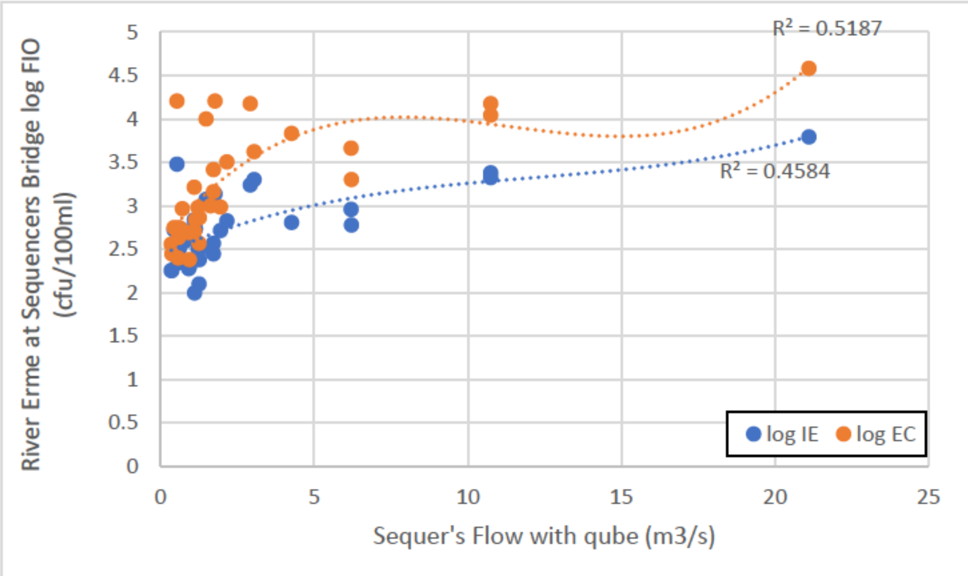


Figure 5.20. Plot of River Erme at Sequers Bridge daily flow versus it's FIO levels.

Routine EA samples between 2012 and 2016 included paired samples at River Erme's mouth. Figure 5.21 shows the presence of correlation between the BW and river mouth. Correlation was weakened by several low BW FIO with high River Erme at mouth FIO levels. This implies although it is likely that the river Erme drives the BW quality, it only impact under certain conditions (tide state vs wind).

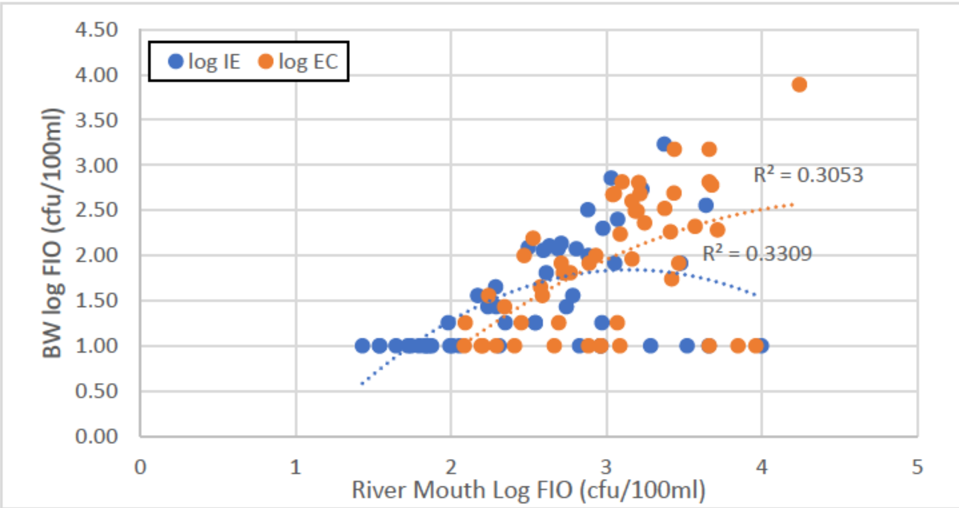


Figure 5.21. Erme at mouth FIO compared to BW FIO levels 2012-2016.

When river Erme at mouth data is sorted via tide state, correlation between here and the BW significantly increases on the flood tide, see figure 5.22. The fact that The flood tide has significantly more correlation suggests the river tends to be pushed back into the BW on the flood tide whereas on the ebb it drains straight past. The fact almost all the elevated river samples with paired low BW FIO levels are in the ebb tide data set strengthens this conclusion.

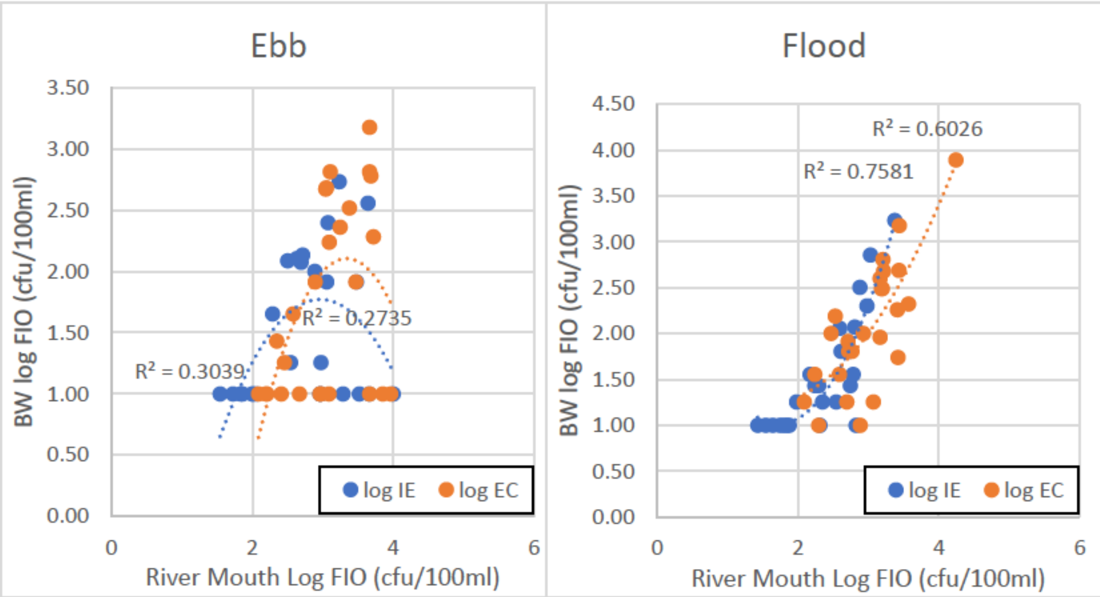


Figure 5.22. Erme at mouth FIO separated by tide state compared to BW FIO levels 2012-2016

River Erme at mouth data was then sorted via positive or negative onshore wind component. Figure 5.23 shows stronger correlation when for onshore wind than offshore. This suggest that onshore wind is needed to push polluted river waters back towards the BW. It is likely the presence of onshore wind is more relevant under flood tide conditions when this polluted river water tends to impact the BW. Data on the flood tide separated by onshore component was not suffice for an accurate conclusion.

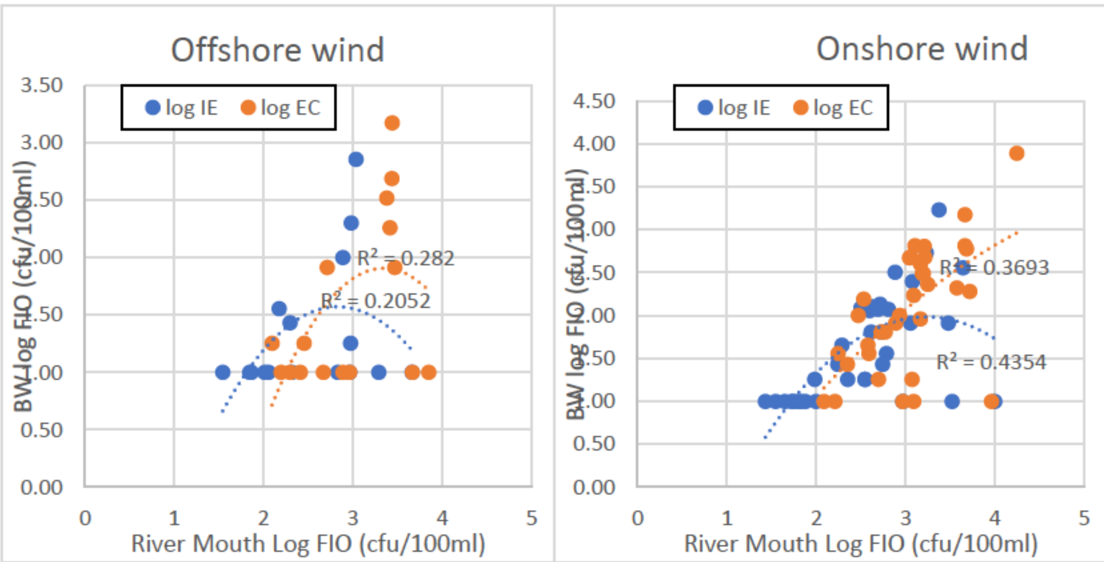


Figure 5.23. Erme at mouth FIO separated by onshore wind component vs BW FIO levels 2012-2016

In figure 5.24 River Erme at mouth FIO level after saliently normalisation, was used to predict BW quality working under the assumption that the freshwater component is all from the one source and that freshwater is the sole source of faecal pollution. Due to the immediate proximity of the mouth to the BW, no decay or tidal factor was applied. This was then compared to the actual BW quality to illustrate how well the river's FIO levels explains the BW's. The river's theoretical BW FIO levels was able to explain 66-76% of the variation in the BW FIO levels. On average theoretical levels account for just over 200% of both FIO at the BW. It is to be expected that the river would over account for the BW where, as established above, it tends to be only the flood tide that the river water impacts on the BW. This and no dilution/dispersion factor being applied. Overall, the River Erme is the key driver in water quality at Mothecombe BW.

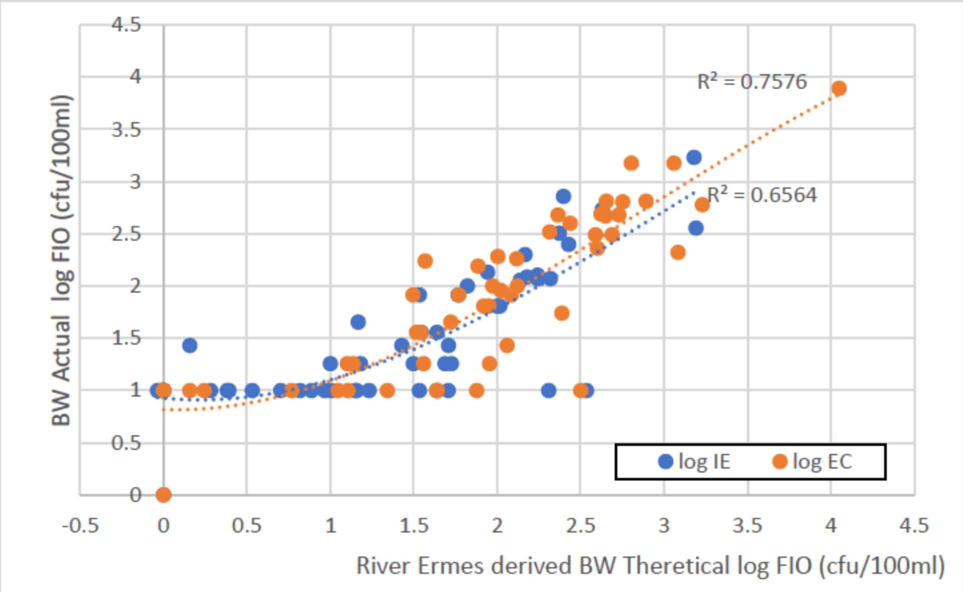


Figure 5.24. Theoretical BW FIO levels derived from River Erme at mouth compared to actual BW FIO levels.

Routine EA data for Goutsford bridge and River Erme at Sequers Bridge had little relationship with the BW. The only correlation of note was seen for IE at Goutsford bridge as shown in Figure 5.25. The lack of correlation at Sequers Bridge suggest all the pollution impaction on the BW occurs downstream of this point.

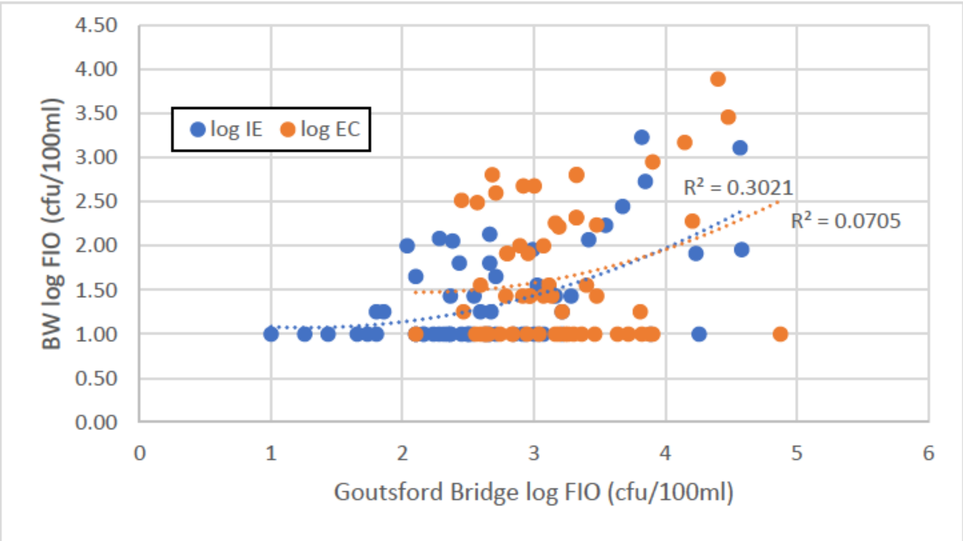


Figure 5.25. Goutsford Bridge FIO vs BW FIO levels 2012-2014

No routine data exists for Wonwell Stream. In Nijhuis surveys it was highlighted as a potential concern for the BW. Figure 5.26 shows derived percentile flows for Wonwell Stream compared to the elevated BW scenarios. A good correlation for *E. coli* was observed suggesting Wonwell stream can influence this FIO level at the BW.

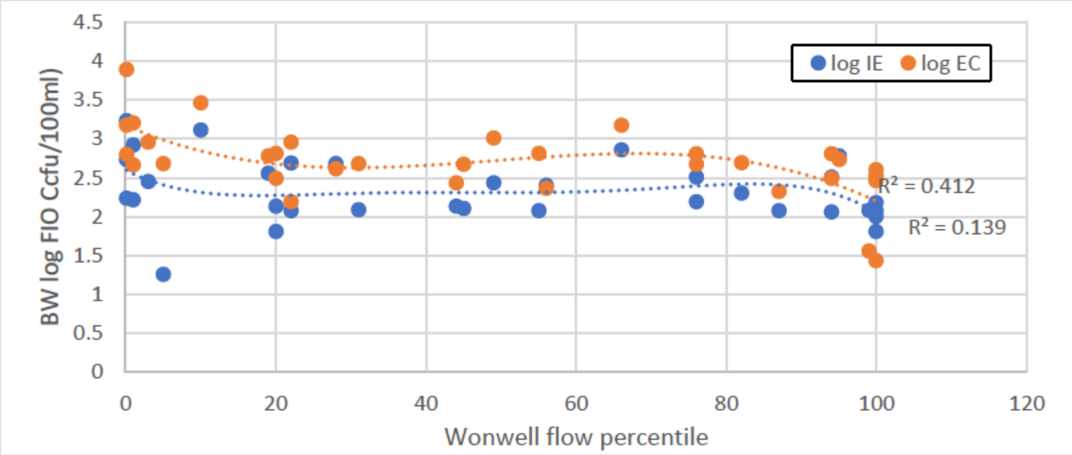


Figure 5.26. Satellite images from Google Earth show the River Erme's discharge location shifts.

It is clear from the above that the River Erme drives the BW quality. As mentioned at low tide (period of greatest risk), the BW sample location is no longer in the protection of the bay and under greater influence from the river. Figure 5.27 shows the low tide discharge location of the river shift from east to west, to the point (as in 2005) that the river sometimes discharges directly onto the BW transect. Which side of the bay the river discharges on to likely dictates whether the river has a greater impact on Wonwell Beach or Mothecombe. It is also worth observing that in the 2017 image where the River Erme had high turbidity, there is a clear patch in Mothecombe bay that is most likely the influence of Mothecombe stream and potential illustrates how it can be a protective influence.

Figure 5.27. Satellite images from Google Earth show the River Erme's discharge location shifts.

5.4. Less than Good/Excellent BWMP FIO characterisation.

As already stated in this report planning class is very sensitive to relatively few high sample results. It is the circumstances surrounding these poor water quality results that the authors believe gives the best opportunity to understand what interventions may have the greatest chance of bringing about a robust Excellent or Good classification at Mothecombe. In this section we characterise these occurrences of poorer bathing water quality in order to understand likely asset contribution in these scenarios.

For 2012-2019 routine compliance rolling-4-year-planning-datasets, 14 of 33 samples greater than the Excellent threshold were identified as needing to be substituted with the 95-percentile threshold (100 cfu/100ml) to achieve at or below 20% risk of failure to achieve an Excellent classification but not possible for 2012 dataset. These are shown in table 3.6.

River flow characteristics during these events is represented in Figure 5.28 below using flows derived from the Ermington Gauge station for River Erme at Sequers Bridge.

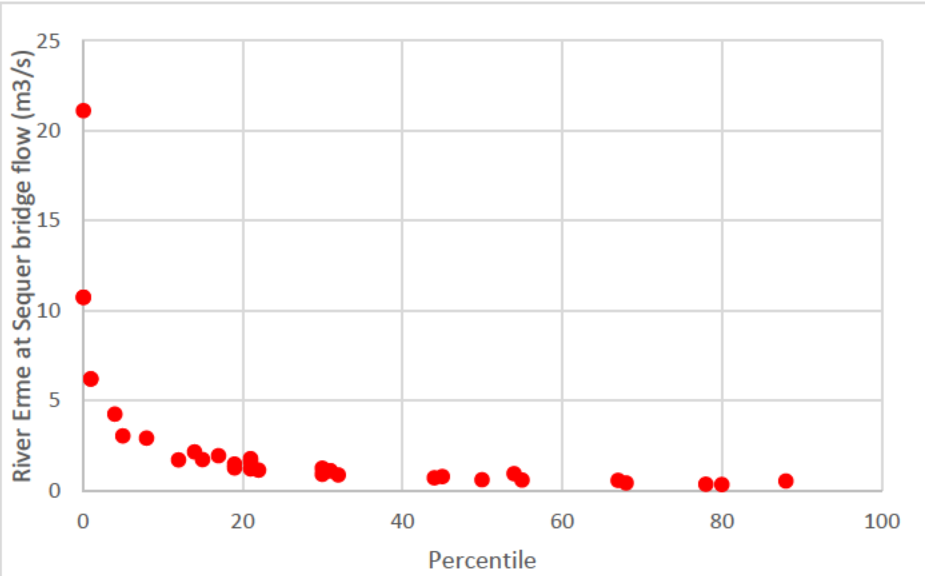


Figure 5.28. River Erme at Sequers Bridge percentile flow (X axis) and flow m3/sec (y-axis) on the day of sampling for 33 samples greater than Excellent threshold.

The red dots in figure 5.28. characterise flow conditions in terms of percentile flow for the relevant month, on the day of sampling. 12 samples (over a 3rd) fall within high flow scenarios Q0.1 to Q17. The majority of elevated samples occur with flows above average/Q50. Only one sample is linked to the lowest 17% of flow conditions. For high flow scenarios, similar numbers were observed for many of the streams' flows that were derived. Many of the streams had more occasions where elevated scenarios occurred under the lowest 17% of flows. This is likely down to the significantly higher volume and variance in flow in the raw river data used to derive stream flows. The most significant difference was observed at Wonwell Stream which had only 8 high flow scenarios between Q0.1 to Q17, meanwhile 9 occasions under the lowest 17% of flows.

Figures 5.19 and 5.26 show the strongest correlation observed when comparing a stream's flow to BW quality. For all streams analyses a similar correlation was seen (R2 between 0.4 and 0.3), apart from Mothecombe stream that was significantly weaker (see figure 5.16).

Table 5.2 shows that most of the 33 elevated samples were taken within 48 hours (2 days) of rainfall. It is worth observing that around a third of the elevated samples occurred after little or no rainfall.

Table 5.2. Highest 33 Ranked FIO results versus radar rain totals to the nearest mm over different catchment areas and timescales.

Date	BW EC	BW IE	Rain Radar (Whole Catch) 24hrs Sum	Rain Radar (1km Radius) 24hrs Sum	Rain Radar (Whole Catch) 48hrs Sum
02-Jul-12	7800	1710	18.3	11.7	21.0
24-Sep-12	2900	1300	50.5	49.4	64.0
02-May-18	1600	827	20.0	16.1	20.5
27-Jul-15	1500	720	1.6	1.0	13.9
12-Sep-19	540	600	0.0	0.0	0.2
06-Jul-12	1500	540	16.0	19.6	17.0
05-Sep-17	900	486	1.6	1.4	17.1
29-Jun-17	410	477	15.1	5.6	21.1
15-Sep-15	600	360	13.0	10.3	30.4
21-Aug-17	470	320	1.4	1.8	3.0
15-Jul-15	310	320	1.2	0.7	1.3
08-Jun-12	900	280	28.0	20.6	52.6
04-Aug-17	1018	270	0.6	0.3	20.4
22-Jun-16	230	250	1.7	1.1	1.8
13-Sep-16	490	200	7.2	3.4	7.6
12-Jul-12	630	172	15.7	9.3	18.3
08-Jun-17	460	164	10.7	9.3	11.8
23-May-17	640	155	0.0	0.0	0.0
28-Aug-19	290	150	1.7	2.0	3.5
22-Jun-12	650	136	10.7	10.4	31.0
19-Sep-17	270	136	0.3	0.0	0.3
28-Aug-15	470	127	0.9	1.2	5.6
02-Sep-12	480	122	0.0	0.0	0.0
18-Jun-19	36	120	1.8	1.4	2.7
03-Jun-15	650	118	0.3	0.2	21.3
31-Jul-12	210	118	5.5	3.3	8.5
11-Jul-17	155	118	9.5	8.4	9.7
31-May-18	27	118	0.7	0.7	5.8
06-Aug-13	640	114	0.8	0.0	22.4
19-Aug-13	330	100	2.3	0.9	12.3
09-May-14	480	18	0.2	0.3	6.6
06-Sep-13	400	64	0.2	0.2	0.3
10-May-13	310	64	5.7	2.3	10.2

Figure 5.29. shows an improvement in water quality around high water, presumably due to reduced impact of river FIO loadings. Elevated scenarios tend to occur on the last few hours of the ebb tide and through the flood. This trend is more apparent when not moderated by the predominance of good water quality data in the full routine dataset. As discussed before, it is likely the BW is at greater risk from the river at low tide state due to BW sample location now being outside the protection of the bay.

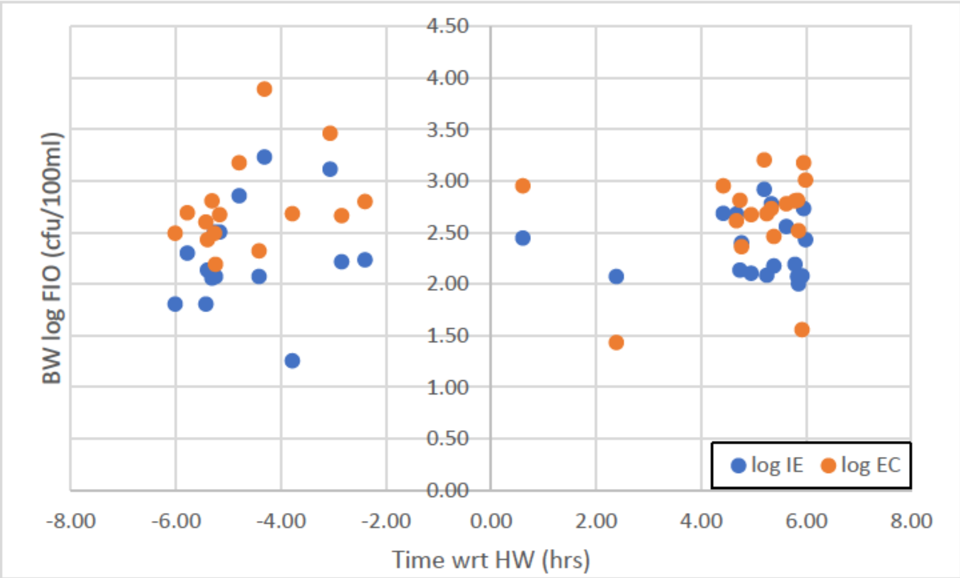


Figure 5.29. Highest 33 Ranked FIO results versus tidal state.

5.5. Nijhuis Surveys Summary

5.5.1. Nijhuis 2019

Nijhuis undertook a series of 4 tidal cycle surveys in July, August, and September 2019. Sampling locations included Mothecombe Stream, Erme Estuary at Mouth, Wonwell Stream and from the bathing water monitoring point. Full methodology and results are reported in (Appendix C – see separate PDF). Prevailing weather conditions were dry for the first two surveys, intermittent rain for the third survey and heavy rain during the final survey. BW quality was slightly worse on wet surveys, and both streams.

Figure 5.30. show the *E. coli* and Intestinal Enterococci over the tidal cycle surveys at each of the sampling locations on the separate days throughout the bathing season. In all most all sample occasions Wonwell Stream was the most elevated sample location. Surprisingly the BW quality seems to have a closer relationship to Wonwell's spikes in FIO levels than Mothecombe stream. On all sample occasions, the BW most closely mirrors the Erme at river mouth sample point FIO levels. This would suggest that the BW's quality is largely influenced by the river Erme. BW spikes on all occasions are preceding by spike in FIO levels at the River Erme Mouth sample point. The only exception to this is the BW spike on the 23/09/2019. This sample had a very low salinity (more stream water than sea) and was a compromised sample due to wave action impacting on sampling method. Further analysis of this data set will not include the mentioned sample.

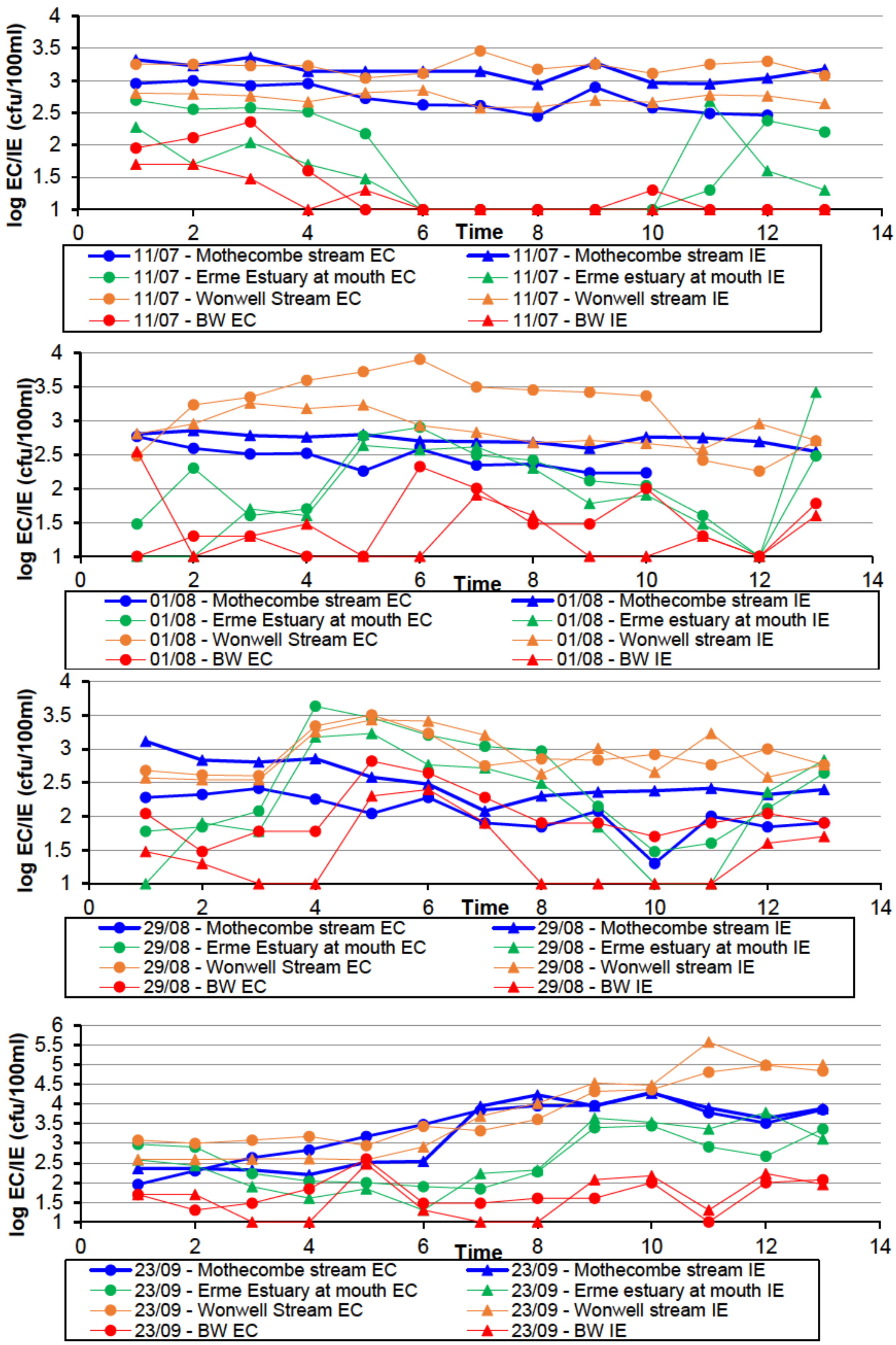


Figure 5.30. Water quality over time for SWW (Nijhuis) surveys. *E. coli* (EC) and Intestinal Enterococci (IE) from Mothecombe stream, Erme estuary at mouth, Wonwell stream and the bathing water (BW) on a) 11th July 2019, b) 1st August 2019, c) 29th August 2019 and d) 23rd September 2019.

In figure 5.31. BW quality was compared to tide state. As with the EA data, elevated samples occurred in the hours surrounding low tide with high tide being dominated by lower FIO levels. This relationship was more pronounced for IE.

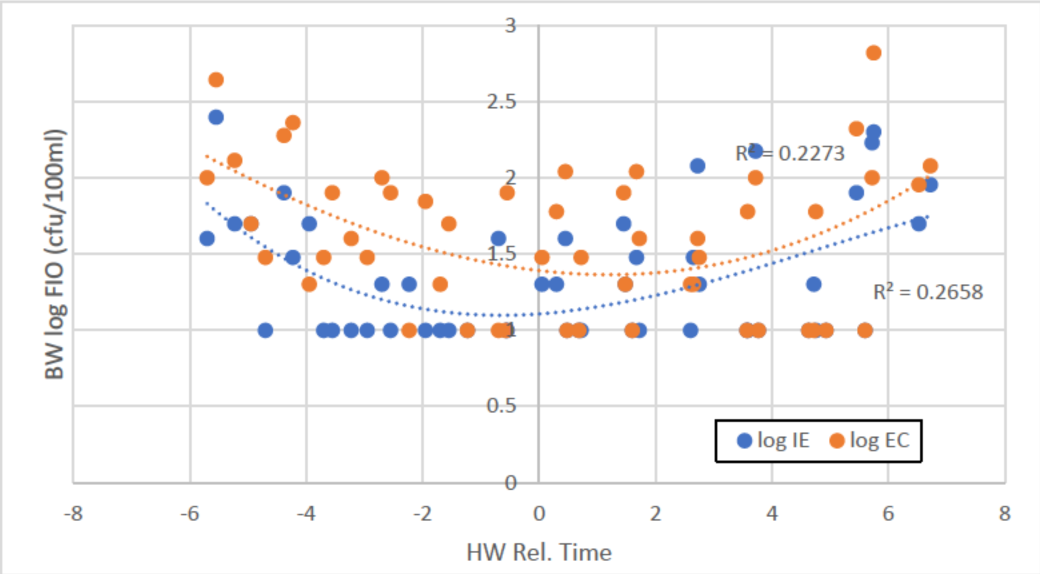


Figure 5.31. BW FIO levels compared to tide state.

When comparing the BW quality to other sample point, the strongest correlation was seen at the river Erme Mouth sample point, as seen in figure 5.32, further suggesting BW quality is driven by the River Erme. Little to no correlation was seen between the BW and Mothecombe Stream (IE R2:0.09, EC R2:0.10). On the other hand, BW IE did have a degree of correlation with Wonwell Stream, see figure 5.33, which does further suggest that the high loading at Wonwell can influence the BW in the right conditions.

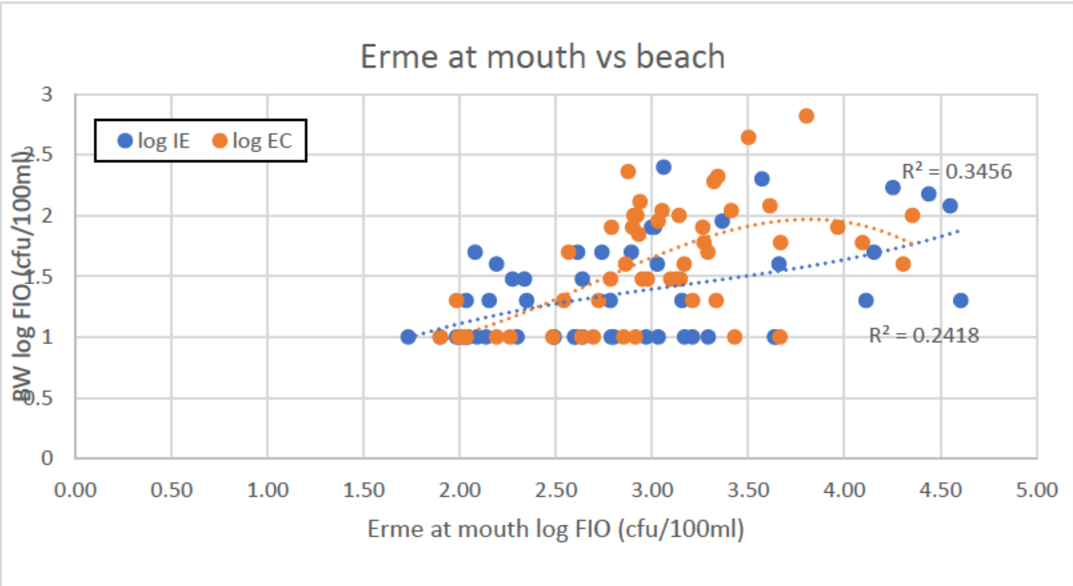


Figure 5.32. BW FIO levels compared to FIO levels at River Erme's Mouth.

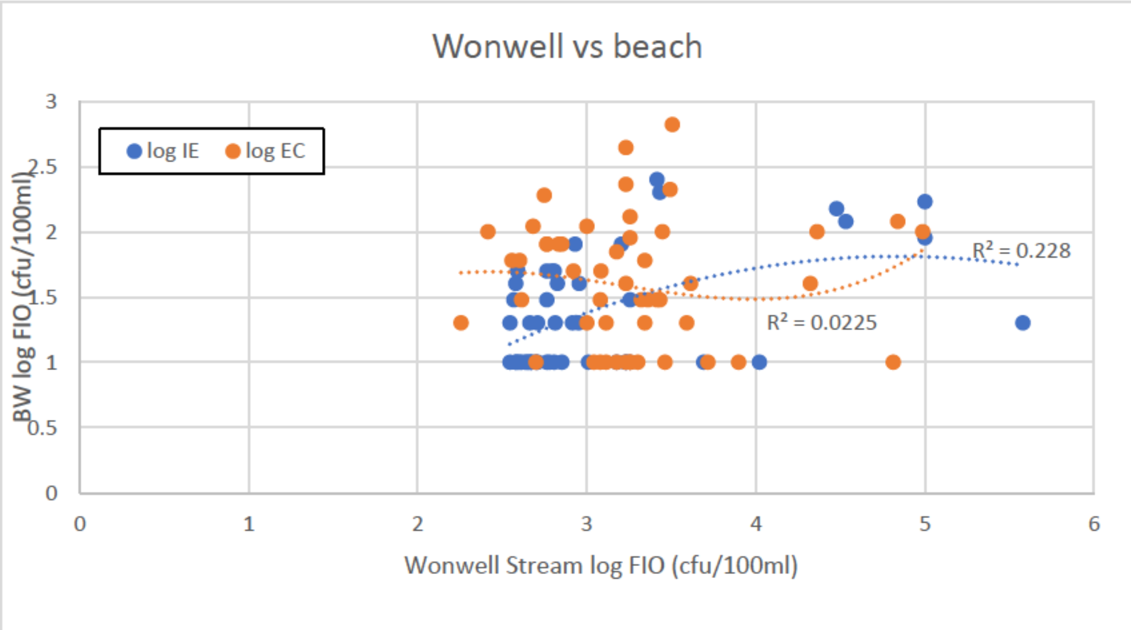


Figure 5.33. BW FIO levels compared to FIO levels at Wonwell Stream.

Data was separated according to the tide state at time of sampling. Further correlation analysis show that correlation was present between the BW point and River Erme mouth regardless of tide state, see figure 5.34. It is worth observing that the correlation was stronger on the Flood tide, as was the case with the EA data set. It is possible the inclusion of River Erme at mouth high tide samples, will have likely weakened the relationship. Correlation between BW IE and Wonwell's IE was stronger in both tide state separated data set than the combined dataset. A degree of correlation was observed between BW and Mothecombe Stream's on the ebb tide particularly for *E. coli* (R2:0.24).

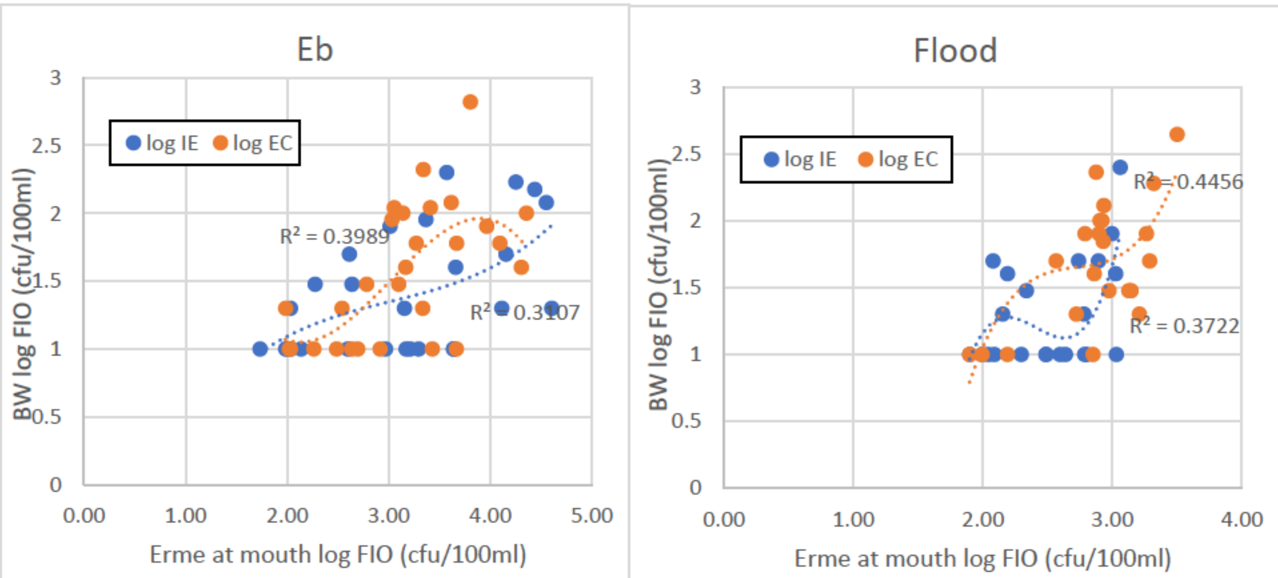


Figure 5.34. BW FIO levels compared to FIO levels at River Erme's mouth.

5.5.2. Nijhuis 2021

Over the course of the 2021 bathing season Nijhuis were contracted to undertake a series of walkovers, sampling relevant sample point along the river Erme. 3 days with 3 sample runs across the day, and 5 days with a single walkover was conducted. Sampling included the BW, Mothecombe Stream, Wonwell Stream, and the River Erme at mouth. Alongside this, several key streams/input for the River Erme up to Sequencers Bridge were identified and sampled (Appendix D).

The 09.09.21 had high levels of rainfall (to the point some streams burst their banks). The impact of rainfall has on water quality is reflected by the fact the BW has highest FIO levels on samples conducted on this day. Sadly, this weather also prevented safe access to a few of the upriver stream sample points. Over the course of the survey many of the BW samples were elevated beyond excellence values.

As with the EA data and previous Nijhuis survey, the River Erme at mouth sample point had a degree of correlation with the BW quality indicating the two were connected. For this data series the relationship became significantly stronger once the River Erme data had been saliently normalised and two samples that had same salinity as the BW removed see figure 5.35.

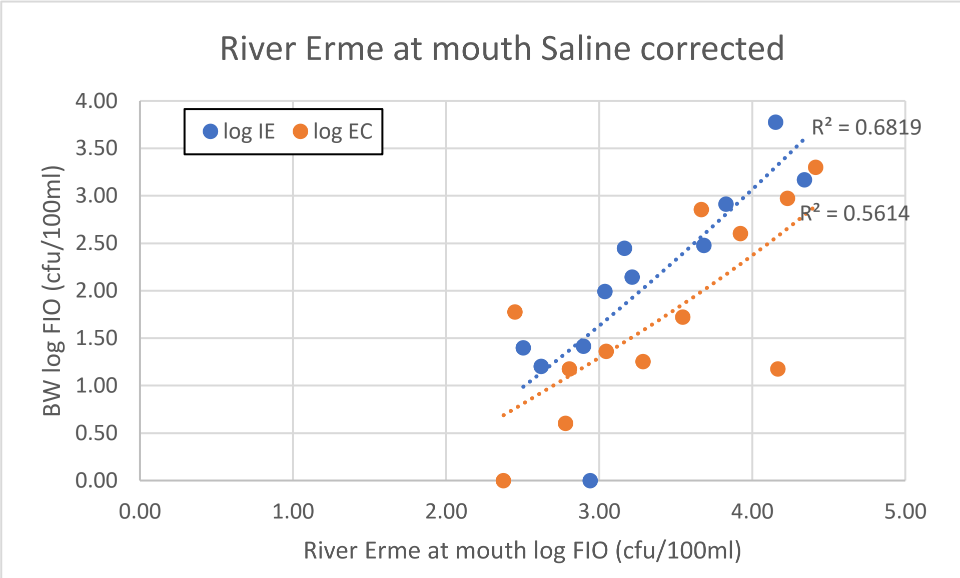


Figure 5.35. BW FIO levels compared to FIO levels at River Erme's Mouth with freshwater correction on River Erme Data and 2 river samples with sea water salinity removed.

Figure 5.36. shows compared to previous survey, significantly more correlation was present between Mothecombe Stream and BW suggesting it can influence the BW quality. In this dataset limited correlation was seen between BW and Wonwell Stream. It is worth observing that this was stronger for *E. coli* (which was weaker at other sample points) suggesting Wonwell might act as a point source under the right conditions see figure 5.37.

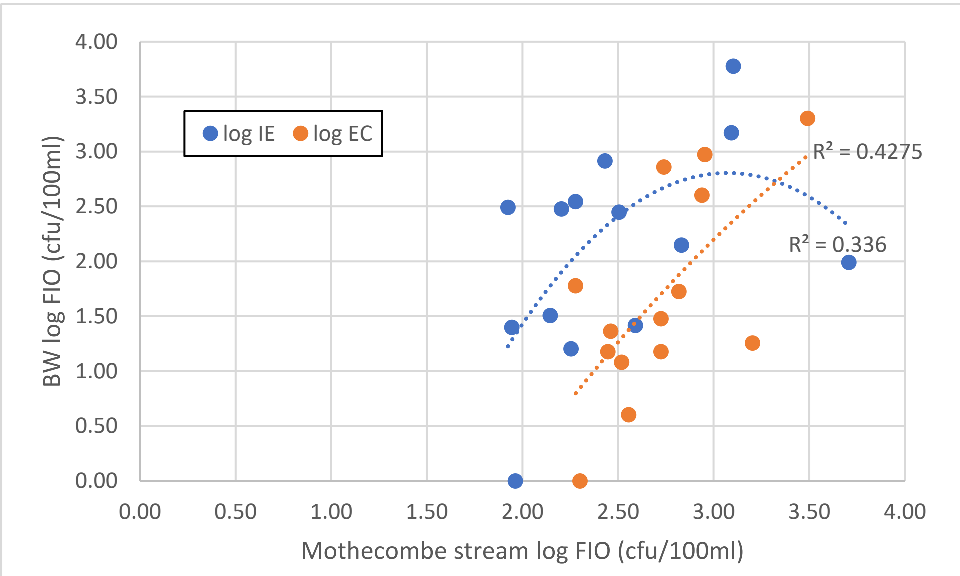


Figure 5.36. BW FIO levels compared to FIO levels at Mothecombe Stream

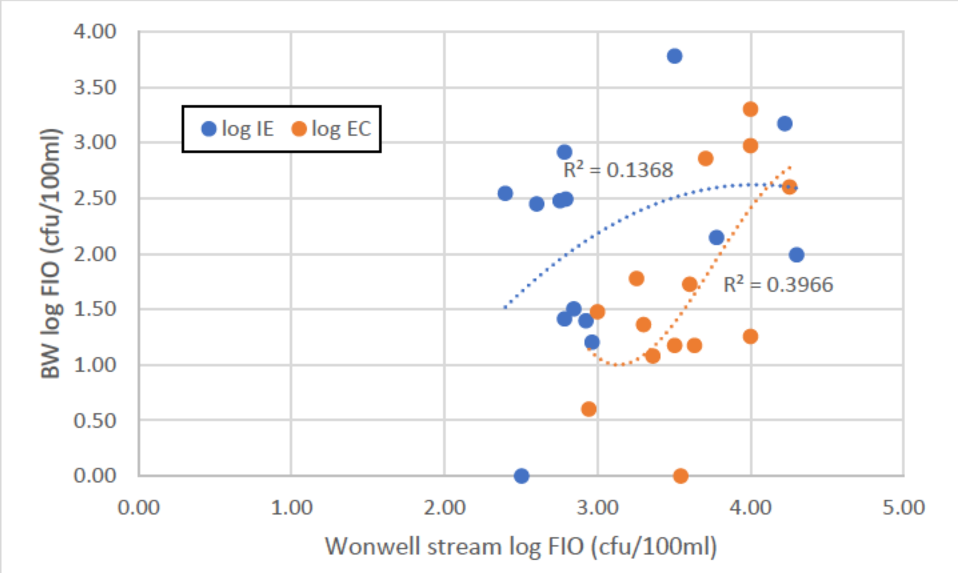


Figure 5.37. BW FIO levels compared to FIO levels at Wonwell Stream

Many of the streams feeding into the River Erme sampled were significantly elevated, particularly higher up in the estuary. When comparing data from these streams and the BW, ability to spot relationships is significantly weakened due to the nature of the temporary difference in samples. The further up in the estuary the greater the difference in time between sample point and BW. Where the BW was generally sampled first, the samples in the upper estuary are not necessarily paired/connected, especially when considering travel and dispersion time (this is particularly the case with samples over an hour apart). Upon analysis, standard deviation at almost all sample points is greater than their means, with high variance even between samples taken on the same day. This shows significant temporal difference at each sample point, reducing the strength or certainty of any conclusions drawn by direct comparison.

Once significant outliers where removed, and freshwater corrections performed, River Erme at the mouth had the highest average counts both FIO. Of all the streams sampled, Oldaport stream/Ayelston Brook on average had the highest *E. coli* and Sheepham Brook the highest IE. It is worth observing that Ayelston Brook was the 2nd biggest contributor for IE (second exit with first exit being the 3rd biggest for IE). Sheepham brook was also seen to be the 3rd biggest contributor for *E. coli* (Wonwell Stream taking 2nd). This flags these two streams as a particular concern. Modbury STW feeds on to Ayelston brook has possibly influenced this, but Sheepham Brook has no know assets on, implicating agricultural use.

The upstream River Erme Sample point had an average *E. coli* count of 1958 and IE 1137cfu/100ml. All the stream feeding into the river were greater than this meaning they all can act as sources of pollution on the river. The only exception to this is Pamflete Stream (with one abnormally elevated sample discounted). It is worth observing that samples missing on the 9th for some of the streams included this River Erme sample location. This means it is likely the averages for the Erme and these other sites are artificially lower (previously mentioned Oldaport and Sheepham Brook had no missing samples).

When comparing streams to the BW, Sheepham Brook was seen to have the highest correlation for IE (see figure 5.38) and Oldaport second exit for *E. coli* (see figure 5.39). River stream sample locations were also compared to River Erme at mouth instead of BW where they should be more connection. Often sites with strongest BW correlation, were significantly weaker when compared to the River at mouth. This was particularly the case for Sheepham Brook. This is possibly down to the 2 omitted samples at the River Erme's mouth being included in BW data. When comparing to the River Erme at mouth, the most significant correlation increase is seen for Flete Stream, see figure 5.40.

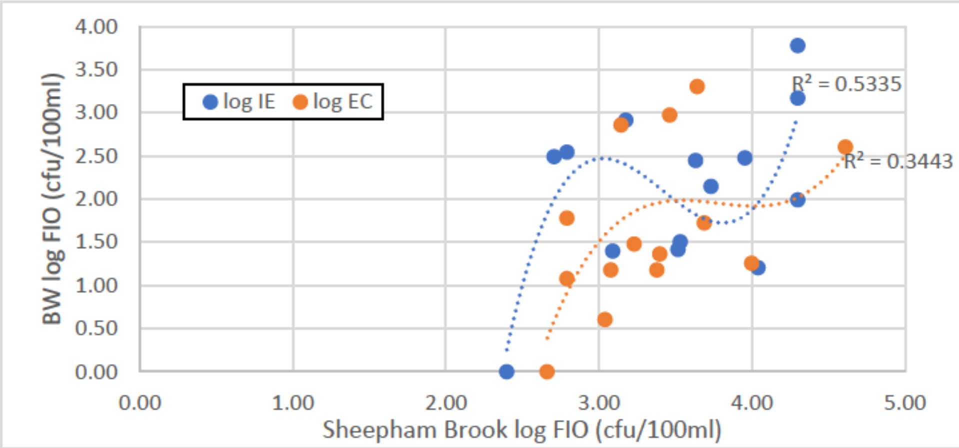


Figure 5.38. BW FIO levels compared to FIO levels at Sheepham Brook.

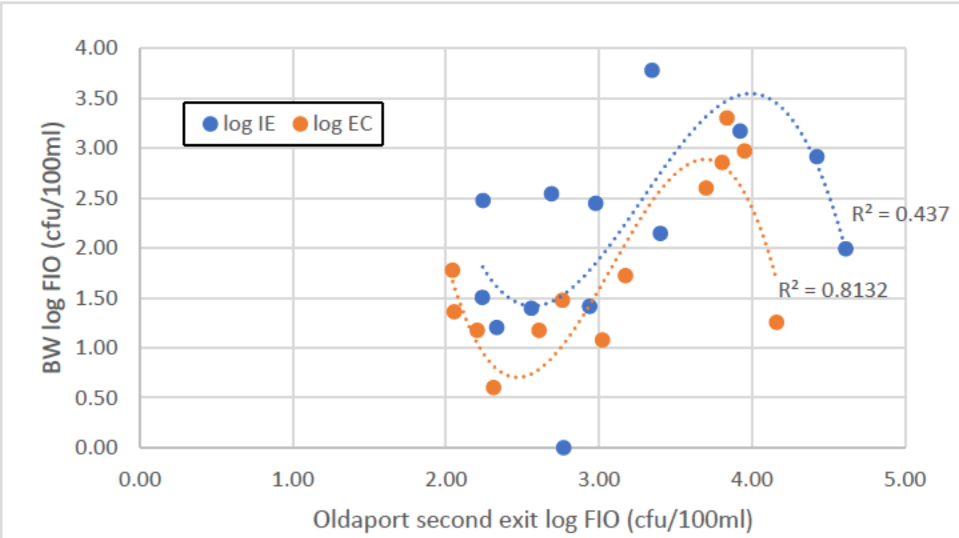


Figure 5.39. BW FIO levels compared to FIO levels at Oldaport second exit.

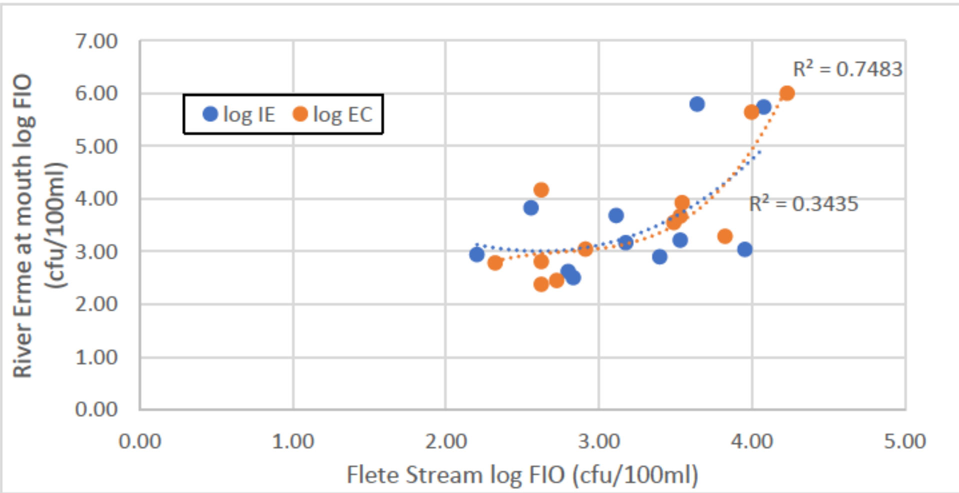


Figure 5.40. BW FIO levels compared to FIO levels at Flete Stream

5.6. Summary of data conclusions and identification of elevated FIO contamination scenarios.

The EA PRF model uses 12-hour average flow at Ermington as the most important factor for predicting poor water quality. The fact 72-hour average flow is also selected for by the PRF, shows how much of a driving factor flow is to the BW quality. When comparing elevated scenarios to flow variables limited correlation was seen. Correlation was stronger for *E. coli* suggesting this FIO is more sensitive to flow, at least higher up in the catchment. It is possible this is indicative of the IE entering the river in closer proximity to the BW and being more sensitive to change in a shorter time frame. Further flow analysis showed that derived flows at Mothecombe Stream had little relationship with BW quality, the best relationship was seen with derived flows for the river Erme at Sequers Bridge and the BW (at least for *E. coli*). Correlation with both FIO significantly improved when flow was compared to FIO at Sequers Bridge. This means increase flow is not only equivocal to a greater volume of polluted river water but the concentration of the FIO has also increased. Overall, this indicates that the BW quality is largely driven by the River Erme.

24 hours antecedent rainfall for the whole catchment was also selected for by the PRF. Correlation plots showed a degree of relationship between this and BW quality. It is worth observing that rainfall is going to be largely connected to flows and these two variables are hard to distinguish. In the Nijhuis 2021 it was observed that highest BW FIO levels occurred under the sample days with the most rainfall. It was also observed that many of the streams had burst their banks on said days (aka extremely high flows).

The PRF selected onshore wind as a further variable. Although little correlation was seen it was observed that almost no elevated samples have been taken with offshore wind. Freshwater analysis looking at routine samples at the River Erme's mouth compared to BW quality showed correlation was significantly stronger with onshore wind that without. It appears that onshore wind plays a role in pushing polluted river waters back into the BW.

For Mothecombe BW tide plays an integral role. Absolute Hours Relative to HW was selected for by the PRF and although little correlation was observed, almost all the elevated scenarios occurred in the hours around low tide. When looking at HW relative time is appear most elevated samples occur in the last couple of hours of the ebb tide and the first 4 of the flood tide. This would imply for the majority of the ebb tide the river has little impact on the BW. During the last hours of the eb tide the BW sample point is going to be further out the bay possible in the river mouth depending on its current discharge location (as implicated by satellite images). On the flood tide the BW is impacted on for a longer duration where the previous riverine plume is being pushed back into the bay. Freshwater analysis of BW samples paired with River Erme at mouth sample agreed with the above. For the full EA dataset correlation between the two was present. After separation via tide state, in the flood tide data showed both FIO had correlation nearly double the strength to the unseparated data. The Nijhuis 2019 data also showed the river mouth had stronger correlation on the flood tide with the BW FIO levels.

Finally, the PRF also selected two time-based variables: Time and Day. Both these variables were seen to have limited correlation and time is potentially an artifact of sample bias. Although there might be some pattern that led to day being selected, the fact the two FIO respond differently and both effect planning class, its inclusion is questionable.

Analysis of Nijhuis data further implicated the River Erme. In the 2021 survey the River Erme at mouth (with data corrections) was able to explain over 50% of the variation in BW quality. For all samples the river sample's FIO levels were significantly higher than that at the BW. Analysis between BW samples and the streams that input into the River Erme highlighted Sheepham Brook as a point source for IE where it had strong correlation with that of the BW. This was also the case for routine EA data taken on Sheepham brook at Goutsford Bridge, further implicating this stream as a point source of pollution. For *E. coli*, the Nijhuis 2021 data displayed the strongest correlation with BW samples at Oldaport second exit. It is also worth observing that when comparing these streams to paired sample taken at the river's mouth correlation was seen to be significantly stronger for Flete Stream, *E. coli* in particular.

Across all the datasets looked at, Mothecombe stream was only seen to have correlation with the BW during the Nijhuis 2021 survey, suggesting it can impact on the BW. It is also worth observing that Wonwell Stream was seen to have a degree of correlation with one or other FIO in both Nijhuis surveys, showing it two can potentially impact on the BW.

Overall high variability was seen at all streams sampled and this did not always coincide with higher rainfall. This combined with the season analysis suggesting peaks separate from rainfall suggest there is a degree of inconsistent land use, such as cows field rotation, reducing consistency on stream quality.

6. Loadings assessment of Bacterial Inputs affecting the Bathing Water

In this section faecal indicator organism (FIO) load is determined for previously identified South West Water (SWW) assets and multiple freshwater inputs. To establish the loadings of the continuous discharges, flow and efficacy data is assessed. Intermittent loads will be calculated from Event Duration Monitoring (EDM) data as an average load per storm overflow discharge events. The relative loads at source are compared to establish the most significant contributor to poor water quality at Mothecombe.

6.1 Loads from continuous discharges

There are 4 sewage treatment works (STW) whose loads potentially impact on Bathing Water quality. Holbeton STW, Modbury STW, Ermington STW, and Ivybridge STW. All these STW discharge onto the River Erme or associated streams.

Holbeton and Ivybridge receive ultraviolet (UV) disinfection. Efficacy data is shown in Table 6.1. These values can be used for calculating bacterial loads from the continuous discharges.

Table 6.1. UV efficacy data 2010-2019 summary statistics at the STW with UV treatment in the catchment. Geomean, 90th percentile and 95th percentile calculated for all year and for bathing season (May-September) 2010-2019.

Site	Data season	Geomean FeEcoli Presumptive	90 percentile EC	95 percentile EC	Geomean FeIntestinal Enterococci Presumptive	90 percentile IE	95 percentile IE
HOLBETON STW	All year	118	2646	8471	44	810	1975
HOLBETON STW	Bathing season	134	2982	10022	25	873	2226
IVYBRIDGE STW	All year	12	323	901	No data	No data	No data
IVYBRIDGE STW	Bathing season	12	110	270	No data	No data	No data

Where no monitoring data exists to demonstrate faecal indicator organisms (FIO) final effluent quality or treatment efficacy for Modbury STW and Ermington STW, which receive secondary treatment. In these cases, default typical secondary treated FIO concentrations have been assumed as described by Kay *et al* (2008) and shown below in Table 6.2.

Table 6.2. High flow and baseline flow FIO concentrations from Kay *et al* 2008

	High flow secondary treated FE	Baseline flow secondary treated FE	Storm
EC geomean cfu/100 ml	5.0E+05	3.3E+05	2.5E+06
IE geomean cfu/100 ml	4.7E+04	2.8E+04	3.8E+05

Daily flow averages were available for the STW in the form of MCERTs. These were used to calculate a monthly average flow for each STW across the Bathing Season. This is available in Table 6.3.

Table 6.3. Average monthly STW MCERTS flow (m3/day) for Holbeton STW, Modbury STW, Ermington STW, and Ivybridge STW.

STW	May Average MCERTS m3/day	June Average MCERTS m3/day	July Average MCERTS m3/day	August Average MCERTS m3/day	September Average MCERTS m3/day
Holbeton STW	142.01	109.10	100.38	111.28	108.47
Modbury STW	282.52	292.43	303.00	342.87	312.73
Ermington STW	108.23	94.49	93.09	116.55	106.47
Ivybridge STW	2657.27	2448.75	2398.77	2669.42	2486.01

Average monthly flows for the STW where then factored up by the monitored or default FIO concentration from Tables 6.1 and 6.2, to produce average monthly loadings at source, for both Intestinal Enterococci (IE) and *E. coli* (EC) (Table 6.4 and Table 6.5 respectively). Final effluent IE quality data for Ivybridge STW was unavailable for this assessment, so the default value of 2.8 x10^4 cfu/100ml (Table 6.2) was used, with a further 2 log reductions assumed (to represent UV treatment).

Table 6.4. Average monthly STW Intestinal Enterococci (IE) loadings (cfu/day) for Holbeton STW, Modbury STW, Ermington STW, and Ivybridge STW.

STW	May STW IE load cfu/day	June STW IE load cfu/day	July STW IE load cfu/day	August STW IE load cfu/day	September STW IE load cfu/day
Holbeton STW	3.55E+07	2.73E+07	2.51E+07	2.78E+07	2.71E+07
Modbury STW	7.91E+10	8.19E+10	8.48E+10	9.60E+10	8.76E+10
Ermington STW	3.03E+10	2.65E+10	2.61E+10	3.26E+10	2.98E+10
Ivybridge STW	7.44E+09	6.86E+09	6.72E+09	7.47E+09	6.96E+09

Table 6.5. Average monthly STW *E. coli* (EC) loadings (cfu/day) for Holbeton STW, Modbury STW, Ermington STW, and Ivybridge STW.

STW	May STW EC load cfu/day	June STW EC load cfu/day	July STW EC load cfu/day	August STW EC load cfu/day	September STW EC load cfu/day
Holbeton STW	1.90E+08	1.46E+08	1.35E+08	1.49E+08	1.45E+08
Modbury STW	9.32E+11	9.65E+11	1.00E+12	1.13E+12	1.03E+12
Ermington STW	3.57E+11	3.12E+11	3.07E+11	3.85E+11	3.51E+11
Ivybridge STW	3.19E+09	2.94E+09	2.88E+09	3.20E+09	2.98E+09

From Tables 6.4 and 6.5, it is apparent the final effluent discharges from Modbury STW and Ermington STW represent over 99% of the total load from the 4 STWs, with the Modbury STW load being roughly triple that from Ermington STW. This is to be expected as these are the two final effluent discharges which do not currently receive UV disinfection.

6.2 Loads from freshwater inputs

To establish a relative loading from all the freshwater sources relevant for Mothecombe and the River Erme an average monthly flow was needed. Qube data was compiled for all relevant sources of freshwater to produce monthly average flow shown in table 6.6.

Table 6.6. Average monthly Qube flows (m3/s) for freshwater sources.

Freshwater	May mean Qube flow m3/s	June mean Qube flow m3/s	July mean Qube flow m3/s	August mean Qube flow m3/s	September mean Qube flow m3/s
Mothecombe Stream	0.005	0.003	0.002	0.002	0.002
RIVER ERME AT SEQUERS BRIDGE	1.395	1.146	0.991	1.048	1.260
Goutsford Bridge/Sheepham Brook	0.189	0.138	0.099	0.101	0.114
Wonwell Stream	0.009	0.005	0.003	0.003	0.003
Pamflete Stream	0.006	0.004	0.003	0.003	0.003
Clyng Mill stream	0.031	0.021	0.014	0.016	0.019
Oldaport stream	0.130	0.095	0.066	0.065	0.072
Holbeton Stream	0.014	0.011	0.007	0.009	0.010
Ford Stream	0.028	0.021	0.014	0.016	0.019
Flete Stream/Lodge Stream	0.032	0.024	0.017	0.016	0.018

Alongside flow, FIO concentrations are also needed for a load to be calculated. Where possible a monthly average was calculated from EA data (Mothecombe Stream, River Erme at Sequers bridge, and Goutsford Bridge). For sites without EA data an average was calculated from Nijhuis 2021 stream sampling data. Due to limited samples (e.g., none in May), a monthly average wasn't possible. For these instances an average for the bathing season was used, see Table 6.7 for freshwater IE and Table 6.8 for freshwater EC.

Table 6.7. Freshwater sources average monthly Intestinal Enterococci (IE) (cfu/100ml) from EA monitoring data and bathing season average from Nijhuis data for 2021.

Freshwater	May mean IE (cfu/100ml)	June mean IE (cfu/100ml)	July mean IE (cfu/100ml)	August mean IE (cfu/100ml)	September mean IE (cfu/100ml)	Bathing season mean IE (cfu/100ml)
Mothecombe Stream	32.4	558.8	245.1	258.5	561.7	612.4
RIVER ERME AT SEQUERS BRIDGE	282.2	538.4	787.5	882.4	431.7	1,136.7
Goutsford Bridge/Sheepham Brook	356.3	1,916.1	3,837.2	2,566.8	4,484.3	6,032.7
Wonwell Stream						3,702.9
Pamflete Stream						3,729.6
Clyng Mill stream						4,174.4
Oldaport stream						5,437.4
Holbeton Stream						1,608.9
Ford Stream						2,238.3
Flete Stream/Lodge Stream						2,194.5

Table 6.8. Freshwater sources average monthly *E. coli* (EC) (cfu/100ml) from EA monitoring data and bathing season average from Nijhuis data for 2021.

Freshwater	May mean EC (cfu/100ml)	June mean EC (cfu/100ml)	July mean EC (cfu/100ml)	August mean EC (cfu/100ml)	September mean EC (cfu/100ml)	Bathing season mean EC (cfu/100ml)
Mothecombe Stream	215.8	554.2	191.1	212.0	420.4	589.2
RIVER ERME AT SEQUERS BRIDGE	1,655.8	1,925.7	3,629.3	1,704.4	1,567.5	1,958.3
GOUTSFORD BRIDGE	819.8	2,910.8	8,303.1	3,013.2	4,213.7	6,023.0
Wonwell Stream						5,434.3
Pamflete Stream						357.7
Clyng Mill stream						4,545.7
Oldaport stream						6,349.8
Holbeton Stream						2,367.9
Ford Stream						2,688.3
Flete Stream						2,683.6

Flow estimates (m3/s) flows for freshwater sources were derived from Qube software Qube and combined with FIO concentrations to produce an average monthly loading for IE (Table 6.9) and EC (Table 6.10).

It should be noted that in the tables below, the freshwater loads for the River Erme (at Sequers Bridge) includes the STW final effluent discharges from Ivybridge STW (UV disinfected) and Ermington STW. Loads calculated for the Oldaport stream will include the final effluent discharge from Modbury STW. Similarly, loads calculated for Holbeton stream will include the final effluent discharge from Holbeton STW (UV disinfected). It also apparent from Tables 6.9 and 6.10, that the closest freshwater input from Mothecombe stream has very low bacterial load relative to the other streams assessed.

Table 6.9 Average monthly Intestinal Enterococci (IE) loadings (cfu/day) for the main freshwater inputs.

Source	May IE load cfu/day	June IE load cfu/day	July IE load cfu/day	August IE load cfu/day	September IE load cfu/day
Mothecombe Stream	1.26E+08	1.30E+09	3.60E+08	3.80E+08	9.71E+08
RIVER ERME AT SEQUERS BRIDGE	3.40E+11	5.33E+11	6.74E+11	7.99E+11	4.70E+11
GOUTSFORD BRIDGE	5.82E+10	2.28E+11	3.29E+11	2.24E+11	4.42E+11
Wonwell Stream	2.85E+10	1.47E+10	8.00E+09	8.32E+09	1.06E+10
Pamflete Stream	2.06E+10	1.32E+10	9.02E+09	8.38E+09	9.67E+09
Clyng Mill stream	1.13E+11	7.68E+10	5.16E+10	5.88E+10	7.00E+10
Oldaport stream	6.11E+11	4.45E+11	3.11E+11	3.04E+11	3.40E+11
Holbeton Stream	1.97E+10	1.47E+10	1.00E+10	1.18E+10	1.39E+10
Ford Stream	5.32E+10	3.96E+10	2.71E+10	3.13E+10	3.71E+10
Flete Stream	6.09E+10	4.46E+10	3.24E+10	3.11E+10	3.36E+10
Total load	1.30E+12	1.41E+12	1.45E+12	1.48E+12	1.43E+12

Table 6.10 Average monthly *E. coli* (EC) loadings (cfu/day) for the main freshwater inputs.

STW	May EC load cfu/day	June EC load cfu/day	July EC load cfu/day	August EC load cfu/day	September EC load cfu/day
Mothecombe Stream	8.39E+08	1.29E+09	2.81E+08	3.11E+08	7.27E+08
RIVER ERME AT SEQUERS BRIDGE	2.00E+12	1.91E+12	3.11E+12	1.54E+12	1.71E+12
GOUTSFORD BRIDGE	1.34E+11	3.47E+11	7.11E+11	2.63E+11	4.15E+11
Wonwell Stream	4.18E+10	2.16E+10	1.17E+10	1.22E+10	1.55E+10
Pamflete Stream	1.98E+09	1.27E+09	8.65E+08	8.04E+08	9.27E+08
Clyng Mill stream	1.23E+11	8.37E+10	5.62E+10	6.40E+10	7.62E+10
Oldaport stream	7.13E+11	5.20E+11	3.64E+11	3.56E+11	3.97E+11
Holbeton Stream	2.91E+10	2.17E+10	1.47E+10	1.74E+10	2.05E+10
Ford Stream	6.39E+10	4.76E+10	3.25E+10	3.76E+10	4.46E+10
Flete Stream	7.44E+10	5.45E+10	3.96E+10	3.80E+10	4.10E+10
Total load	3.18E+12	3.00E+12	4.34E+12	2.33E+12	2.72E+12

These are given as monthly relative percentages for IE and EC in tables 6.11 and 6.12 respectively.

Table 6.11 Average monthly Intestinal Enterococci (IE) loadings (cfu/day) for the main freshwater inputs shown as percentages.

Source	May IE load cfu/day	June IE load cfu/day	July IE load cfu/day	August IE load cfu/day	September IE load cfu/day
Mothecombe Stream	0.01%	0.09%	0.02%	0.03%	0.07%
RIVER ERME AT SEQUERS BRIDGE	26.07%	37.77%	46.41%	54.08%	32.92%
GOUTSFORD BRIDGE	4.46%	16.19%	22.62%	15.16%	30.94%
Wonwell Stream	2.18%	1.04%	0.55%	0.56%	0.74%
Pamflete Stream	1.58%	0.94%	0.62%	0.57%	0.68%
Clyng Mill stream	8.63%	5.44%	3.55%	3.98%	4.90%
Oldaport stream	46.81%	31.52%	21.44%	20.60%	23.83%
Holbeton Stream	1.51%	1.04%	0.69%	0.80%	0.97%
Ford Stream	4.08%	2.81%	1.86%	2.12%	2.60%
Flete Stream	4.67%	3.16%	2.23%	2.10%	2.35%

Table 6.10 Average monthly *E. coli* (EC) loadings (cfu/day) for the main freshwater inputs shown as percentages.

STW	May EC load cfu/day	June EC load cfu/day	July EC load cfu/day	August EC load cfu/day	September EC load cfu/day
Mothecombe Stream	0.03%	0.04%	0.01%	0.01%	0.03%
RIVER ERME AT SEQUERS BRIDGE	62.81%	63.45%	71.63%	66.18%	62.78%
GOUTSFORD BRIDGE	4.21%	11.55%	16.39%	11.27%	15.27%
Wonwell Stream	1.32%	0.72%	0.27%	0.52%	0.57%
Pamflete Stream	0.06%	0.04%	0.02%	0.03%	0.03%
Clyng Mill stream	3.86%	2.78%	1.29%	2.75%	2.80%
Oldaport stream	22.45%	17.29%	8.38%	15.24%	14.61%
Holbeton Stream	0.91%	0.72%	0.34%	0.75%	0.75%
Ford Stream	2.01%	1.58%	0.75%	1.61%	1.64%
Flete Stream	2.34%	1.81%	0.91%	1.63%	1.51%

6.3 Loads from Intermittent discharges

There are several intermittent SWW assets that discharge into the River Erme or relevant tributaries. These are listed with recorded Event Duration Monitoring (EDM) data from the 2021 bathing season. No BRAVA data is available for these sites to estimate flow rate, so flow estimates from historic modelling and design information have been used.

Table 6.11. Average storm overflow discharge duration (mins), estimated flow (m3/min) and 2021 bathing season storm overflow discharges for intermittent discharges impacting on Mothecombe.

Intermittent Name	2021 BS Average Duration (min)	Average flow m^3/min	2021 bathing season spills
HOLBETON STW_SSO_HOLBETON	73	0.36	14
HOLBETON STW_SO_HOLBETON	27	1	11
ERMINGTON STW_SSO_ERMINGTON	17	1.2	2
TOWN HILL_CSO_ERMINGTON	28	1.2	6
MODBURY STW_SSO_MODBURY	68	0.3	8
PLAYING FIELD_CSO_ERMINGTON	0	-	0
POUNDWELL MEADOW_CSO_MODBURY	105	1.2	3
IVYBRIDGE STW_SSO_IVYBRIDGE	1172	3	5
IVYBRIDGE STW_SO_IVYBRIDGE	267	7	1

No monitoring data exists to indicate potential FIO storm concentrations, so a default concentration has been taken from Kay *et al.* (2008), shown in Table 6.2. This was used in conjunction with the average duration per storm overflow discharge from the 2021 bathing season and flow rate in the table above to produce an average load for IE (Table 6.12) and EC (Table 6.13) per storm overflow discharge event. Although Ivybridge STW SSO and SO have the highest source loads, they are both 11 km upstream of the bathing water and approximately two tidal cycles will need to occur before these discharges reach the bathing water. Therefore, will undergo significant dilution, dispersion, and decay, minimising their impact at Mothecombe.

Table 6.12 Average Intestinal Enterococci (IE) load per storm overflow discharge for intermittent discharges impacting on Mothecombe and relative percentages.

Intermittent Name	Average IE load/avg spill (cfu/100ml)	Average IE load/avg spill (%)	2021 bathing season spills
HOLBETON STW_SSO_HOLBETON	9.99E+10	0.47%	14
HOLBETON STW_SO_HOLBETON	1.03E+11	0.48%	11
ERMINGTON STW_SSO_ERMINGTON	7.75E+10	0.36%	2
TOWN HILL_CSO_ERMINGTON	1.28E+11	0.60%	6
MODBURY STW_SSO_MODBURY	7.75E+10	0.36%	8
PLAYING FIELD_CSO_ERMINGTON			0
POUNDWELL MEADOW_CSO_MODBURY	4.79E+11	2.23%	3
IVYBRIDGE STW_SSO_IVYBRIDGE	1.34E+13	62.36%	5
IVYBRIDGE STW_SO_IVYBRIDGE	7.10E+12	33.15%	1

Table 6.13 Average *E. coli* (EC) load per storm overflow discharge for intermittent discharges impacting on Mothecombe and relative percentages.

Intermittent Name	Average EC load/avg spill (cfu/100ml)	Average EC load/avg spill (%)	2021 bathing season spills
HOLBETON STW_SSO_HOLBETON	6.57E+11	0.47%	14
HOLBETON STW_SO_HOLBETON	6.75E+11	0.48%	11
ERMINGTON STW_SSO_ERMINGTON	5.10E+11	0.36%	2
TOWN HILL_CSO_ERMINGTON	8.40E+11	0.60%	6
MODBURY STW_SSO_MODBURY	5.10E+11	0.36%	8
PLAYING FIELD_CSO_ERMINGTON			0
POUNDWELL MEADOW_CSO_MODBURY	3.15E+12	2.23%	3
IVYBRIDGE STW_SSO_IVYBRIDGE	8.79E+13	62.36%	5
IVYBRIDGE STW_SO_IVYBRIDGE	4.67E+13	33.15%	1

As previously mentioned, the discharges from Ivybridge provide the largest loads at source but their impact is significantly reduced by dilution, dispersion, and decay, as well as their limited storm overflow discharge frequency.

Although the loads from Holbeton STW SO and SSO are relatively small, the frequency of operation is such that any potential impact would be seen at the bathing water more often. The larger discharge from Poundwell Meadow CSO occurs much less frequently.

6.4 Intermittent Loading on Elevated BW FIO Events.

An annual breakdown of bathing season EDM duration and storm overflow discharges is shown in Appendix E. These data are summarised in Table 6.14.

Table 6.14. Event duration monitoring summary results 2011 to 2018.

Site Name	Average duration /year (Hours)	Median duration /year (Hours)	Average duration /spill (Hours)	Average spills/year	Median spills/year
HOLBETON STW_SSO_HOLBETON	8.3	0.2	1.3	6.5	1.5
HOLBETON STW_SO_HOLBETON	8.3	1.8	1.3	6.3	1.5
ERMINGTON STW_SSO_ERMINGTON	0.1	0.0	0.1	1.1	0.0
ERMINGTON STW_EO_ERMINGTON	0.1	0.0	0.1	1.1	0.0
TOWN HILL_CSO_ERMINGTON	0.9	0.2	0.7	1.4	0.5
MODBURY STW_SSO_MODBURY	11.4	0.0	3.8	3.0	0.0
PLAYING FIELD_CSO_ERMINGTON	0.0	0.0	0.0	0.0	0.0
POUNDWELL MEADOW_CSO_MODBURY	9.5	3.6	6.9	1.4	0.5
IVYBRIDGE STW_SSO_IVYBRIDGE	6.1	0.0	9.8	0.6	0.0
IVYBRIDGE STW_SO_IVYBRIDGE	6.1	0.0	9.8	0.6	0.0

EDM storm overflow discharge data was check against elevated FIO events to find discharges that might have coincided. A summary of which is available in Table 6.15.

Table 6.15. Details of the 33 elevated samples at Mothecombe and whether there was an intermittent storm overflow discharge occurring within the 3 days prior.

Date	Sample time	EC cfu/100ml	IE cfu/100ml	Spills up to 3 days prior?
12/09/2019	11:10:00	540	600	
28/08/2019	10:00:00	290	150	
02/05/2018	13:20:00	1600	827	Y
19/09/2017	12:55:00	270	136	
05/09/2017	10:35:00	900	486	Y
21/08/2017	13:25:00	470	320	
04/08/2017	10:00:00	1018	270	Y
29/06/2017	15:20:00	410	477	Y
08/06/2017	15:25:00	460	164	Y
23/05/2017	10:00:00	640	155	
13/09/2016	10:13:00	490	200	Y
15/09/2015	13:25:00	600	360	Y
28/08/2015	10:15:00	470	127	
27/07/2015	10:15:00	1500	720	Y
15/07/2015	13:10:00	310	320	
03/06/2015	12:55:00	650	118	Y
09/05/2014	10:35:00	480	18	
06/09/2013	13:59:00	400	64	
19/08/2013	10:45:00	330	100	
06/08/2013	13:20:00	640	114	
10/05/2013	13:05:00	310	64	
24/09/2012	10:05:00	2900	1300	
02/09/2012	13:00:00	480	122	
12/07/2012	10:10:00	630	172	
06/07/2012	14:30:00	1500	540	
02/07/2012	13:10:00	7800	1710	
22/06/2012	13:05:00	650	136	
08/06/2012	10:10:00	900	280	
18/06/2019	13:10:00	36	120	
31/05/2018	10:05:00	27	118	Y
11/07/2017	15:00:00	155	118	Y
22/06/2016	12:38:00	230	250	
31/07/2012	12:55:00	210	118	

Assets whose storm overflow discharges might have impacted on the BW were: HOLBETON STW_SO, HOLBETON STW_SSO, IVYBRIDGE STW_SSO, POUNDWELL MEADOW_CSO, MODBURY STW_SSO, TOWN HILL_CSO (listed in order of frequency of said discharges). Details of these spill events are given in Appendix F.

7. Options for SWW assets

This section explores the possible options that could be taken to allow for the bathing water (BW) to achieve a robust 'Good' or 'Excellent' Bathing Water classification. Any possibly interventions by South West Water (SWW) will be explored here.

7.1. Possible intervention options SWW assets.

At Mothecombe Intestinal Enterococci (IE) is the limiting parameter that dictates classification, although historically *E. coli* (EC) has also determined classification. Statistical analysis in Section 3 demonstrated t6 of the 28 EC elevated above the 95 percentile EC limit of 250 cfu/100ml would need to be replaced with 'Excellent' water quality to achieve a robust 'Good' classification 2012 to 2019. For IE 2 of the 30 IE elevated above the limit of 100 cfu/100ml needed to be replaced with 'Excellent' water quality to achieve robust 'Good' classification. For the time frame looked at it was not seen to be possible to achieve a robust 'Excellent' water quality.

7.2. Possible intervention options SWW assets.

Based on our assessment, the largest continuous discharges are Modbury STW and Ermington STW. These contribute to the high loads seen in the Oldaport stream and River Erme respectively. Given the importance of the freshwater component in the elevated bathing water samples, as demonstrated throughout this report, contributions from these STW are assessed as being significant. We therefore propose that both Modbury STW and Ermington STW have effective biological treatment with ultraviolet (UV) disinfection.

A review of EDM data and assessment of loads show that Holbeton STW SSO and SO may be impacting on water quality more frequently than other intermittents discharge and water quality at the bathing water would benefit from a reduction in storm overflow discharges. Due to this we propose that the discharges be improved to a design standard of 2 significant (greater than 50m^3) storm overflow discharges per bathing season (aggregated).

7.3. Possible intervention options SWW assets in combination with non-SWW sources.

A reduction of bacterial load coming from Modbury STW and Ermington SW as a result of UV disinfection and from Holbeton STW SSO and SO as a result of a 2 storm overflow discharges per BS intervention, in combination with land management interventions and ongoing vigilance with respect to misconnection could help achieve robust Good bathing water quality at Mothecombe in future compliance periods and improve to Excellent in the longer term.

7.4. Estimate of costs (simple interventions at significant SWW assets).

Cost of the solutions described in Section 7.2 will be provided in the PR24 WINEP development.

8. Conclusions

Oceanographic studies and salinity analysis demonstrate the importance of freshwater inputs on the bathing water quality at Mothecombe. Local freshwater inputs include the Mothecombe Stream and Wonwell Stream and the other freshwater inputs up the Erme Estuary. It was determined that the River Erme is the most significant freshwater input in terms of flow, followed by the Sheepham Brook.

- **Section 3 demonstrated that Mothecombe has had a 'Good' Bathing Water classification since 2016.**
- **The Planning Classification has also been 'Good' since 2016, although this decreased to 'Sufficient' in 2021, with a 90% risk of failing to reach Good and 100% risk of failing to reach 'Excellent'.**

For Mothecombe Intestinal enterococci (IE) is the main FIO parameter that determines planning class for the most recent planning data sets. *E. coli* (EC) was the FIO that determined class in earlier data sets. Further statistical analysis in Section 3 demonstrated 6 of the 28 EC elevated above the 95 percentile EC limit of 250 cfu/100ml would need to be replaced with 'Excellent' water quality to achieve a robust 'Good' classification 2012 to 2019. For IE 2 of the 30 IE elevated above the 100 cfu/100ml threshold needed to be replaced with 'Excellent' water quality to achieve robust 'Good' classification. For the time frame looked at, it was not seen to be possible to achieve a robust 'Excellent' water quality.

Section 4 looked at possible sources of pollution. The main freshwater input to the Erme Estuary is the River Erme, while there are nine other streams which flow into the Estuary. Microbial source tracking (MST) analysis carried out by SWW on 2021 bathing season samples collected by Nijhuis showed that sources at the BW were predominantly ruminant although human sources were also present. The Erme Estuary samples were also predominantly ruminant with nearly equal presence of human, and one occasion with a signal from canine sources. The only substantial source found in the Mothecombe Stream was human.

Pollution Risk Forecasting (PRF) and routine data collected by the Environment Agency (EA) was assessed in Section 5. The EA PRF model uses Flow 12 hours average as the most important factor for predicting poor water quality. River flow clearly plays a large role in BW quality where the model also selected for 72 hours average flow as well. Analysis suggested that increased flow had a greater relationship with EC levels than IE. The PRF also selected for 24 hours antecedent rainfall for the whole catchment. This was seen to have good relationship with both FIO. Time and day where also selected for. Time was seen to be a possible artifact from the data where samples are largely collected at one of two times of day. Day was seen to have a limited relation with the different FIO appearing to respond differently. The PRF selected 15 hours average Wind onshore component. Elevated samples tended to occur in the presence of positive onshore wind component. The same was seen for alongshore, but this is likely down to it being the predominant wind direction. Finally absolute hours relative to high water was also selected for with elevated events tending to occur around low tide.

- **Freshwater analysis revealed little relationship between the BW and Mothecombe Stream.**
- **The BW water was seen to have a better relationship with the river Erme (at mouth).**
- **This relationship was significantly stronger once the data set was sorted into tide state with the flood tide seen to have the strongest relationship.**

Considering the tendency for elevated counts around low water, it is likely that on the ebb tide the river can discharge past the bay without impacting on quality whereas on the flood tide this gets pushed back into the bay. It was also observed that at low tide the BW transect is no longer sheltered in the bay but almost on the river mouth itself.

Nijhuis data for 2019 and 2021 came to similar conclusions although Mothecombe Stream was seen to have a slightly more significant relationship. Wonwell Stream was also seen to have a degree of correlation with poor quality coinciding with that at the BW. The Nijhuis 2021 survey looked at freshwater tributaries on the River Erme. Of these Sheepham Brook and Oldaport Stream were seen to have the strongest relationship with the BW. Flete Stream had the best relationship with water quality at the river mouth.

There are 4 STW and several storm overflows whose loads potentially impact on Bathing Water quality. 2 of the 4 STW receive UV disinfection (Holbeton STW and Ivybridge STW), while the other two receive secondary treatment (Modbury STW and Ermington STW). An assessment of asset performance in Section 6 showed that 11 of 33 elevated FIO scenarios coincided with a storm overflow discharge event from either Holbeton STW SO, Holbeton STW SSO, Ivybridge STW SSO, Poundwell Meadow CSO, Modbury STW SSO, Town Hill CSO The most frequent storm overflow discharge was Holbeton STW SO.

Loadings assessment showed the bulk of the pollution is likely sourced on the River Erme upstream of Sequers Bridge. Oldaport Stream was also seen to be a significant cause of loadings for the BW. Based on our assessment, the largest continuous discharges are Modbury STW and Ermington STW. These contribute to the high loads seen in the Oldaport stream and River Erme respectively. Given the importance of the freshwater component in the elevated bathing water samples, as demonstrated throughout this report, contributions from these STW are assessed as being significant.

- **We therefore propose that both Modbury STW and Ermington STW have effective biological treatment with ultraviolet (UV) disinfection.**

A review of EDM data and assessment of loads show that Holbeton STW SSO and SO may be impacting on water quality more frequently than other intermittents discharge and water quality at the bathing water would benefit from a reduction in storm overflow discharges.

- **Due to this we propose that the discharges be improved to a design standard of 2 significant (greater than 50m^3) storm overflow discharges per bathing season (aggregated).**

9. References

Admiralty Tide Tables (ATT) Vol. 1 2010. United Kingdom and Ireland including European Channel Ports. Admiralty Hydrographic Office 2009

Environment Agency Bathing Water Profile in: https://environment.data.gov.uk/bwq/profiles/

Kay et al 2008 - D. Kay, J. Crowther, C.M. Stapleton, M.D. Wyer, L. Fewtrell, A. Edwards, C.A. Francis, A.T. McDonald, J. Watkins, J. Wilkinson. Faecal indicator organism concentrations in sewage and treated effluents. Water Research 2008, Volume 42, Issues 1-2, pp. 442-454.

Qube Flows: Qube.hydrosolutions.co.uk. 2022. *Qube Map*. [online] Available at: <https://qube.hydrosolutions.co.uk/map/> [Accessed 6 May 2022].

Tyrrell 2017 – Environment Agency. Bathing water pollution risk forecasting and shellfish water pilot work programme 2016 to 2017, Report – SC160015/R

South West Water

Appendix A: Measure Specification Form

Investigation measure specification form

Water company / Environment Agency measure specification form	
Environment Agency area(s):	Devon Cornwall and the Isles of Scilly
Water company:	South West Water Ltd
Measure type:	Investigation
Measure name:	Mothecombe bathing water ambition investigation
Measure ID:	7SW300035
Driver Codes:	BW_INV4
Bathing water:	Mothecombe
WINEP Completion Deadline	~~30/09/2021~~ 30/09/2022
WINEP scope: Investigation part 1. Catchment investigation to understand what water company action would be needed to achieve a robust classification of Good (less than 20% risk of failing planning class of Good). Investigation part 2. Catchment investigation to understand what water company action would be needed to achieve a robust classification of Excellent (less than 20% risk of failing planning class of Excellent).	
Investigation objectives: Part 1. To understand the significance and contribution of water company assets to poor bacterial water quality at the bathing water monitoring point, in order to assess what water company action would significantly improve the chance of achieving a robust classification of Good (less than 20% risk of failing planning class of Good). Part 2. To understand the significance and contribution of water company assets to poor bacterial water quality at the bathing water monitoring point, in order to assess what water company action would significantly improve the chance of achieving a robust classification of Excellent (less than 20% risk of failing planning class of Excellent).	
Details of work to be carried out: The attached sheet defines the activities to be undertaken as part of the investigation for this bathing water and the indicative timeframe for these activities. The initial review of the sources relating to bathing water quality shown in the activities sheet uses available information and data which are summarised in a draft dataform. The draft dataform for each bathing water is provided in a package to support the measure specification forms for the BW_INV4 investigations. A copy of the generic report structure for the initial review is attached as an annex to this package of dataforms.	

Timescales for delivery, including key milestones: Indicative Interim Milestones: Delivery of draft initial review report to EA by April 2020. Delivery of final initial review report to EA by ~~September 2020~~ September 2021. Key Milestones: Delivery of draft final report to EA by ~~July 2021~~ July 2022. Delivery of final report to EA by ~~30 September 2021~~ 30 September 2022.		
The successful outcome of the investigation requires regular liaison between the water company and the Environment Agency over the period covered by the BW_INV4 investigations. It is recommended that a regular liaison group for the BW investigations needs to be established by end of June 2019 with a timetable of proposed liaison meeting dates.		
Outcome. (For investigations this should include identifying the options): The identification of what water company action would significantly improve the chance of achieving a robust classification of Good (less than 20% risk of failing planning class of Good). The identification of what water company action would significantly improve the chance of achieving a robust classification of Excellent (less than 20% risk of failing planning class of Excellent).		
Other details:		
Signatures		
Environment Agency Team Leader / Technical Specialist as appropriate)	Signed: D Trewolla [redacted]	Date: 8/5/19
Water company	[redacted]	Date: 10/5/19
By giving approval, the Environment Agency does not accept responsibility for the engineering design or construction of the scheme. The Environment Agency gives approval without prejudice to its statutory powers to take any necessary enforcement action.		

Appendix B: EA Archived Reports

EA Reports:

EA ID	Report title	Author	Date
1381	Investigation Inpact Inputs to Erme Estuary on Bathing Water Q Mothecombe TWU/93/28	NRA TWG	1993
1308	Survey of the Benthic Macroinvertebrate infauna May 1991 - Avon and Erme Estuaries	NRA SW Region	1991
1300	Invstgtn Causes Failure comply with EC Directive on Bathing WQ Mothecombe - TWIU/89/11	NRA TWG	1990
1400	Mothecombe Beach,An Investgn Into the causes of Failure to comply with ECBW	NRA TWG	1989
1309	Surveys of Harbours, Rias, Estuaries in South Britain, Avon & Erme Estuaries	Jon Moore	1988

SWW or other Reports which are relevant:

EA ID	Report title	Author	Date

Existing Available Models:

To include:
Date and indication of model performance
Hydrodynamic and WQ
Sewerage network models

EA ID	Report title	Author	Date

Relevant Sewerage Network Models:

Name	Model Type	Model Build Date	Last Verification Date	Last Used
Holbeton STW	Infoworks	2011	2011	2011
Ermington STW	Infoworks	2009	2009	AMP5
Modbury STW	Infoworks	2009	2010	AMP5
Ivybridge STW	Infoworks	2009	2009	2011

Appendix C: 2019 Nijhuis report

(See separate PDF)

Appendix D: 2021 Nijhuis data

Sampling Point	Date	Time	E.coli (Pres) by MF	Intestinal Enterococci (2 Dil) Pres	Salinity	Temperature
			no/100ml	no/100ml	PSU	deg_C
Wonwell Stream	28/06/2021	09:10	>10000	>20000	0.2	16.4
Clyng Mill Stream	28/06/2021	09:20	5800	12200	3.1	16.9
Oldaport stream/Ayelston Brook	28/06/2021	09:30	6700	3200	19.8	15.9
Oldaport stream second exit	28/06/2021	09:40	4900	13900	23.5	16.7
Goutsford Br Stream (sheepham brook)	28/06/2021	09:50	>10000	>20000	0.1	15.2
Mothecombe BW monitoring point	28/06/2021	09:20	18	98	32.3	15.8
Mothecombe stream	28/06/2021	09:30	1600	5100	0.2	15
Erme Estuary at mouth	28/06/2021	09:45	240	135	31.1	16.3
Pamflete Stream	28/06/2021	10:25	39	11500	0.2	17.8
Holbeton Stream	28/06/2021	10:55	>10000	4300	0.2	15.2
Sequer's Bridge Lodge Stream	28/06/2021	11:10	3200	6100	14.9	18
Ford Stream	28/06/2021	11:35	>10000	10300	1	17.1
River Erme	28/06/2021	11:55	9900	3200	0	15.1
Flete Stream	28/06/2021	12:01	6700	9000	0.2	15.2
Wonwell Stream	13/07/2021	11:11	4000	610	0.5	15.3
Oldaport stream/Ayelston Brook	13/07/2021	12:19	6800	2600	0.9	17.7
Oldaport stream second exit	13/07/2021	12:12	960	560	12.7	19.3
Clyng Mill Stream	13/07/2021	12:31	1100	4900	0.1	18.1
Goutsford Br Stream (sheepham brook)	13/07/2021	13:53	4900	3300	0.5	16.2
Pamflete Stream	13/07/2021	14:53	95000	31000	13.8	20
Erme Estuary at mouth	13/07/2021	16:16	2000	450	15.3	24.5
Flete Stream	13/07/2021	10:47	3100	2500	0	17
River Erme	13/07/2021	11:20	1500	860	0	16
Holbeton Stream	13/07/2021	13:06	4700	2900	0	17.2
Sequer's Bridge Lodge Stream	13/07/2021	14:00	27000	920	2.4	22.4
Mothecombe BW monitoring point	13/07/2021	15:53	53	26	28.7	20.2
Mothecombe stream	13/07/2021	16:06	660	390	0.9	17.6
Wonwell Stream	22/07/2021	07:00	4300	570	0.2	14.3
Oldaport stream second exit	22/07/2021	08:21	170	73	20.7	22.3
River Erme	22/07/2021	10:28	2000	660	0	18.4

Erme Estuary at mouth	22/07/2021	07:00	700	230	33.8	18.4
Mothecombe BW monitoring point	22/07/2021	07:30	15	300	36.4	13.6
Flete Stream	22/07/2021	10:35	420	1300	0.2	16
Goutsford Br Stream (sheepham brook)	22/07/2021	09:47	2400	9000	0.1	16.8
Oldaport stream/Ayelston Brook	22/07/2021	08:07	4900	1100	3.7	16.9
Holbeton Stream	22/07/2021	08:30	790	820	0.1	14.6
River Erme	22/07/2021	14:00	460	500	0	19.4
Wonwell Stream	22/07/2021	11:45	880	610	0.2	16.6
Oldaport stream second exit	22/07/2021	12:54	100	13000	18.2	25.9
Sequer's Bridge Lodge Stream	22/07/2021	08:50	1700	15	4.2	24
Ford Stream	22/07/2021	14:00	1700	390	0.1	20.3
Ford Stream	22/07/2021	10:30	890	3000	0.1	18
Erme Estuary at mouth	22/07/2021	12:15	170	1900	25.5	11.1
Holbeton Stream	22/07/2021	13:45	790	660	0.1	16.5
Pamflete Stream	22/07/2021	13:00	470	230	8.1	23.5
Sequer's Bridge Lodge Stream	22/07/2021	13:30	2100	20	0.1	25.3
Mothecombe BW monitoring point	22/07/2021	11:45	4	820	24.5	23.5
Oldaport stream/Ayelston Brook	22/07/2021	12:48	1800	710	0.5	18.8
Flete Stream	22/07/2021	13:55	210	360	0.2	17.3
Goutsford Br Stream (sheepham brook)	22/07/2021	13:40	1100	1500	0.3	19.6
Clyng Mill stream	22/07/2021	08:33	760	9100	1	16
Mothecombe stream	22/07/2021	11:40	360	270	0.2	17.3
Clyng Mill stream	22/07/2021	12:39	2200	830	0.3	20.1
Erme Estuary at mouth	22/07/2021	18:29	31000	17000	34.4	20.5
Wonwell Stream	22/07/2021	18:00	1000	250	0.2	19.2
Mothecombe BW monitoring point	22/07/2021	17:56	30	350	33	21.5
Mothecombe stream	22/07/2021	18:06	530	190	0.4	18.4
Clyng Mill stream	22/07/2021	18:50	1600	1500	19.4	22.7
Oldaport stream second exit	22/07/2021	18:30	39	33	33.1	21.4
Oldaport stream/Ayelston Brook	22/07/2021	18:40	630	1100	28.3	23.1
Pamflete Stream	22/07/2021	19:23	38	200	0.2	22.2
Holbeton Stream	22/07/2021	19:53	710	1200	0.2	16
Goutsford Br Stream (sheepham brook)	22/07/2021	19:45	1700	620	0.2	20.8
River Erme	22/07/2021	20:15	340	690	0	20.6
Flete Stream	22/07/2021	20:25	17000	12000	0.1	19.8

Sequer's Bridge Lodge Stream	22/07/2021	20:22	1400	600	21.8	22.5
Ford Stream	22/07/2021	21:00	100000	34000	0.2	18.7
Mothecombe stream	22/07/2021	07:25	530	160	0.4	15.2
Wonwell Stream	05/08/2021	09:10	18000	400	0.1	14.7
Clyng Mill stream	05/08/2021	10:00	4500	960	0.1	15
Oldaport stream/Ayelston Brook	05/08/2021	10:05	36000	2500	0.1	14.9
Oldaport stream second exit	05/08/2021	10:10	5000	950	0.2	15.2
Goutsford Br Stream (sheepham brook)	05/08/2021	11:00	41000	4300	0.2	14.1
River Erme	05/08/2021	11:35	1500	660	0	15
Flete Stream	05/08/2021	11:55	3500	1500	0	16.8
Mothecombe BW monitoring point	05/08/2021	09:06	400	280	30.6	17.5
Mothecombe stream	05/08/2021	09:22	870	320	0.2	14.5
Erme Estuary at mouth	05/08/2021	09:43	3500	610	20.7	16.6
Pamflete Stream	05/08/2021	10:34	140	91	0.2	17.5
Holbeton Stream	05/08/2021	11:15	2400	2500	0.1	14.4
Sequer's Bridge Lodge Stream	05/08/2021	11:39	630	200	6.6	18.7
Ford Stream	05/08/2021	12:06	4100	2800	0.1	15.5
Mothecombe BW monitoring point	30/08/2021	11:45	None Detected	None Detected	32.3	18.3
Mothecombe stream	30/08/2021	11:35	200	92	0.2	15.8
Wonwell Stream	30/08/2021	11:00	3500	320	0.2	14.3
Clyng Mill stream	30/08/2021	11:55	250	75	0.2	14.8
Flete Stream	30/08/2021	13:44	420	160	0.2	14.8
Ford Stream	30/08/2021	13:50	320	350	0.1	14.5
Goutsford Br Stream (sheepham brook)	30/08/2021	13:09	460	250	0.1	15.2
Holbeton Stream	30/08/2021	13:35	310	350	0.1	14.8
Oldaport stream/Ayelston Brook	30/08/2021	12:05	2200	1040	5.7	14.7
Oldaport stream second exit	30/08/2021	12:12	None Detected	310	16.8	16.7
Pamflete Stream	30/08/2021	12:30	170	81	0.2	16.6
River Erme	30/08/2021	13:35	230	150	0	14.9
Sequer's Bridge Lodge Stream	30/08/2021	12:55	280	230	13.2	19.2
Erme Estuary at mouth	30/08/2021	11:15	26	96	31.6	18
Erme Estuary at mouth	09/09/2021	11:25	1000	840	33.4	18.5
Mothecombe stream	09/09/2021	11:00	900	1270	0.5	16.3
Pamflete Stream	09/09/2021	12:05	550	270	0.2	18.8

Mothecombe stream	09/09/2021	07:05	3100	1240	0.3	15.5
Erme Estuary at mouth	09/09/2021	07:25	580	490	34.7	18
Mothecombe BW monitoring point	09/09/2021	07:00	2000	1480.00	29.7	17.9
Mothecombe BW monitoring point	09/09/2021	11:05	940	6000	29.7	17.9
Pamflete Stream	09/09/2021	08:15	43	700	34.7	18.4
Oldaport stream second exit	09/09/2021	12:10	4500	1120	17.7	19.2
Oldaport stream/Ayelston Brook	09/09/2021	12:00	> 10000	1920	14.5	18.5
Oldaport stream/Ayelston Brook	09/09/2021	08:20	5000	8600	25	17.9
Clyng Mill stream	09/09/2021	08:10	1200	1300	29.9	17.8
Oldaport stream second exit	09/09/2021	08:35	850	1040	31.1	17.8
Clyng Mill stream	09/09/2021	11:50	5200	3600	3.2	17.8
Wonwell Stream	09/09/2021	07:05	> 10000	16800	0.2	15.8
Wonwell Stream	09/09/2021	11:00	> 10000	3200	0.3	17.1
Goutsford Br Stream (sheepham brook)	09/09/2021	10:05	4400	20000	1.3	17.8
Goutsford Br Stream (sheepham brook)	09/09/2021	13:10	2900	> 20000	0.1	17
Mothecombe BW monitoring point	09/09/2021	18:12	720	140	31.1	18.7
Mothecombe stream	09/09/2021	18:06	550	680	0.5	17
Wonwell Stream	09/09/2021	18:15	5100	6000	0.2	16.1
Clyng Mill stream	09/09/2021	19:00	2000	1120	26.6	19.1
Flete Stream	09/09/2021	20:12	3400	3400	0	17.7
Ford Stream	09/09/2021	19:45	2000	1160	15.8	19.3
Goutsford Br Stream (sheepham brook)	09/09/2021	20:20	1400	5400	2.3	17.9
Holbeton Stream	09/09/2021	19:30	4100	3200	12.1	18.6
Oldaport stream/Ayelston Brook	09/09/2021	19:10	1800	1300	14.6	19
Oldaport stream second exit	09/09/2021	19:17	2200	870	23.3	19.2
Pamflete Stream	09/09/2021	18:36	250	110	0.1	19.1
River Erme	09/09/2021	20:07	2800	2200	0.3	17.9
Erme Estuary at mouth	09/09/2021	18:24	510	180	31.6	18.7
Oldaport stream second exit	14/09/2021	08:00	58	110	17.4	18.2
Oldaport stream second exit	14/09/2021	12:00	280	46	26.1	18.2
Clyng Mill stream	14/09/2021	08:20	> 10000	3600	0.5	14.8
Clyng Mill stream	14/09/2021	12:20	2700	2600	4.4	18
Flete Stream	14/09/2021	09:45	820	630	0.2	14.8
Flete Stream	14/09/2021	13:10	y	4400	0.3	16.1

Oldaport stream/Ayelston Brook	14/09/2021	08:10	8300	1700	3.1	15.7
Oldaport stream/Ayelston Brook	14/09/2021	12:10	820	250	29.9	17.9
Goutsford Br Stream (sheepham brook)	14/09/2021	09:30	2500	11000	0.1	15.5
Goutsford Br Stream (sheepham brook)	14/09/2021	12:50	620	3400	0.1	17
Holbeton Stream	14/09/2021	08:30	900	390		
Holbeton Stream	14/09/2021	11:55	650	590		
Wonwell Stream	14/09/2021	07:20	2000	920	0.3	14.2
Wonwell Stream	14/09/2021	11:20	2300	700	0.2	16.1
River Erme	14/09/2021	10:00	2500	2200	0	15.6
River Erme	14/09/2021	13:30	1300	1900	0	17.1
Erme Estuary at mouth	14/09/2021	07:35	610	230		
Erme Estuary at mouth	14/09/2021	10:55	6100	8700		
Mothecombe stream	14/09/2021	07:15	290	180		
Mothecombe stream	14/09/2021	10:35	330	140		
Pamflete Stream	14/09/2021	08:10	280	95		
Pamflete Stream	14/09/2021	11:20	84	71		
Mothecombe BW monitoring point	14/09/2021	07:20	23	16		
Mothecombe BW monitoring point	14/09/2021	10:40	12	32		
Sequer's Bridge Lodge Stream	14/09/2021	08:40	700	120		
Sequer's Bridge Lodge Stream	14/09/2021	11:45	530	120		
Ford Stream	14/09/2021	09:05	2300	1100		
Ford Stream	14/09/2021	12:05	1200	750		
Ford Stream	14/09/2021	19:53	1100	810	0.5	17.8
Sequer's Bridge Lodge Stream	14/09/2021	19:29	1300	330	13.3	19.2
Wonwell Stream	14/09/2021	18:05	3200	840	0.2	18
Oldaport stream second exit	14/09/2021	18:45	62	140	21.8	22
Clyng Mill stream	14/09/2021	19:00	> 10000	2100	0.5	17.5
Goutsford Br Stream (sheepham brook)	14/09/2021	19:45	1200	1230	0.1	17.1
Oldaport stream/Ayelston Brook	14/09/2021	18:50	2900	970	1.7	17.6
Flete Stream	14/09/2021	20:15	420	680	0	16.9
Mothecombe stream	14/09/2021	17:53	280	88	0.3	14.3
River Erme	14/09/2021	20:22	590	460	0.7	16.3
Erme Estuary at mouth	14/09/2021	18:06	340	170	16.6	14.5
Mothecombe BW monitoring point	14/09/2021	17:48	15	25	31.4	20
Holbeton Stream	14/09/2021	19:10	440	450	0.2	14.8

Pamflete Stream	14/09/2021	18:47	150	370	0.2	18.9
Pamflete Stream	17/09/2021	11:20	43	150	0.2	19.1
Holbeton Stream	17/09/2021	10:19	420	240	0.2	14.7
Ford Stream	17/09/2021	10:00	1100	320	0.2	15.4
Sequer's Bridge Lodge Stream	17/09/2021	10:40	420	250	15.7	19.5
Erme Estuary at mouth	17/09/2021	12:00	61	None Detected	27.8	20.1
Clyng Mill stream	17/09/2021	11:20	200	180	0.3	15.6
Wonwell Stream	17/09/2021	12:15	1800	620	0.2	16.4
Oldaport stream/Ayelston Brook	17/09/2021	11:30	2800	820	0.7	15.4
Goutsford Br Stream (sheepham brook)	17/09/2021	10:35	620	510	0.1	14.7
River Erme	17/09/2021	09:40	380	160	0.1	14.5
Flete Stream	17/09/2021	09:50	530	210	0.1	14.4
Oldaport stream second exit	17/09/2021	11:35	49	None Detected	19.8	19.6
Mothecombe stream	17/09/2021	12:20	190	84	0.2	17.4
Mothecombe BW monitoring point	17/09/2021	12:10	60	310	26.9	20.4

SOUTH WEST WATER

Appendix E: EDM bathing season summary data

Site Name	CD WorkOrder	Consent No	2011 Duration (Hours)	2011 # Spills	2012 Duration (Hours)	2012 # Spills	2013 Duration (Hours)	2013 # Spills	2014 Duration (Hours)	2014 # Spills	2015 Duration (Hours)	2015 # Spills	2016 Duration (Hours)	2016 # Spills
ERME RD_CSO_IVYBRIDGE	CD513640	201862	0	0	0	0	0	0	0	0	0	0	0	0
ERMINGTON STW_EO_ERMINGTON	CD301790	NRA-SW-1188	0	0	0	0	0	0	0	0	0	0	0	0
ERMINGTON STW_SSO_ERMINGTON	CD201790	NRA-SW-1188	0	0	0	0	0	0	0	0	0	0	0	0
HOLBETON STW SO HOLBETON	CD402400	202650	0	0	0	0	0	0	0	0	16.04	14	3.56	3
HOLBETON STW_SSO_HOLBETON	CD202400	202650	0	0	0	0	0	0	0	0	19	16	0.42	3
IVYBRIDGE STW SO IVYBRIDGE	CD202581	203299	0	0	0	0	0	0	0	0	0	0	0	0
IVYBRIDGE STW_SSO_IVYBRIDGE	CD202580	203299	0	0	0	0	0	0	0	0	0	0	0	0
MODBURY STW_SSO_MODBURY	CD203370	SWWA 2259	0	0	0	0	0	0	0	0	0	0	89.09	20
PLAYING FIELD_CSO_ERMINGTON	CD513410	201875	0	0	0	0	0	0	0	0	0	0	0	0
POUNDWELL MEADOW_CSO_MODBURY	CD509010	201962	0	0	0	0	0	0	0	0	14.02	3	7.5	1
TOWN HILL CSO ERMINGTON	CD513420	201874	0	0	0	0	0	0	0	0	0.44	4	2.28	2

Site Name	CD WorkOrder	Consent No	2017 Duration (Hours)	2017 # Spills	2018 Duration (Hours)	2018 # Spills	2019 Duration (Hours)	2019 # Spills	2020 Duration (Hours)	2020 # Spills	2021 Duration (Hours)	2021 # Spills
ERME RD_CSO_IVYBRIDGE	CD513640	201862	0	0	0	0	0	0	0	0	0	0
ERMINGTON STW_EO_ERMINGTON	CD301790	NRA-SW-1188	1	8.51	0	0	0	0	0	0	0	0
ERMINGTON STW_SSO_ERMINGTON	CD201790	NRA-SW-1188	1	8.51	0	0	2.86	2	0.71	1	0	0
HOLBETON STW_SO_HOLBETON	CD402400	202650	26.17	18	20.76	15	4.45	10	3.95	12	4.88	11
HOLBETON STW_SSO_HOLBETON	CD202400	202650	26.17	18	20.76	15	27.58	9	5.35	13	17.09	14
IVYBRIDGE STW_SO_IVYBRIDGE	CD202581	203299	40.29	4	8.85	1	31.45	3	17.85	3	97.63	5
IVYBRIDGE STW_SSO_IVYBRIDGE	CD202580	203299	40.29	4	8.85	1	3.65	2	2.54	2	4.45	1
MODBURY STW_SSO_MODBURY	CD203370	SWWA 2259	0.67	2	1.69	2	9.19	6	40.17	9	9.1	8
PLAYING FIELD_CSO_ERMINGTON	CD513410	201875	0	0	0	0	0	0	0	0	0	0
POUNDWELL MEADOW_CSO_MODBURY	CD509010	201962	47.13	6	7.29	1	48.03	6	43.01	6	5.23	3
TOWN HILL_CSO_ERMINGTON	CD513420	201874	3.15	4	1.37	1	0	0	0	0	2.75	6

Appendix F: EDM Event data for elevated FIO scenarios

Site Name	CD WorkOrder	Consent No.	Bathing Beach	Event Start Date	Event Start Time	Event Stop Date	Event Stop Time	Duration (Hours)	# Spills	Elevated IE at BW
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	02/05/2018	06:29:21	02/05/2018	06:35:41	0.11	1	02/05/2018
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	01/05/2018	07:39:50	02/05/2018	08:19:11	11.65	2	02/05/2018
MODBURY STW_SSO_MODBURY	CD203370	SWWA 2259	MOTHECOMBE BEACH	02/05/2018	04:14:42	02/05/2018	08:54:24	0.86	1	02/05/2018
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	03/09/2017	08:41:31	03/09/2017	13:56:31	3	1	05/09/2017
IVYBRIDGE STW_SSO_IVYBRIDGE	CD202580	203299	MOTHECOMBE BEACH	03/09/2017	15:15:06	03/09/2017	16:09:46	0.91	1	05/09/2017
IVYBRIDGE STW_SSO_IVYBRIDGE	CD202581	203299	MOTHECOMBE BEACH	03/09/2017	14:24:52	03/09/2017	23:58:14	9.56	1	05/09/2017
POUNDWELL MEADOW_CSO_MODBURY	CD509010	201962	MOTHECOMBE BEACH	03/09/2017	11:43:31	03/09/2017	21:43:17	10	1	05/09/2017
TOWN HILL_CSO_ERMINGTON	CD513420	201874	MOTHECOMBE BEACH	03/09/2017	11:01:40	03/09/2017	11:30:00	0.47	1	05/09/2017
IVYBRIDGE STW_SSO_IVYBRIDGE	CD202581	203299	MOTHECOMBE BEACH	02/08/2017	11:30:48	03/08/2017	14:22:38	26.86	2	04/08/2017
POUNDWELL MEADOW_CSO_MODBURY	CD509010	201962	MOTHECOMBE BEACH	02/08/2017	09:47:24	03/08/2017	01:26:15	15.65	2	04/08/2017
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	28/06/2017	13:09:31	28/06/2017	13:19:21	0.16	1	29/06/2017
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	08/06/2017	07:50:00	08/06/2017	07:59:01	0.15	1	08/06/2017
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	06/06/2017	00:32:00	06/06/2017	08:42:51	0.94	1	08/06/2017

MODBURY STW_SSO_MODBURY	CD203370	SWWA 2259	MOTHECOMBE BEACH	13/09/2016	09:24:27	13/09/2016	09:52:31	0.47	1	13/09/2016
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	13/09/2015	18:27:21	15/09/2015	03:40:31	3.03	2	15/09/2015
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	26/07/2015	06:00:10	26/07/2015	11:14:11	2.42	1	27/07/2015
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	26/07/2015	05:55:21	26/07/2015	06:41:21	0.75	1	27/07/2015
POUNDWELL MEADOW_CSO_MODBURY	CD509010	201962	MOTHECOMBE BEACH	26/07/2015	08:15:10	26/07/2015	13:34:04	5.32	1	27/07/2015
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	01/06/2015	18:43:01	02/06/2015	03:17:22	2.74	1	03/06/2015
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	01/06/2015	23:09:51	01/06/2015	23:34:41	0.41	1	03/06/2015
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	30/05/2018	07:14:01	30/05/2018	07:33:21	0.32	1	31/05/2018
HOLBETON STW_SSO_HOLBETON	CD202400	202650	MOTHECOMBE BEACH	30/05/2018	07:07:51	30/05/2018	07:54:41	0.78	1	31/05/2018
HOLBETON STW_SO_HOLBETON	CD402400	202650	MOTHECOMBE BEACH	11/07/2017	13:46:10	12/07/2017	00:22:01	1.56	1	11/07/2017