ENVIRONMENT AGENCY

DEVON AREA
INTERNAL REPORT

CONTINUOUS WATER QUALITY MONITORING RESULTS COLLECTED FROM THE RIVER TORRIDGE AT COCKSHILHAY AND BEAM BRIDGE FOR THE EU UWWTD

SEPTEMBER 1997
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(CATCHMENT 29B)

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CONTINUOUS WATER QUALITY MONITORING RESULTS COLLECTED FROM THE RIVER TORRIDGE AT COCKSHILHAY AND BEAM BRIDGE FOR THE EC UWWTD.

1. CATCHMENT DESCRIPTION

The River Torridge rises at Baxworthy Cross (NGR SS 290 224) and flows south-east where it is joined by the River Waldon north-east of Bradford (NGR SS 426 079). The river is then joined further downstream by the River Lew north of Hatherleigh at NGR SS 534 050, flows north and is joined by the River Okement (NGR SS 551 072). The River Torridge is then joined by the River Mere south of Beaford (NGR SS 551 130) and the River Yeo 2 km south of Bideford (NGR SS 462 245) below the freshwater limit. The River Torridge is 100.71 km long and drains a freshwater catchment equivalent to 857 km^2 (Ref. 1).

2. TERMS OF REFERENCE

2.1 OBJECTIVES

The Environment Agency has a commitment to monitor the River Torridge for evidence of nutrient enrichment between Great Torrington Sewage Treatment Works and the Tidal limit (Ref. 2).

Two fixed site continuous water quality monitors are present on the lower reaches of the River Torridge. The station at Beam Bridge (at NGR SS 4766 2026) is approximately 1¼ km downstream from Great Torrington Sewage Treatment Works (STW) final effluent discharge point (at NGR SS 4818 1918) whilst the station at Cockshilhay (at NGR SS 4971 1796) is approximately 2¾ km upstream of the STW discharge (see Figure 1).

Data collected from the two continuous water quality monitoring stations is to be used as support evidence in the nomination of the stretch of river as a 'Sensitive Area' to be designated under the EC Urban Waste Water Treatment Directive (UWWTD) (91/271/EC).

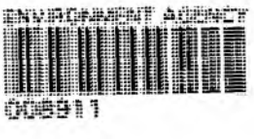
2.2 PROJECT TEAM

T. Cronin (Project Leader)
P. Rose (Project Manager, author)

2.3 METHOD

The two continuous water quality monitors are pHOX 1600 series instruments enclosed in prefabricated heated / ventilated glass fibre huts. The monitors are self cleaning (aerated back-washing system with biocide injection switchable to a 6, 12 or 24 hourly cycle) with river water being continuously driven through the monitor via a dual pumping system.

The ranges covered for the dissolved oxygen and pH parameters are 0-200% saturation and 2-12 pH units respectively. Data is sent back to Manley House Communications room via the Meteorburst Communication System every 15 minutes



3. RESULTS

The annotated data in graphical form is supplied in APPENDIX I. An example of the data in text form is given in APPENDIX II. A comparison of the data sets is presented in Table 1.

Although the data supplied represents the period 1994 to 1996 inclusive from the Beam Bridge site and 1996 from the Cockshilhay site, no calibration, validation or service records exist for the period 1994-1995. The data collected during this period cannot be relied on as being correct an as such must only be used as an indication of trend.

Damage caused by the floods of winter 1995 resulted in both monitors being non-operational. The servicing and recommission of the monitors was carried out by A & T Services Ltd. . From June 1996 onwards, both sites were operational and being calibrated (and serviced as required) on a weekly basis. For this reason, the statistics given with the graphs have only been calculated for the 1996 period on a month by month basis.

None of the reported dissolved oxygen concentrations (% saturation) of the River Torridge at the sites Beam Bridge or Cockshilhay exceeded the DoE's criteria of 150 % saturation (daytime, Ref. 3) during the year 1996. The data previous to this period were not validated and must be considered numerically unsafe; however, the data do show diurnal variations and approximate magnitude of the swings in graphical form (see APPENDIX I).

4. DISCUSSION

Although the validated data sets for both sites do not contain any concentrations of dissolved oxygen above the DoE criteria, the diurnal variations of both dissolved oxygen concentration and pH levels shown in the graphic representation do indicate high levels of aquatic plant life activity.

Dissolved oxygen, pH and aquatic plant life.

The cyclical trends in the dissolved oxygen concentrations can be generally explained through the combined processes of photosynthesis and respiration of the aquatic plant life. During daylight, both processes are active. If there is sufficient solar radiation and the populations of algae / aquatic macrophytes are great enough, the quantities of dissolved oxygen utilised by respiration will be equalled then exceeded by that produced by photosynthesis.

As light levels decrease during the afternoon to night time, photosynthesis reduces then stops whilst the process of respiration generally stays at the same level (an exception being the Cyanobacteria or Blue Greens that have a slightly different metabolic process than the more advanced 'higher' aquatic plants. Ref 4). As a direct consequence, the dissolved oxygen in the water column is utilised by respiration (by both flora and fauna) and the levels fall. This variation gives rise to the characteristic diurnal cycle observed in the dissolved oxygen concentrations

Diurnal cycles observed in the pH data is also attributable to the aquatic plant activity. During daylight, carbon dioxide (CO_2) in the water column (either present as a by-product of respiration or via diffusion from the atmosphere) is used by the aquatic micro and

macrophytes during photosynthesis. If levels of CO_2 become depleted, some of the aquatic plants can utilise bicarbonate ions instead. (Ref. 5).As an end product of the process, Hydroxide ions are secreted which in turn increases the pH level of the water (Ref.5).

During the night, the CO_2 produced by respiration is not being utilised by photosynthesis ie hydroxide ions are not being produced and the daytime pH levels start to fall. A proportion of the increasing quantities of CO_2 being produced combines with the water to form carbonic acid. Whilst Carbonic acid itself will lower the pH of the water, the acid can also dissociate into free hydrogen and bicarbonate ions. The greater the quantities of hydrogen ions in the water column, the more acidic the water (Ref. 5). These pH cycles tend to mirror the variations observed in the dissolved oxygen concentrations.

Dissolved oxygen, pH and eutrophication.

The wide variations in dissolved oxygen concentrations and pH levels suggest high levels of aquatic plant life present at these two points of the River Torridge. In order for the plants to be thriving there must be enough nutrients present in the water column to sustain the plant populations. The enrichment of the watercourse with plant nutrients, mainly nitrates and phosphates, can be from by-products of natural decay, agricultural run-off through to loading from effluent discharges.

The data collected from the continuous monitors suggests that the River Torridge at both monitoring sites up and downstream of Great Torrington STW is slightly eutrophic in nature even though none of the validated dissolved oxygen data collected exceeded the DoE level of 150 % saturation. However, the comparison of the data sets from the Beam Bridge site to those collected at the Cockshilhay site indicate that the diurnal cycles downstream of the Great Torrington STW effluent discharge point are generally slightly greater than those upstream. This can be seen in both the graphical representation and from the Standard Deviation (SD) of the data sets (see Table 1).

This would suggest that whilst the lower reaches of the River Torridge may be considered as slightly eutrophic, (probably caused by a combination of factors such as agricultural run-off and inputs from STW effluents upstream), there is a slight exacerbation of the problem by yet further nutrient loading from the Great Torrington STW effluent discharge.

Further uses for the continuous water quality monitors on the River Torridge.

Besides collecting data for the possible UWWTD designation, the monitor situated at Cockshilhay is approximately 2.5 km upstream of a surface water abstraction site (07/0173 at NGR SS 4820 1910) owned by SWWS Ltd. (see Figure 1).

SWWS Ltd. currently have no licence to abstract from the site 07/0173. However, during drought conditions and under regulation by the Environment Agency, emergency abstractions are possible. The location of the monitor at Cockshilhay would make it worth consideration to use the monitor station as a form of intake protection during such times.

5. CONCLUSION

1. None of the data collected from the continuous water quality monitors at Cockshilhay and Beam Bridge contained Dissolved Oxygen concentrations exceeding the DoE UWWTD criteria of 150 % saturation.

2. Dissolved Oxygen and pH data collected from both sites show strong diurnal cycles during the summer months.

3. The diurnal cycles recorded are attributed to high levels of aquatic plant activity.

4. The high levels of aquatic micro and macrophytes are probably the result of nutrient enrichment of the lower reaches of the River Torridge from upstream sources such as agricultural run-off and discharges from upstream STW's.

5. The slight eutrophication of the River Torridge at Beam Bridge is probably exacerbated by nutrient loading from the input of Great Torrington STW effluent discharge.

6. REFERENCES.

1. NRA. (1993). River Torridge Catchment Management Plan. Consultation Report.

2. NRA. (1994). River Torridge Catchment Management Plan. Final Report.

3. DoE Consultation paper (1993). NRA programme for the monitoring of water quality.

4. Fay, P. (1983). The Blue Greens. Studies in Biology no. 160. Edward Arnold. London.

5. Jeffries, M. & Mills, D. (1990). Freshwater Ecology. Principles and Applications. Belhaven Press. London.

Figure 1. Map showing the River Torridge and positions of the Fixed Site Continuous Monitors up and downstream of Great Torrington Sewage Treatment Works (STW).

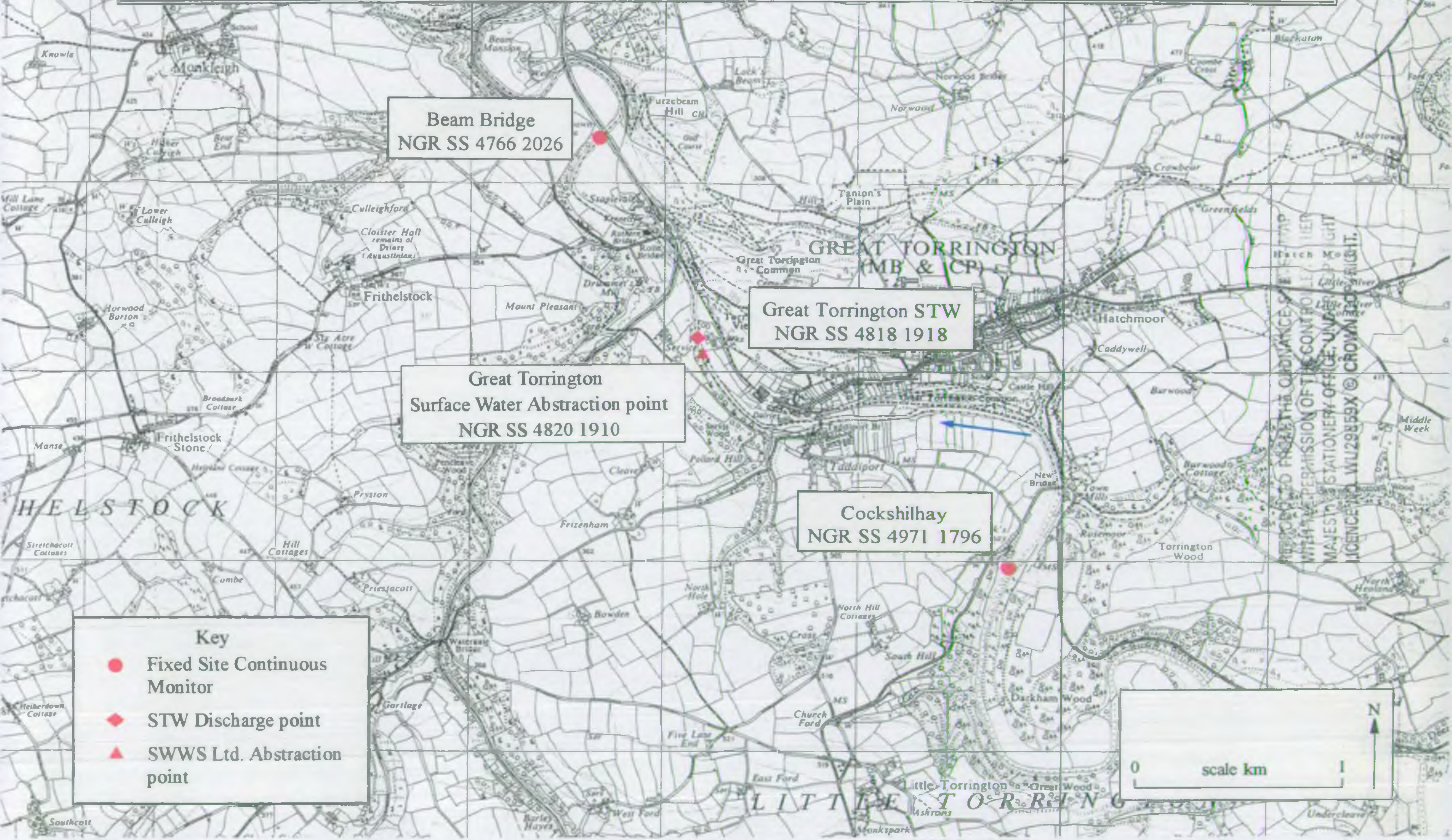


Table 1. Comparison of data collected from Cockshilhay and Beam Bridge (Up and Downstream of Great Torrington STW respectively) during 1996.

	Cockshilhay					Beam Bridge					
Month	Comments	No. of readings	Maximum	Minimum	Mean	SD	Comments	No. of readings	Maximum	Minimum	Mean	SD
June	The data starting to show diurnal variations in DO concentrations and corresponding changes in pH levels	2220	114.77	84.39	97.17	6.13	The data already showing strong diurnal variations in DO concentrations and corresponding changes in pH levels.	1926	118.41	71.41	93.81	10.35
July	Diurnal variations stronger than June. SD (or variation) less than that of data set D/S of STW. pH data set mirroring trends of DO.	2140	125.75	84.88	100.45	8.81	Diurnal variations stronger than June. SD (or variation) greater than that of data set U/S of STW indicating greater amplitude or wider 'swings' in diurnal cycles.	711	130.88	81.97	105.01	14.17
August	Amplitude of cycles decreasing in comparison to Julys data. pH cycles still following trend of DO data	2579	116.97	85.43	97.86	6.38	Amplitude of cycles decreasing in comparison to Julys data. pH cycles still following trend of DO data.	2955	104.42	71.67	86.91	7.46
September	Amplitude of cycles shown in the DO data set dying out and much reduced by the end of the month. Although the pH data set is reduced due to probe failure, what is present reflects DO trend.	1157	122.82	89.4	101.43	7.76	Amplitude of cycles shown in both DO and pH data sets still dying out and much reduced by the end of the month.	1760	110.21	75.55	89.27	9.02
October	Diurnal cycles are not particularly apparent for either DO or pH graphs. This is reflected in the lower SD for the data sets.	1099	100.74	80	93.49	2.84	Diurnal cycles are not particularly apparent for either DO or pH graphs. This is reflected in the lower SD for the data sets.	2248	95.52	75.55	85.77	3.93
November	As previous month	2168	103.67	88.66	96.29	2.85	As previous month	2274	95.96	79.62	88.74	3.04
December	As previous month	1100	101.05	88.12	96.86	1.89	As previous month.	2936	99.33	69	87.06	5.37

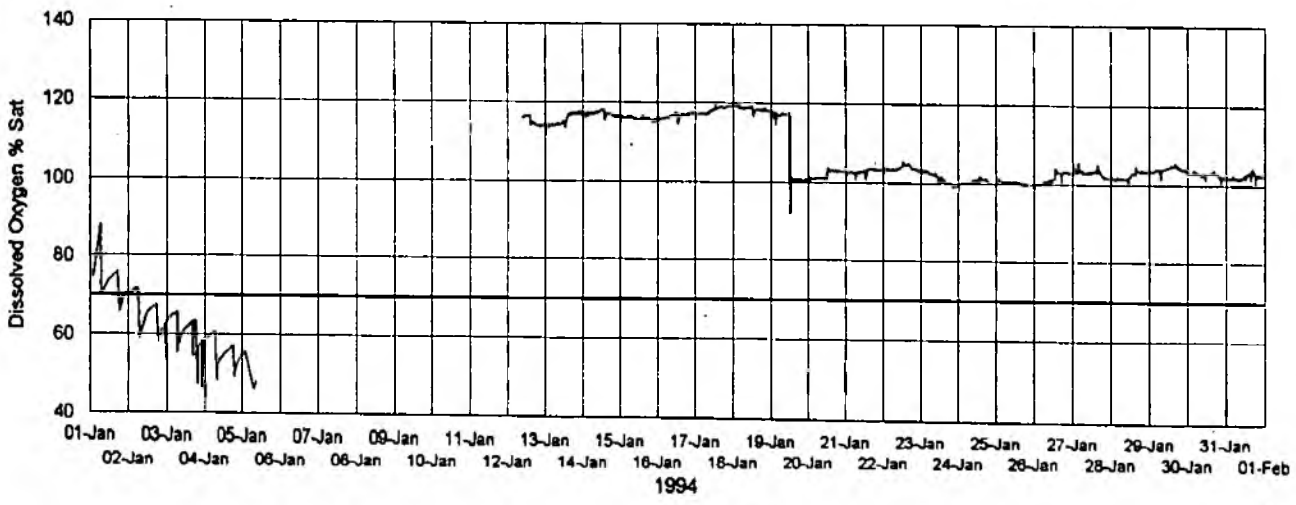
SD: Standard Deviatio

APPENDIX I

CONTINUOUS WATER QUALITY MONITORING
BEAM BRIDGE 1994-1996

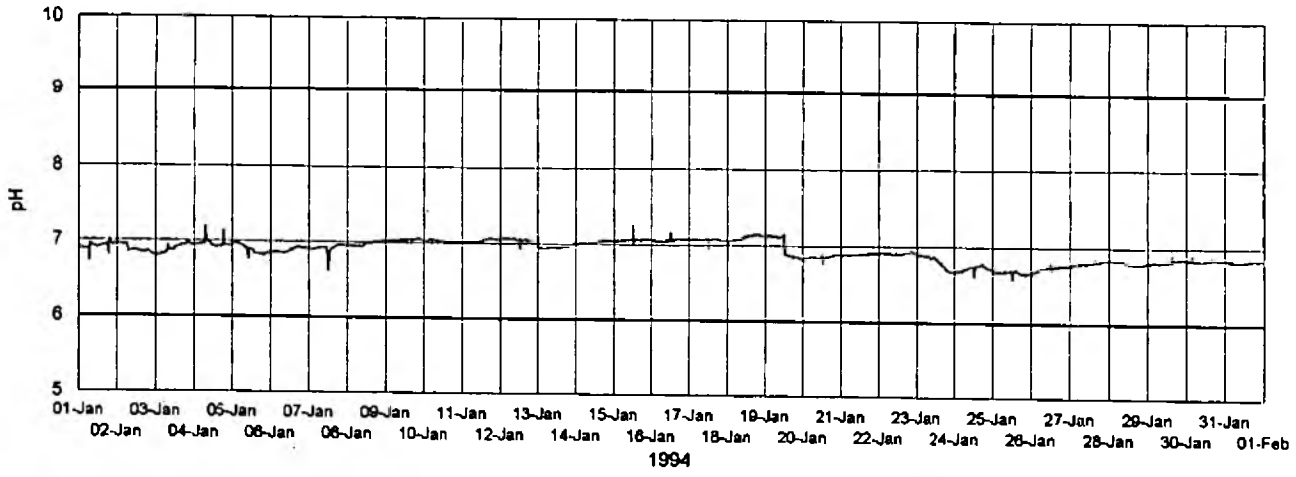
River Torridge January 1994
Beam Bridge

Dissolved Oxygen % saturation January 1994



No validation data available for this month. Use data as an indication of trend only.

pH January 1994



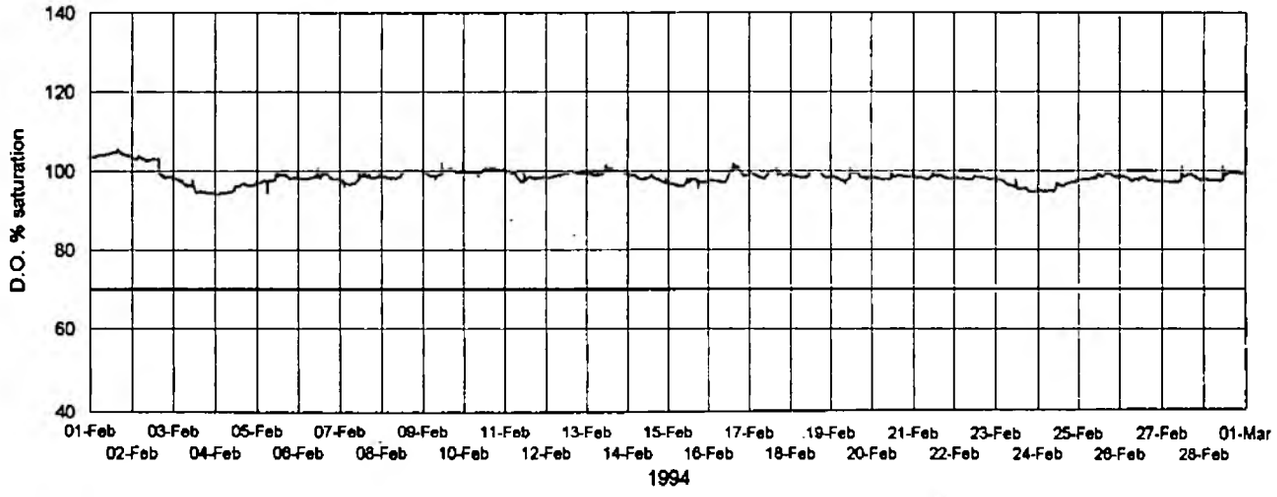
No validation data available for this month. Use data as an indication of trend only.

Key

Environmental Quality Standard

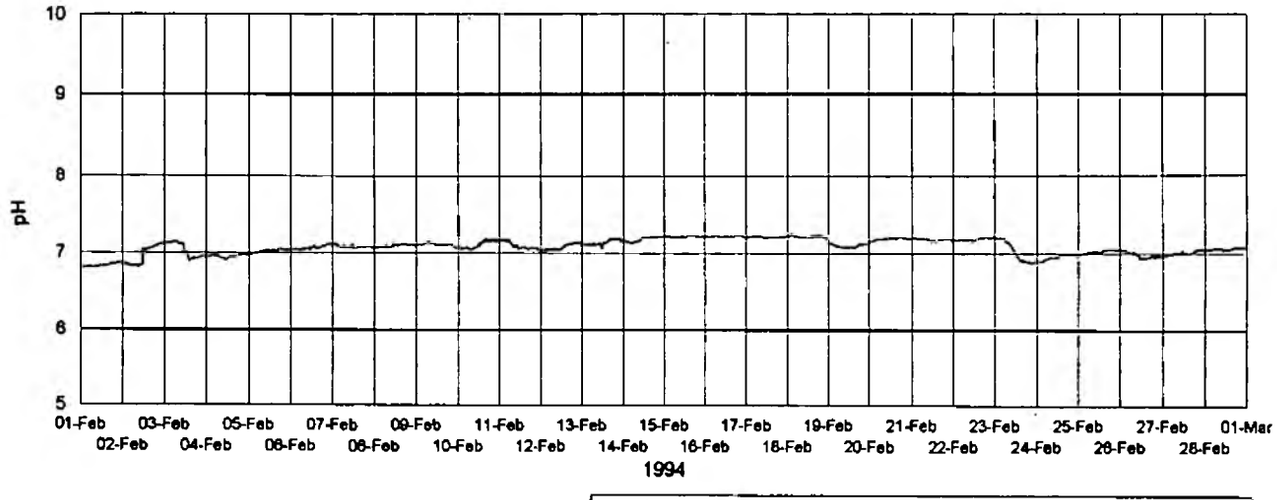
River Torridge February 1994
Beam Bridge

D.O. % saturation February 1994



No validation data available for this month. Use data as an indication of trend only.

pH, February 1994

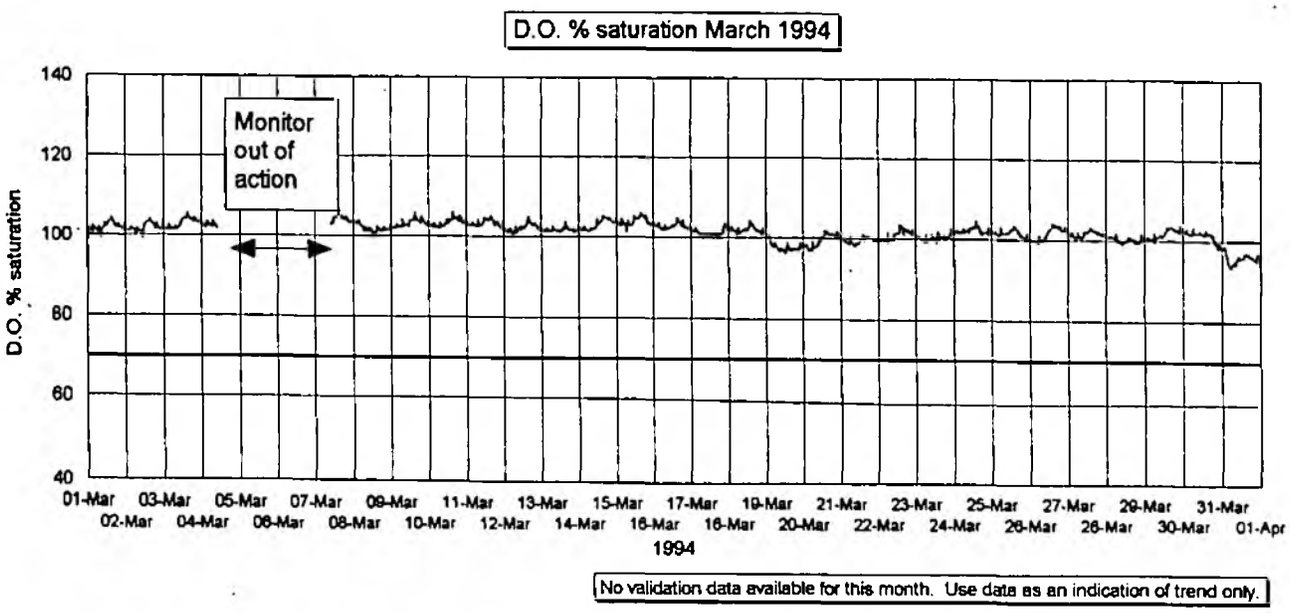


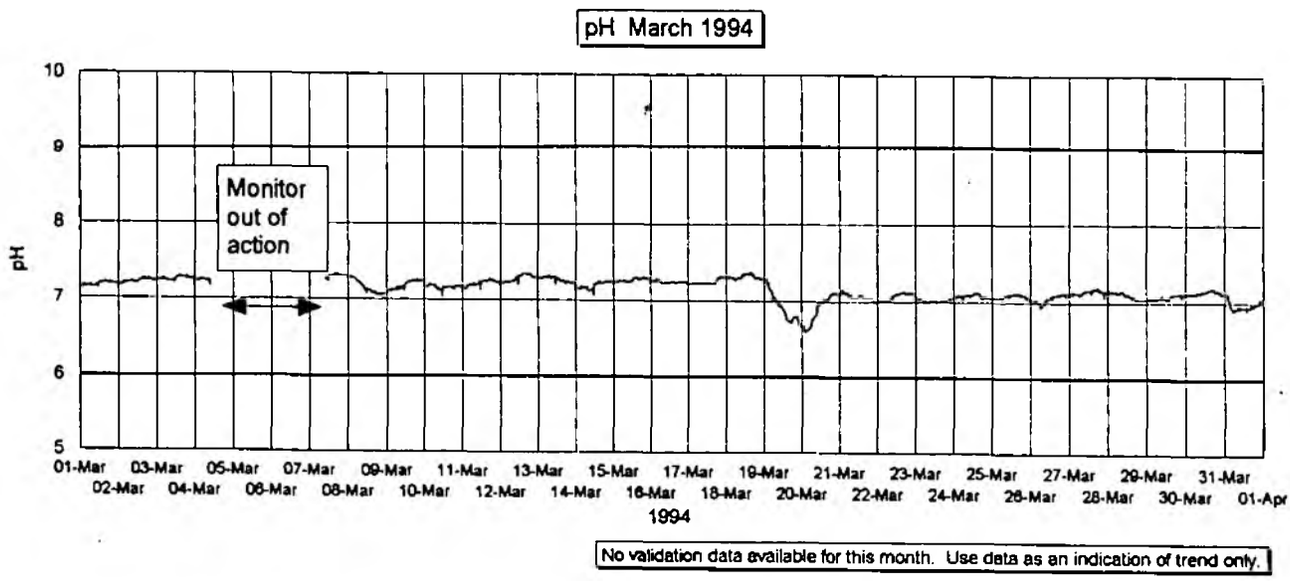
No validation data available for this month. Use data as an indication of trend only.

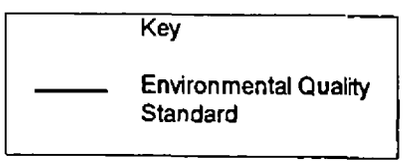
Key

——— Environmental Quality Standard

River Torridge March 1994
Beam Bridge

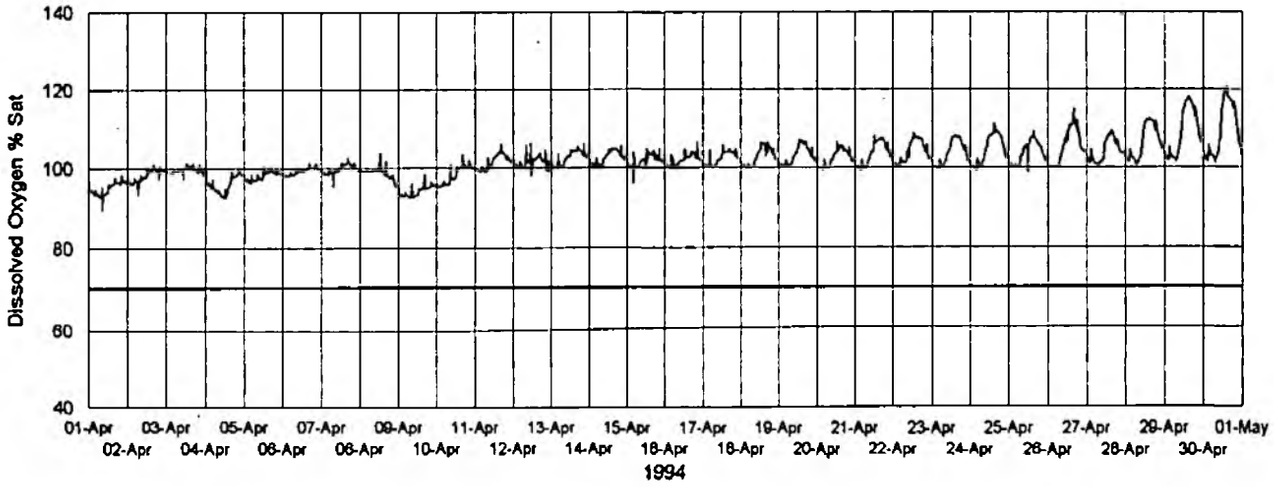






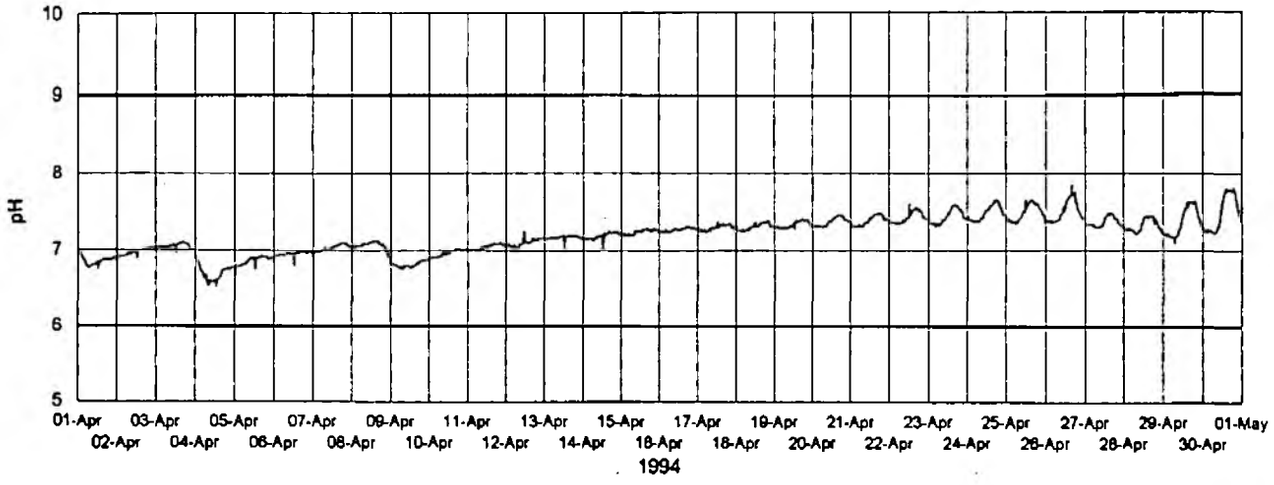
River Torridge April 1994
Beam Bridge

Dissolved Oxygen % saturation April 1994



No validation data available for this month. Use data as an indication of trend only.

pH April 1994



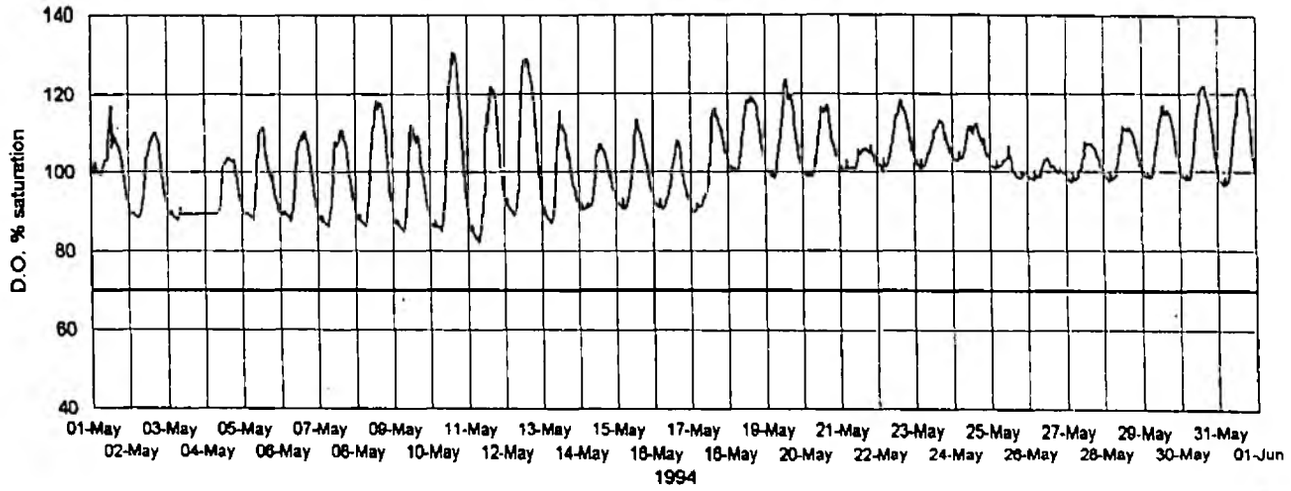
No validation data available for this month. Use data as an indication of trend only.

Key

Environmental Quality Standard

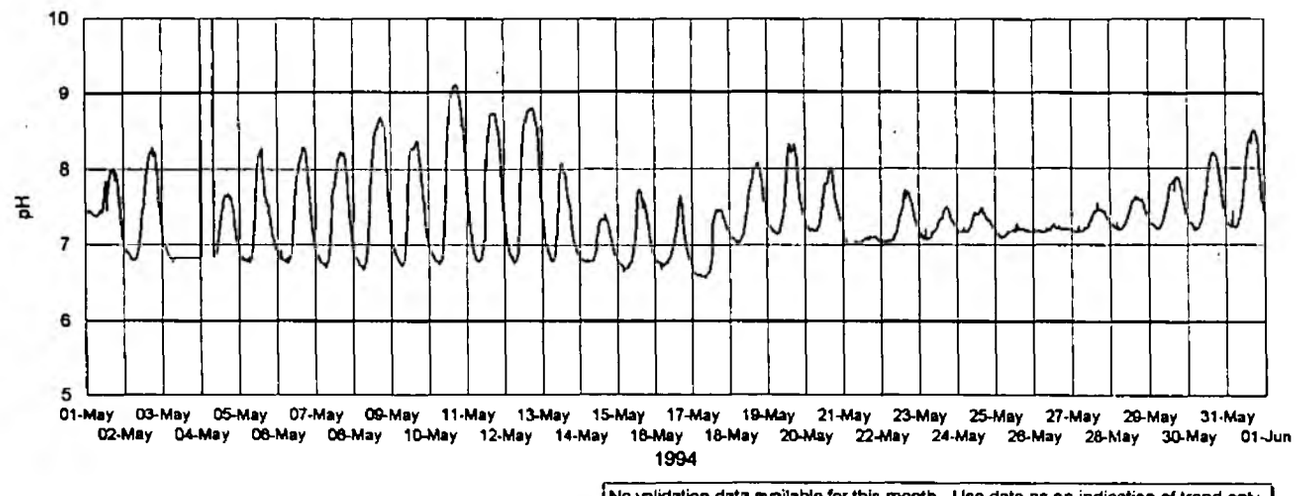
River Torridge May 1994
Beam Bridge

D.O. % saturation May 1994



No validation data available for this month. Use data as an indication of trend only.

pH May 1994



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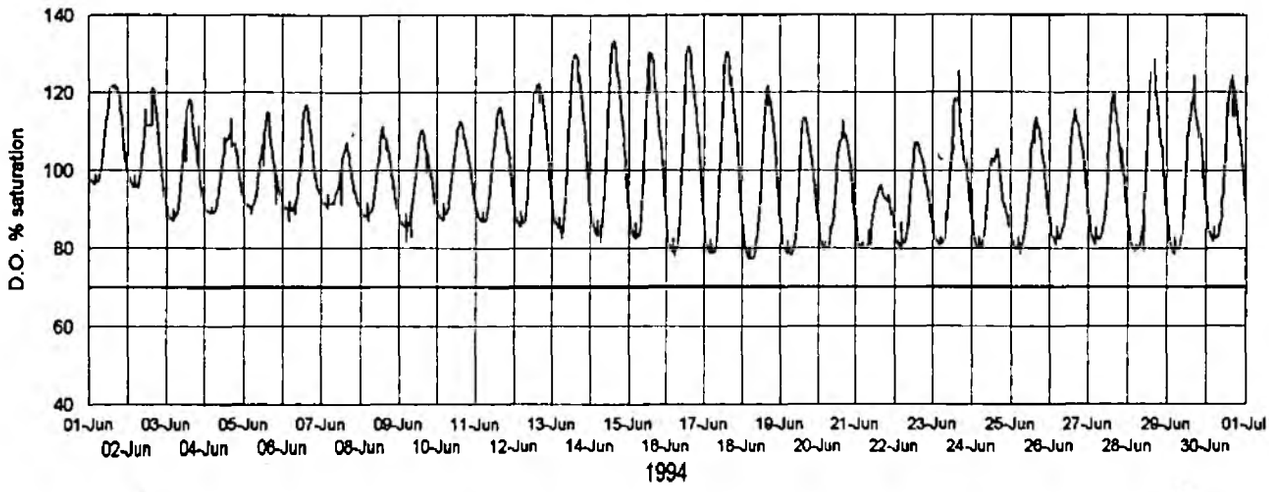
——— Environmental Quality Standard

River Torridge June 1994
Beam Bridge

D.O. % saturation June 1994



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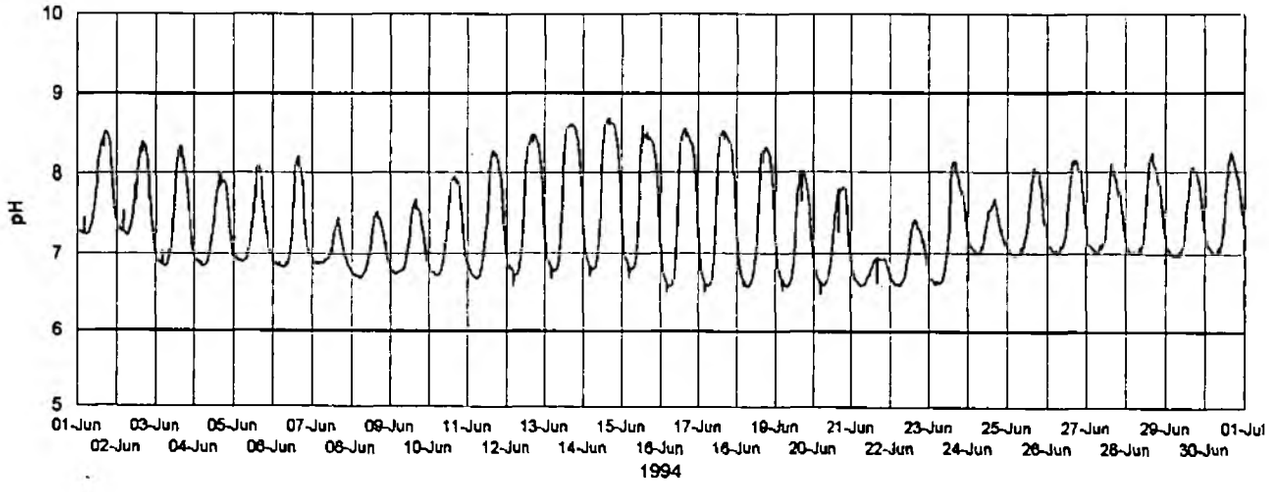
pH June 1994



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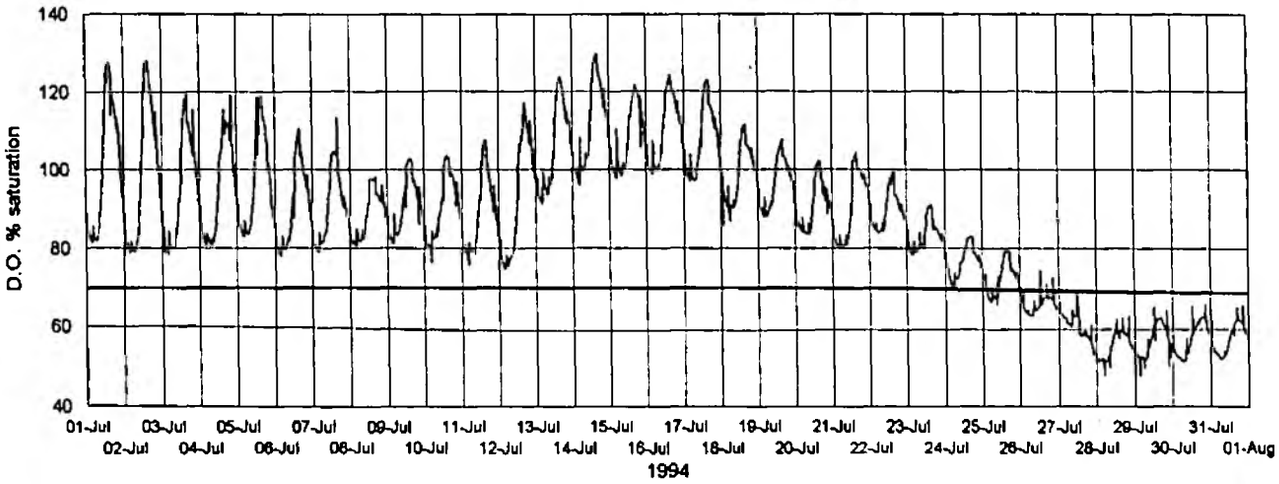
Key

——— Environmental Quality Standard

River Torridge July 1994
Beam Bridge

D.O. % saturation July 1994



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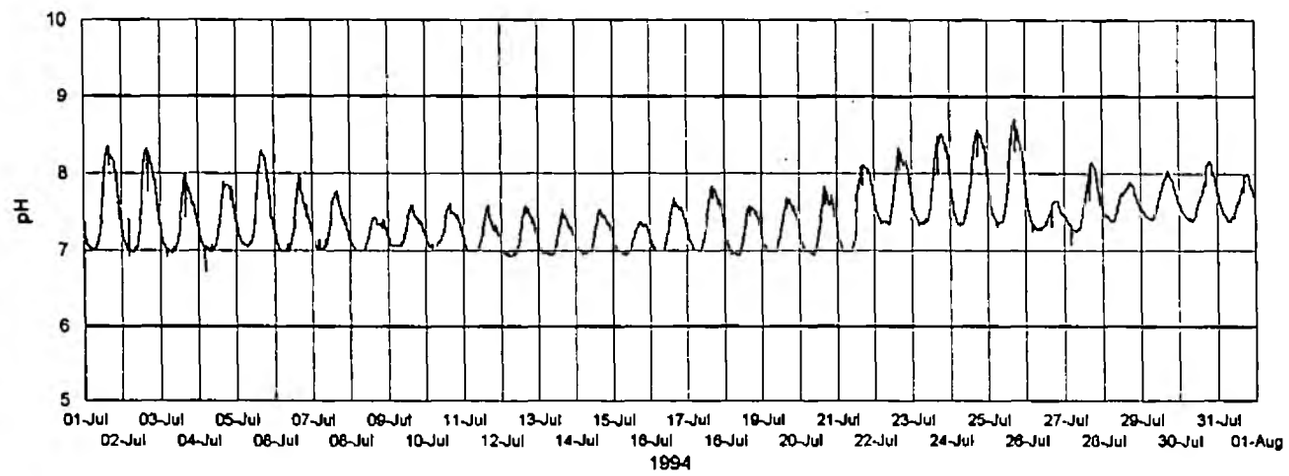
pH July 1994



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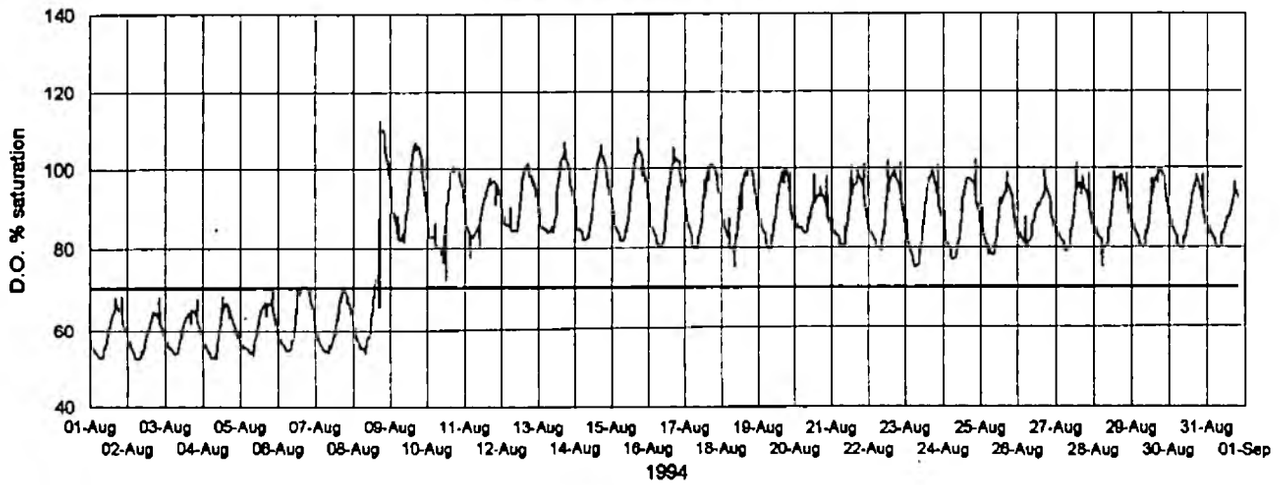
Key

——— Environmental Quality Standard

River Torridge August 1994
Beam Bridge

D.O. % saturation August 1994



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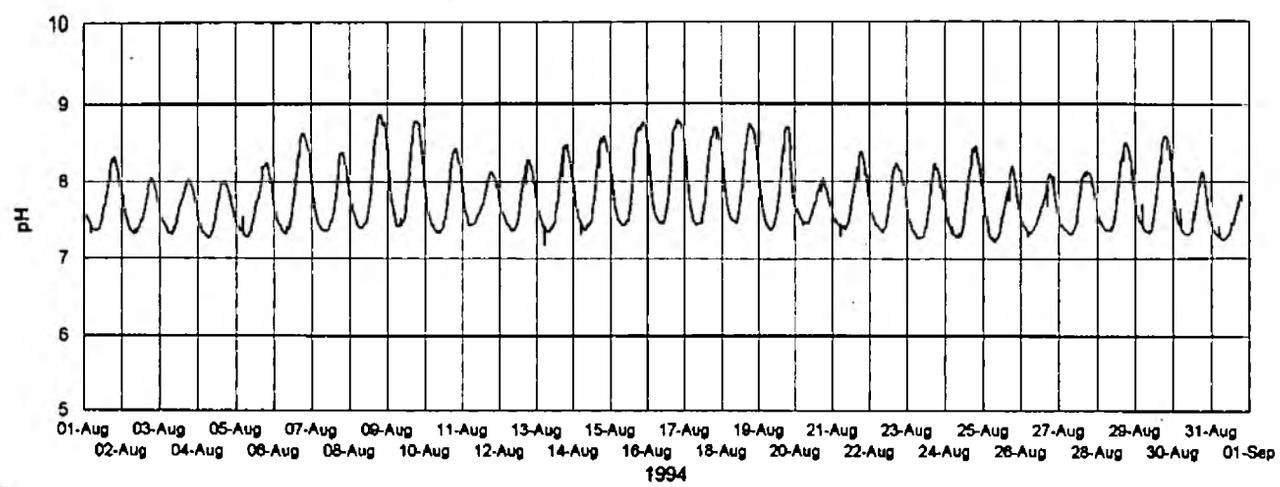
pH August 1994



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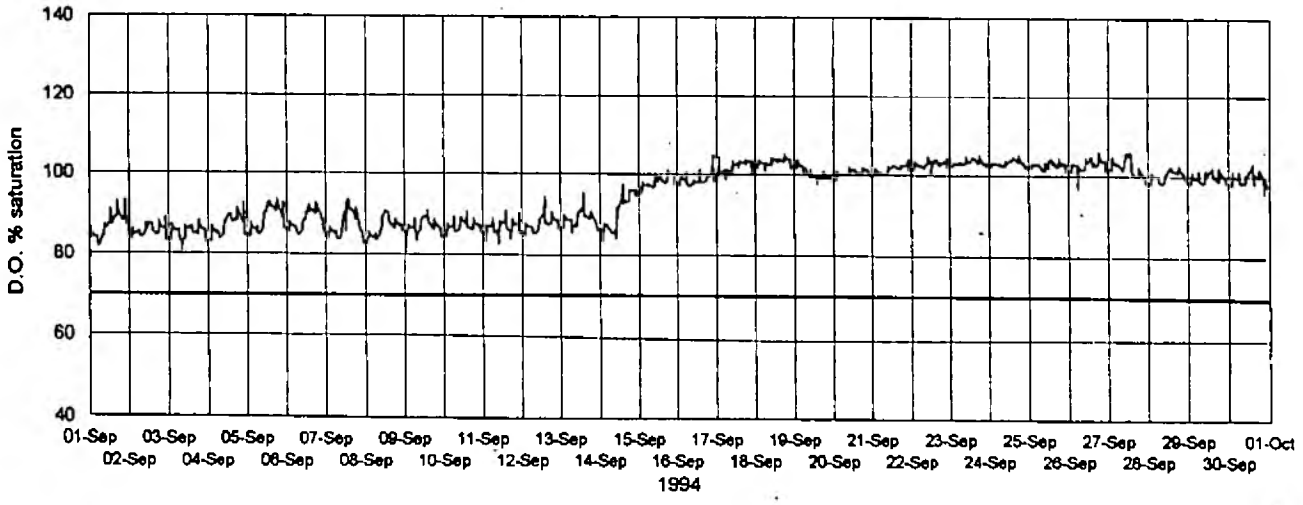
——— Environmental Quality Standard

River Torridge September 1994
Beam Bridge

D.O. % saturation September 1994



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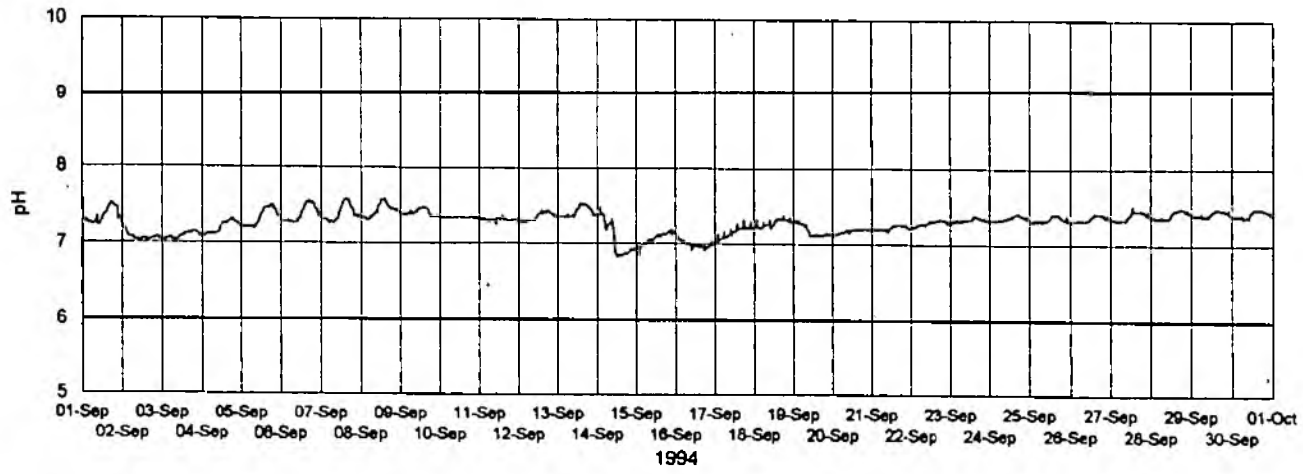
pH September 1994



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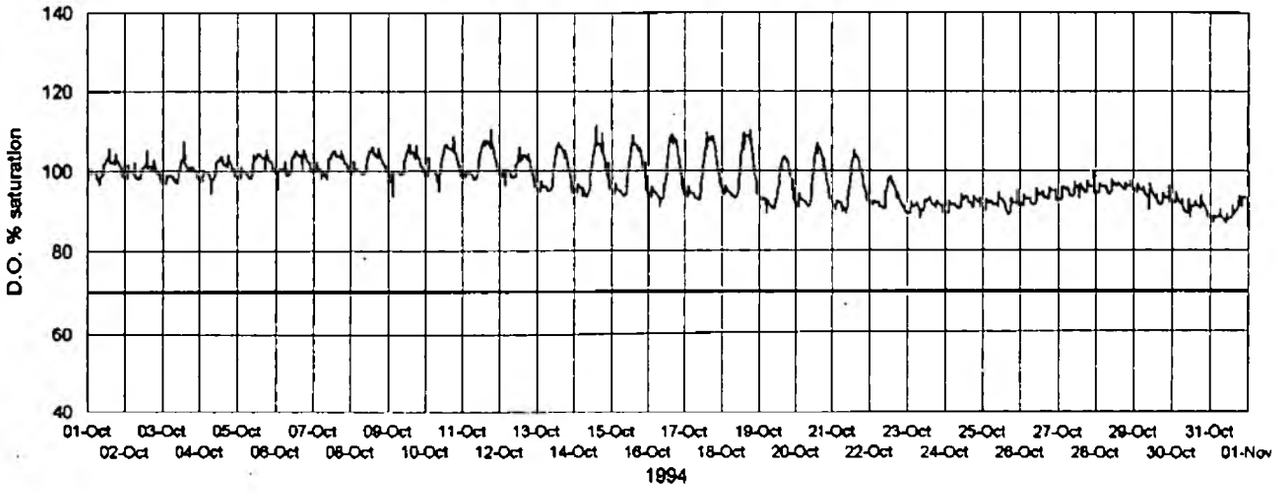
River Torridge October 1994
Beam Bridge

D.O. % saturation October 1994



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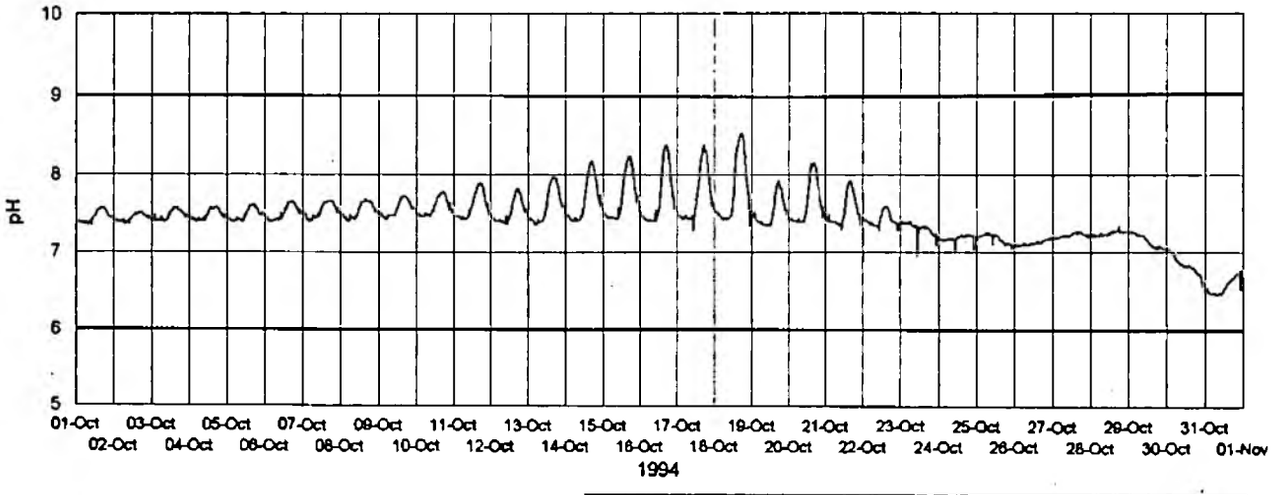
pH October 1994



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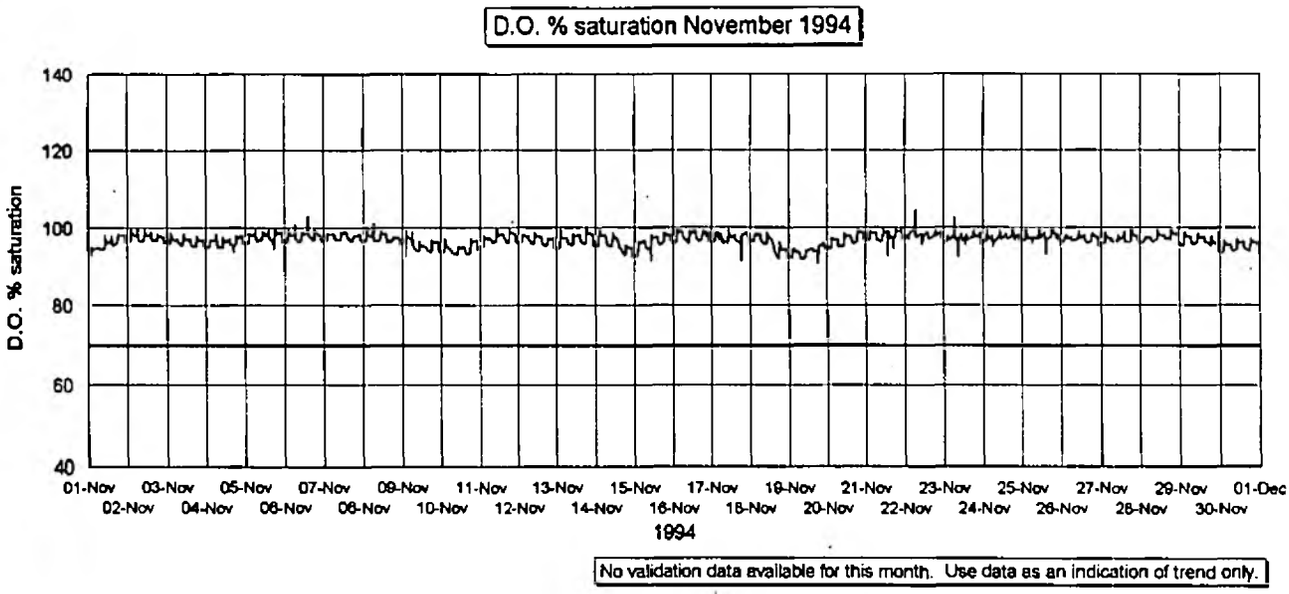
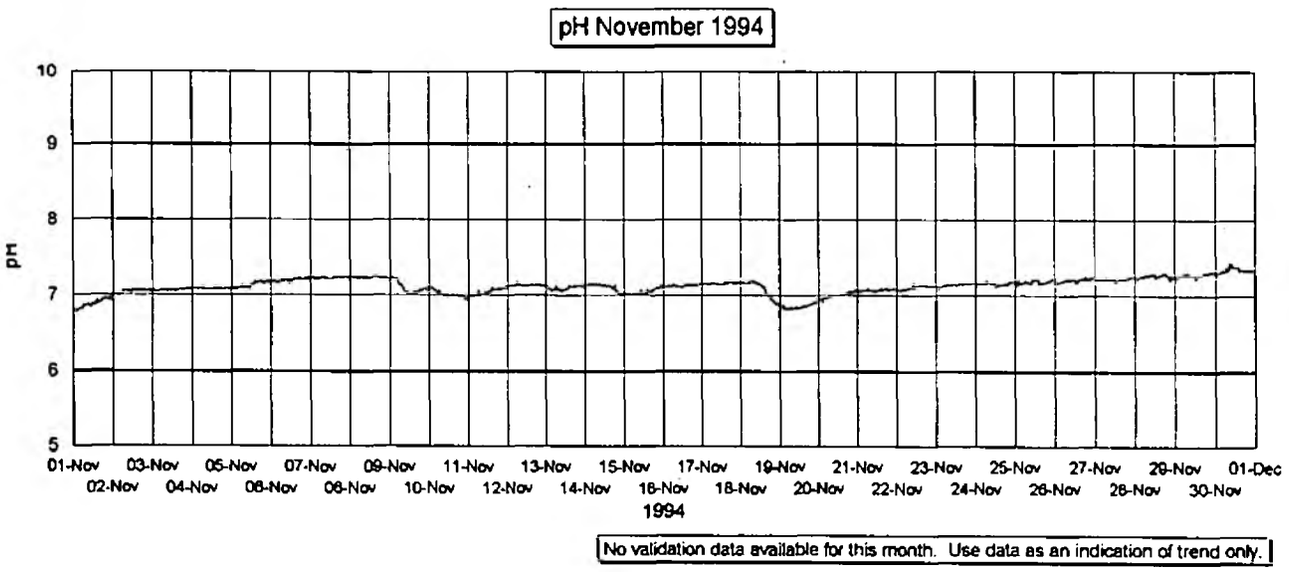
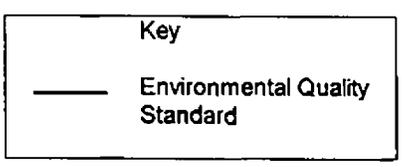
Environmental Quality Standard

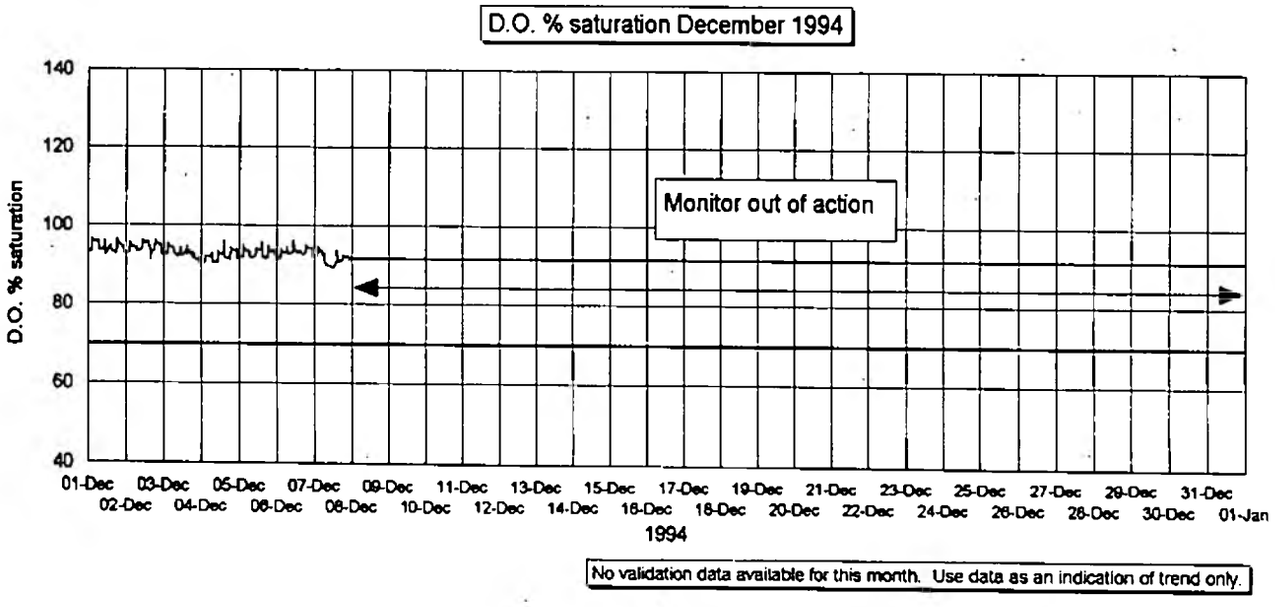
River Torridge November 1994
Beam Bridge







River Torridge December 1994
Beam Bridge



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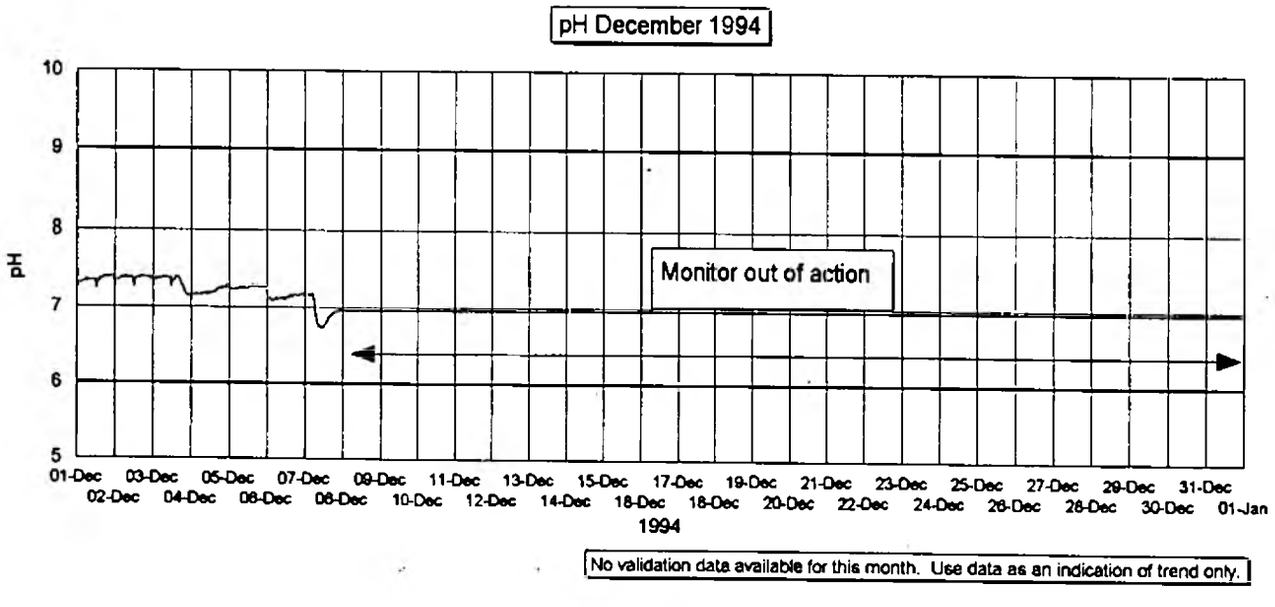


No validation data available for this month. Use data as an indication of trend only.

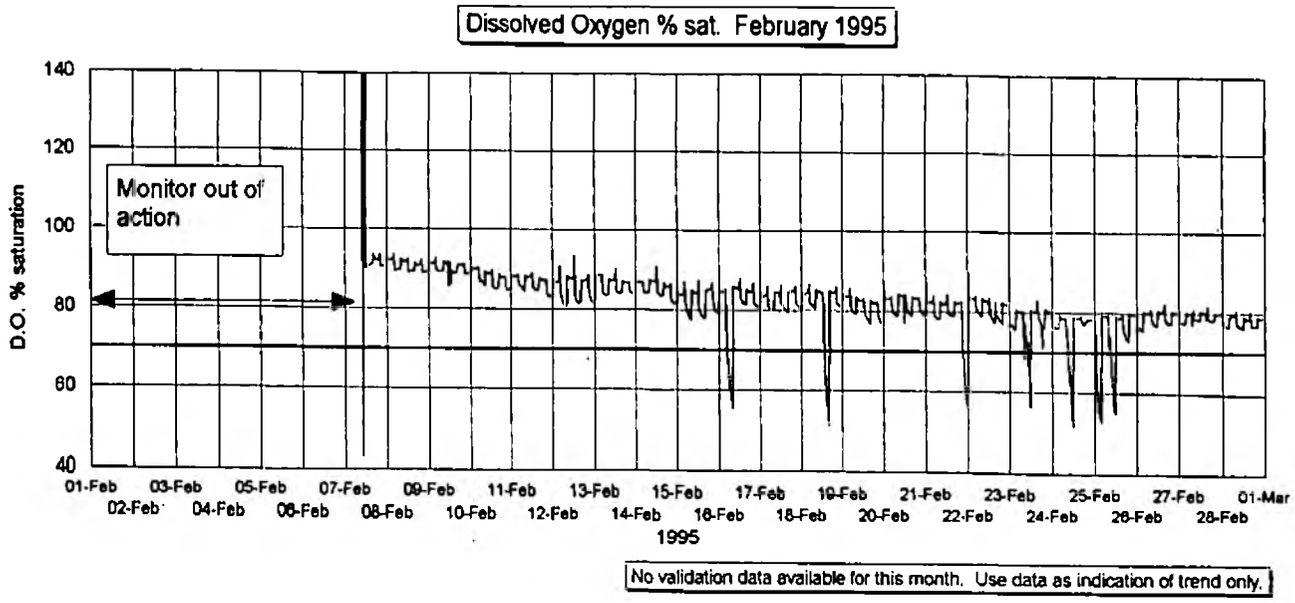
Key

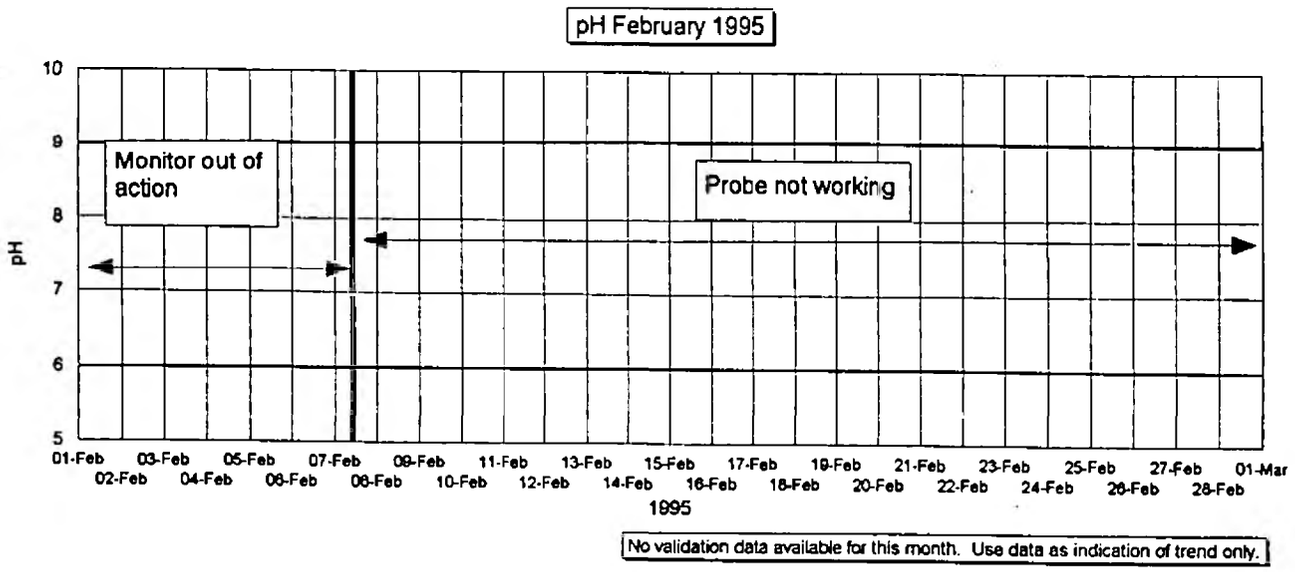
——— Environmental Quality Standard

River Torridge January 1995
Beam Bridge

Monitor out of action all month

River Torridge February 1995
Beam Bridge

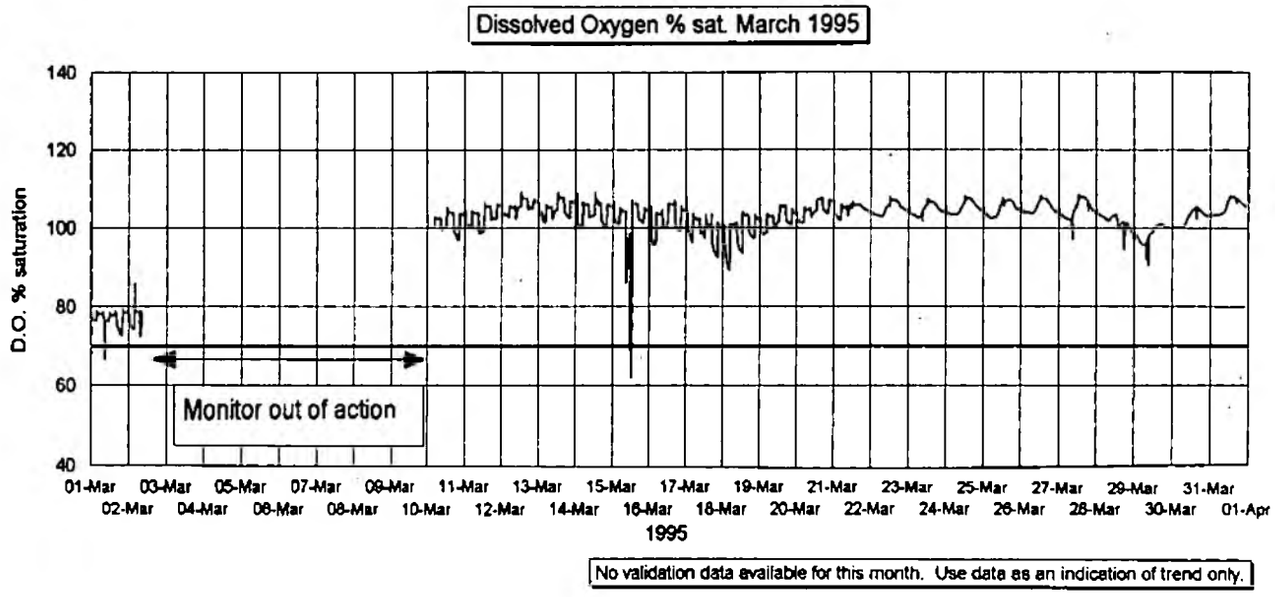


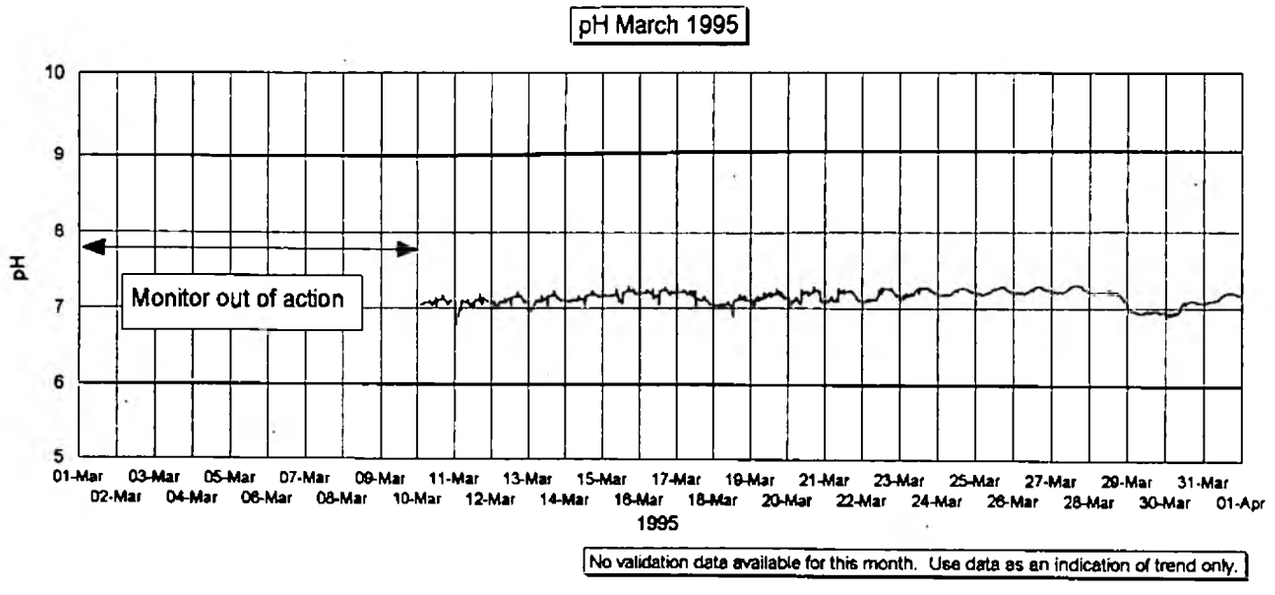


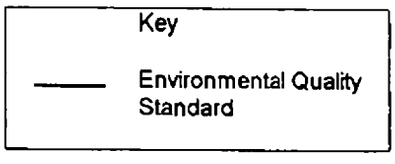
Key

——— Environmental Quality Standard

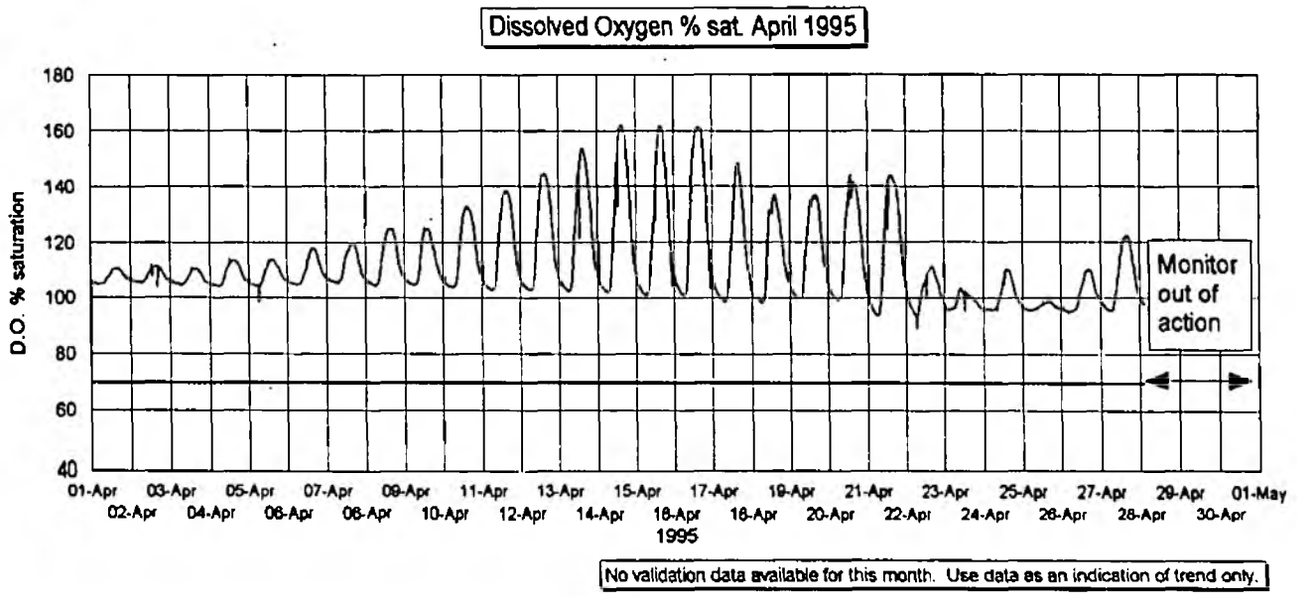
River Torridge March 1995
Beam Bridge

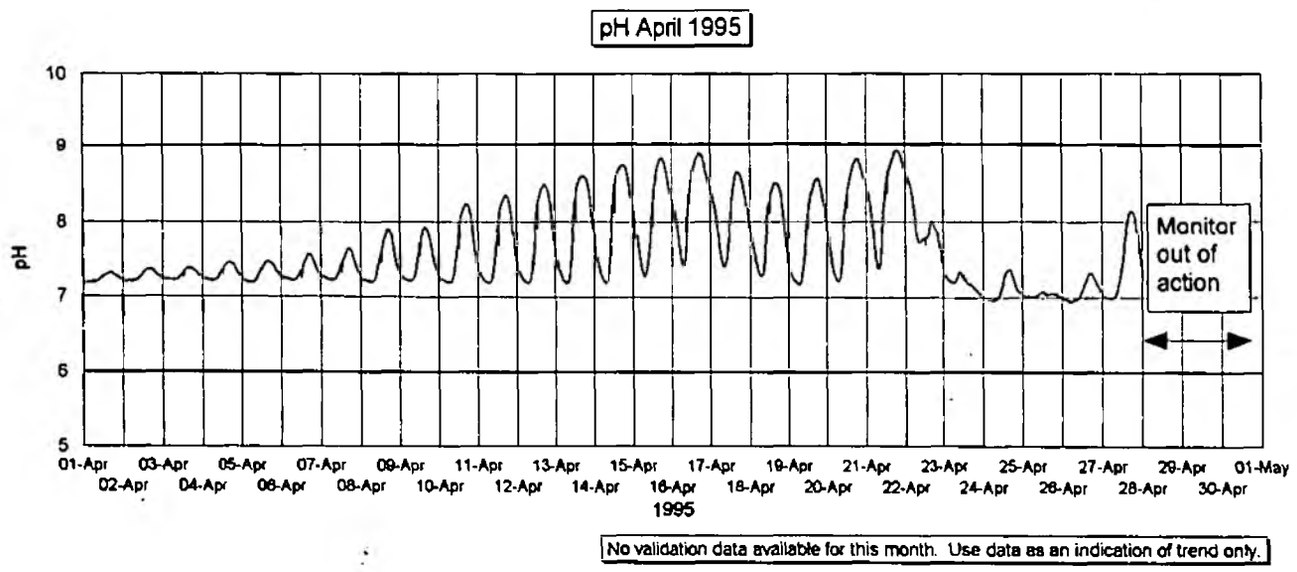






River Torridge April 1995
Beam Bridge

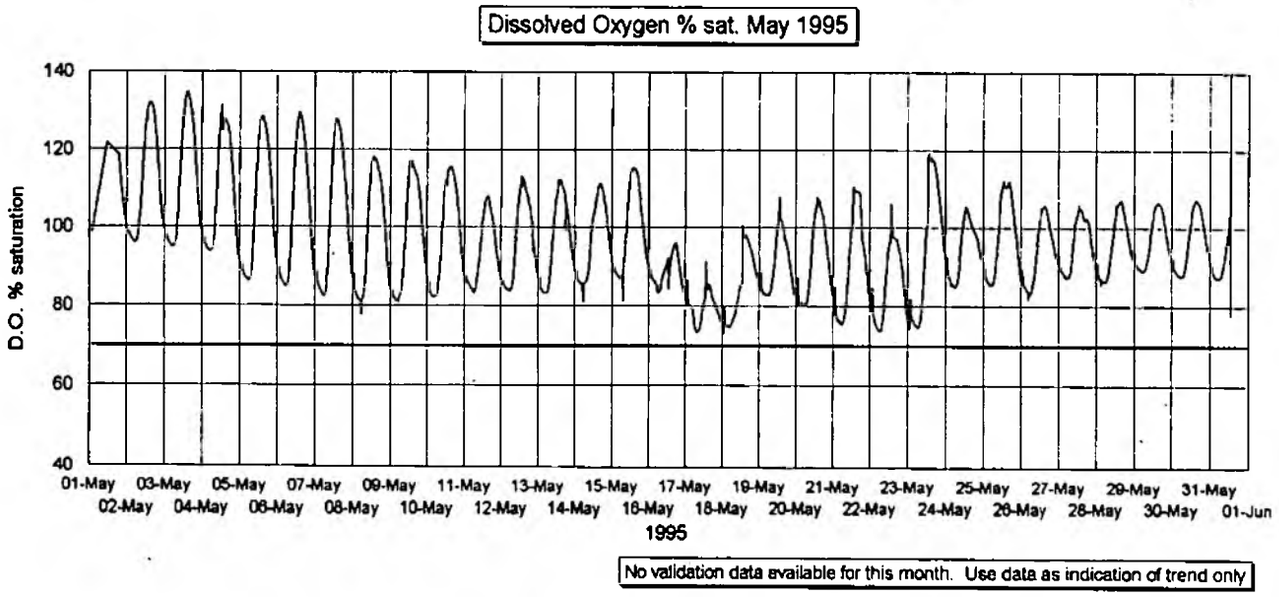


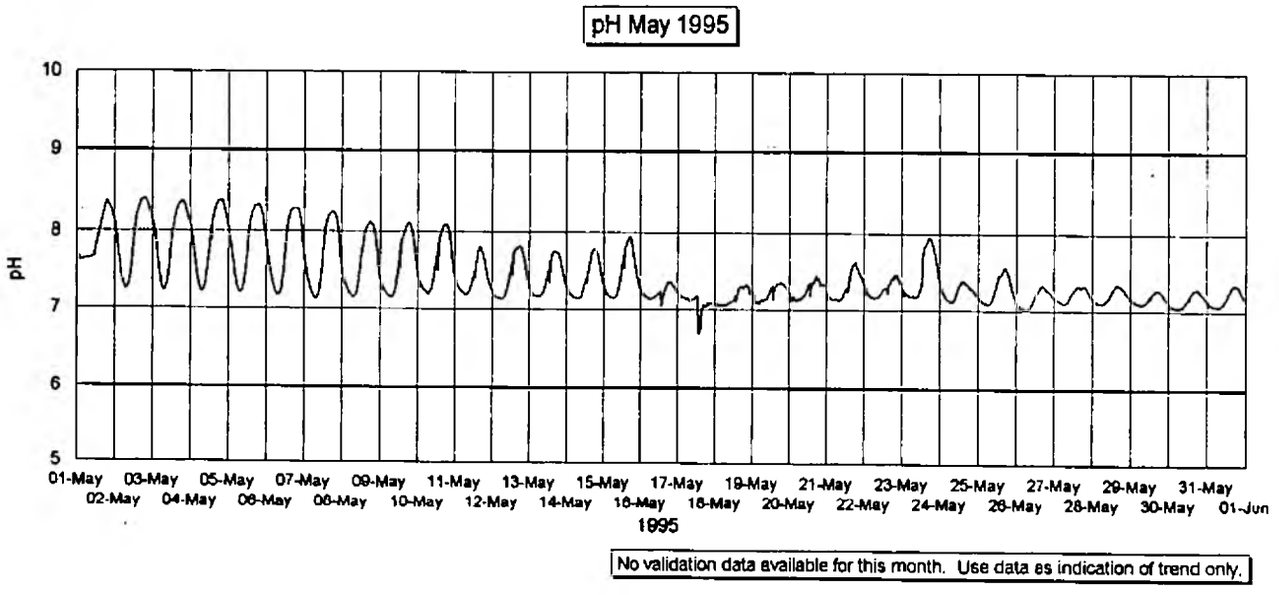


Key

——— Environmental Quality Standard

River Torridge May 1995
Beam Bridge



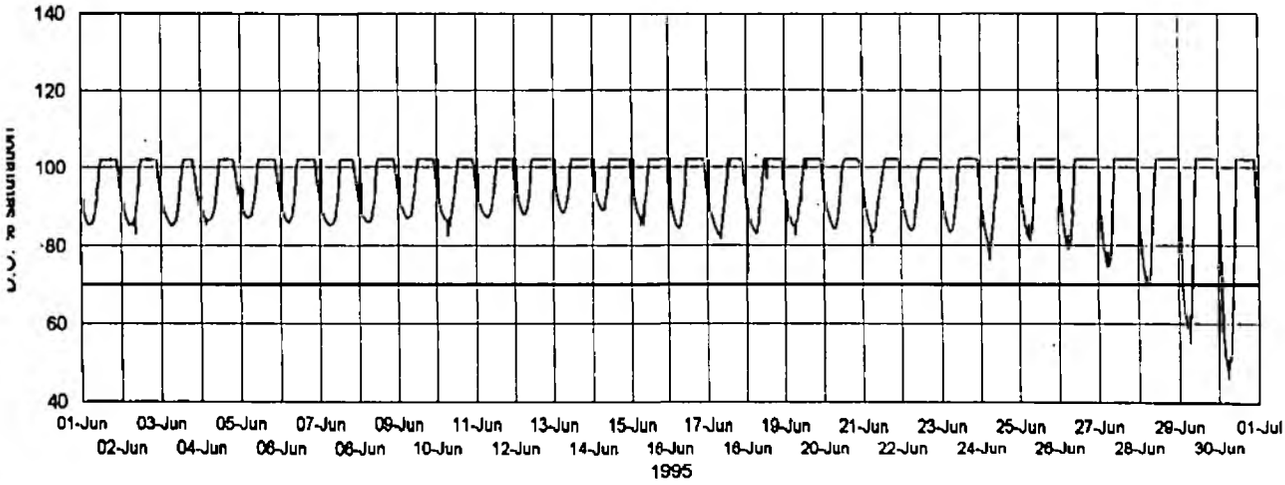


Key

——— Environmental Quality Standard

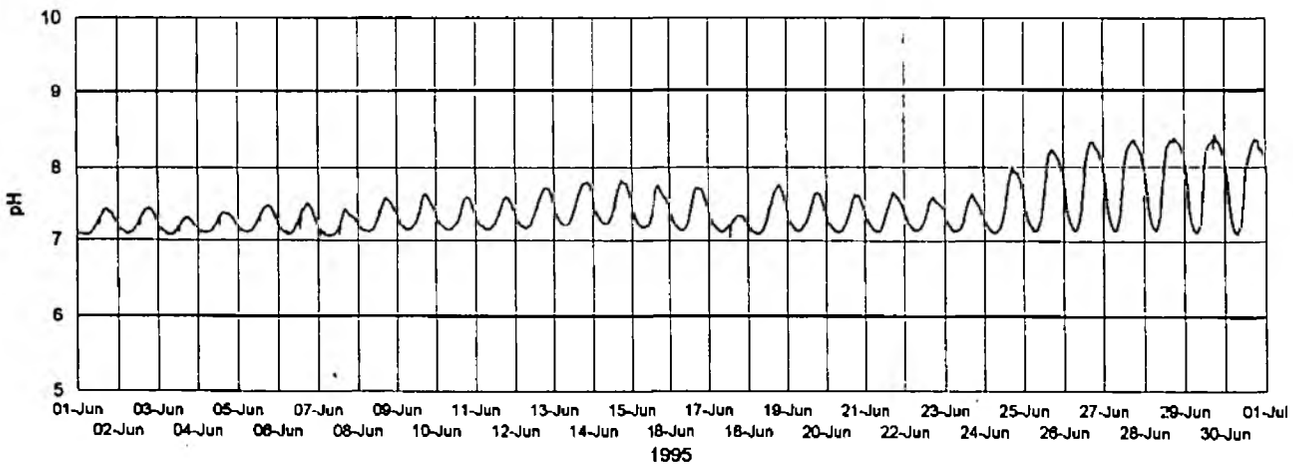
River Torridge June 1995
Beam Bridge

Dissolved Oxygen % sat. June 1995



No validation data available for this month. Use data as indication of trend only.

pH June 1995



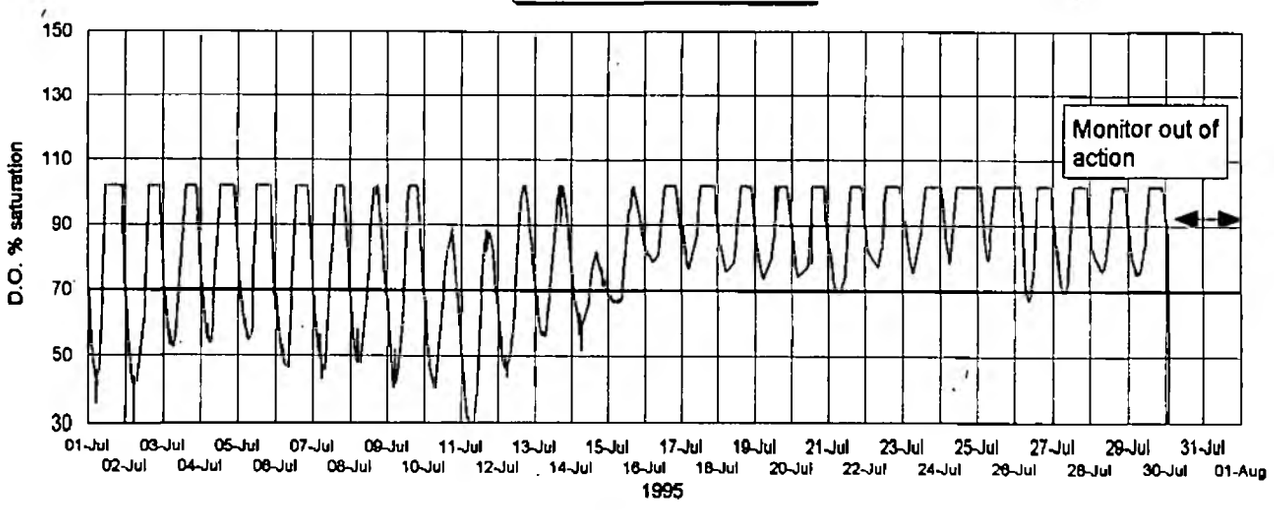
No validation data available for this month. Use data as indication of trend only.

Key

——— Environmental Quality Standard

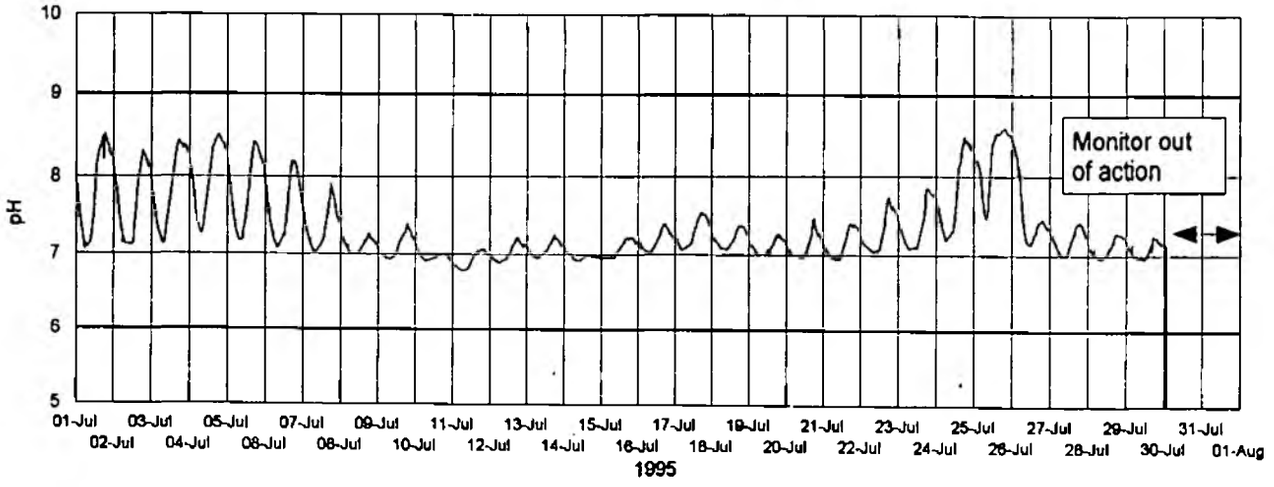
River Torridge July 1995
Beam Bridge

D.O. % saturation July 1995



No validation data available for this month. Use data as indication of trend only.

pH July 1995



No validation data available for this month. Use data as indication of trend only.

Key

——— Environmental Quality Standard

River Torridge August 1995
Beam Bridge

Monitor out of action all month

River Torridge September 1995
Beam Bridge

Monitor out of action all month

River Torridge October 1995
Beam Bridge

Monitor out of action all month

River Torridge November 1995
Beam Bridge

Monitor out of action all month

River Torridge December 1995
Beam Bridge

Monitor out of action all month

River Torridge January 1996
Beam Bridge

Monitor out of action all month

River Torridge February 1996
Beam Bridge

Monitor out of action all month

River Torridge March 1996
Beam Bridge

Monitor out of action all month

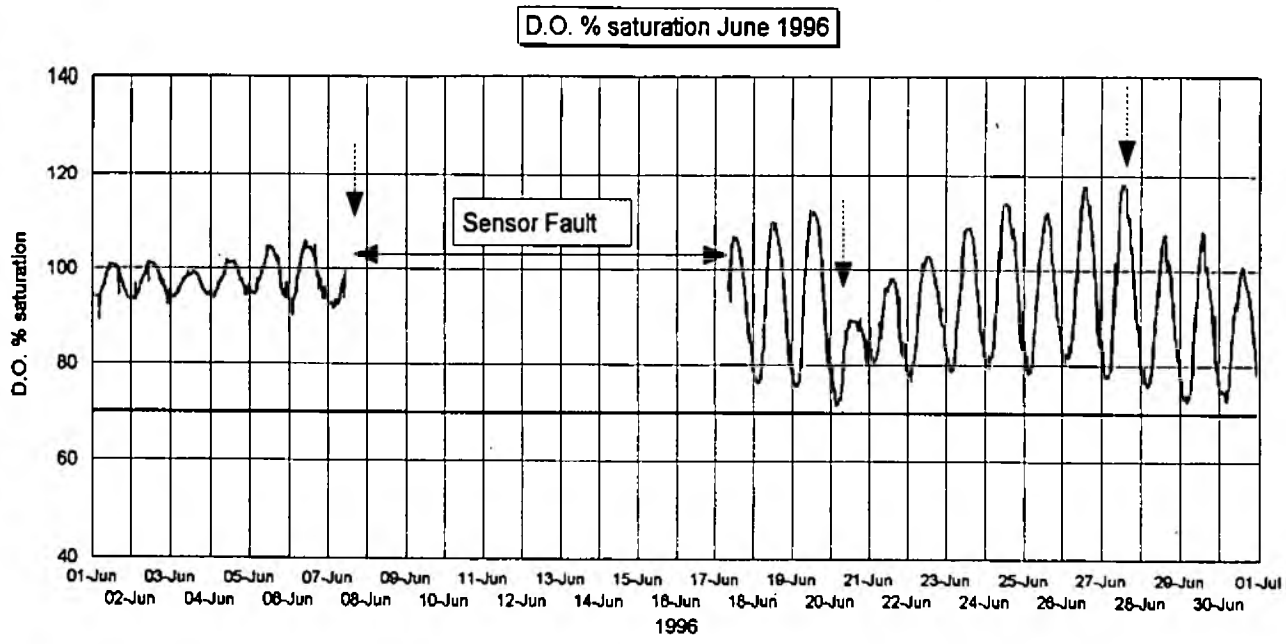
River Torridge April 1996
Beam Bridge

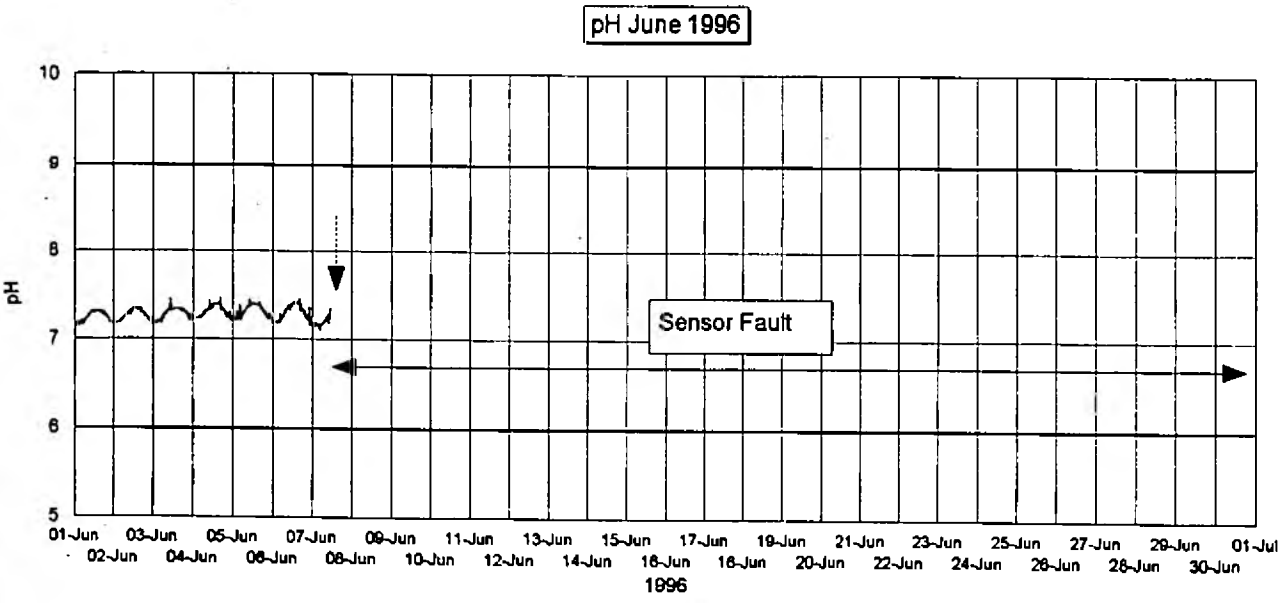
Monitor out of action all month

River Torridge May 1996
Beam Bridge

Monitor out of action all month

River Torridge June 1996
Beam Bridge





Dissolved Oxygen % saturation

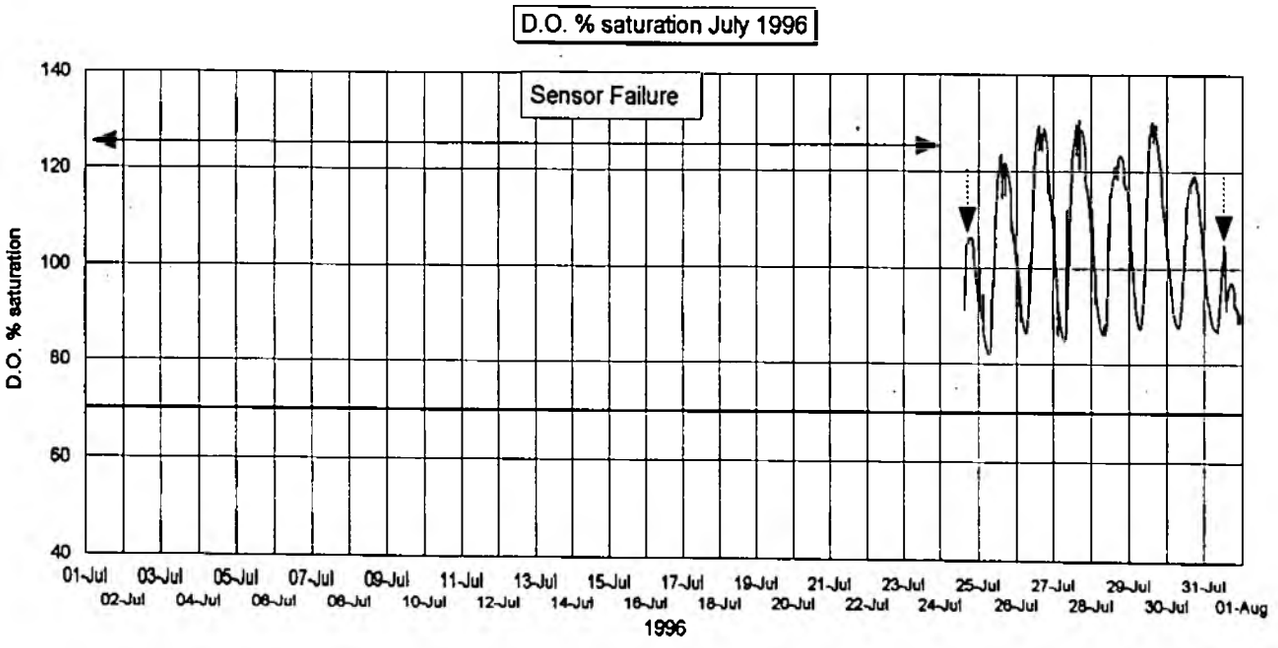
Number of readings	1926
Maximum	118.41
Minimum	71.41
Mean	93.81
Standard Deviation	10.35
No. exceeding DoE criteria	0

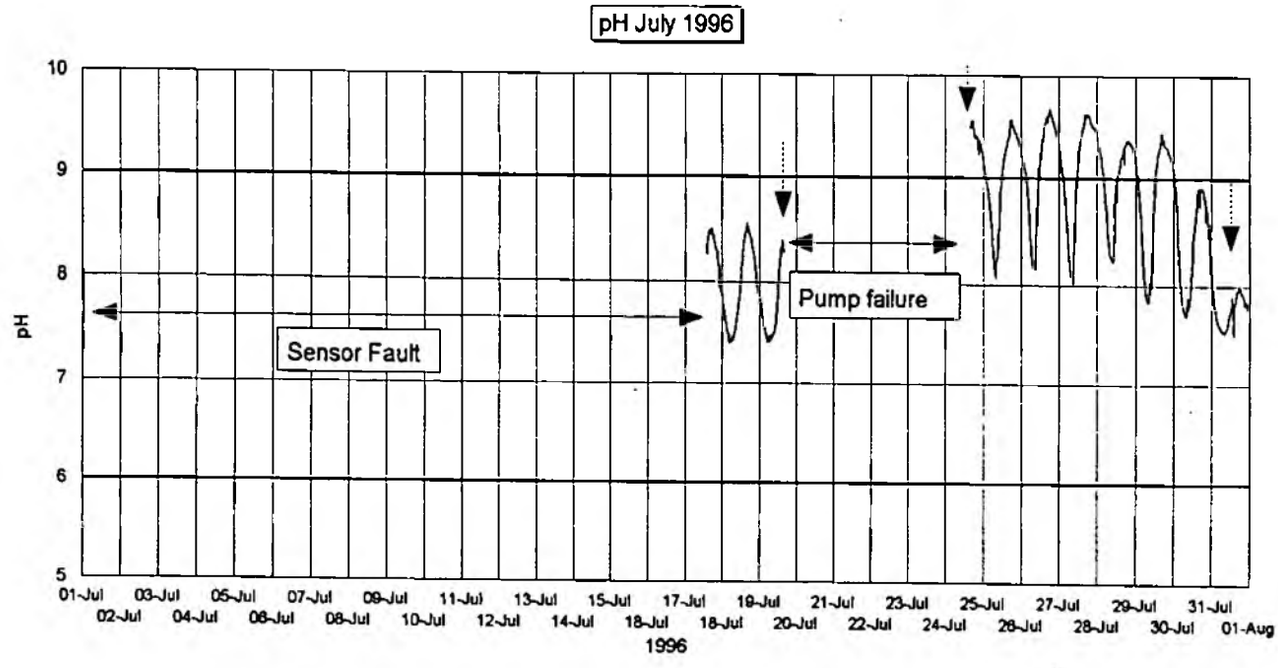
Key

Environmental Quality Standard

Celibration

River Torridge July 1996
Beam Bridge





Dissolved Oxygen % saturation

Number of readings	711
Maximum	130.88
Minimum	81.97
Mean	105.01
Standard Deviation	14.17
No. exceeding DoE criteria	0

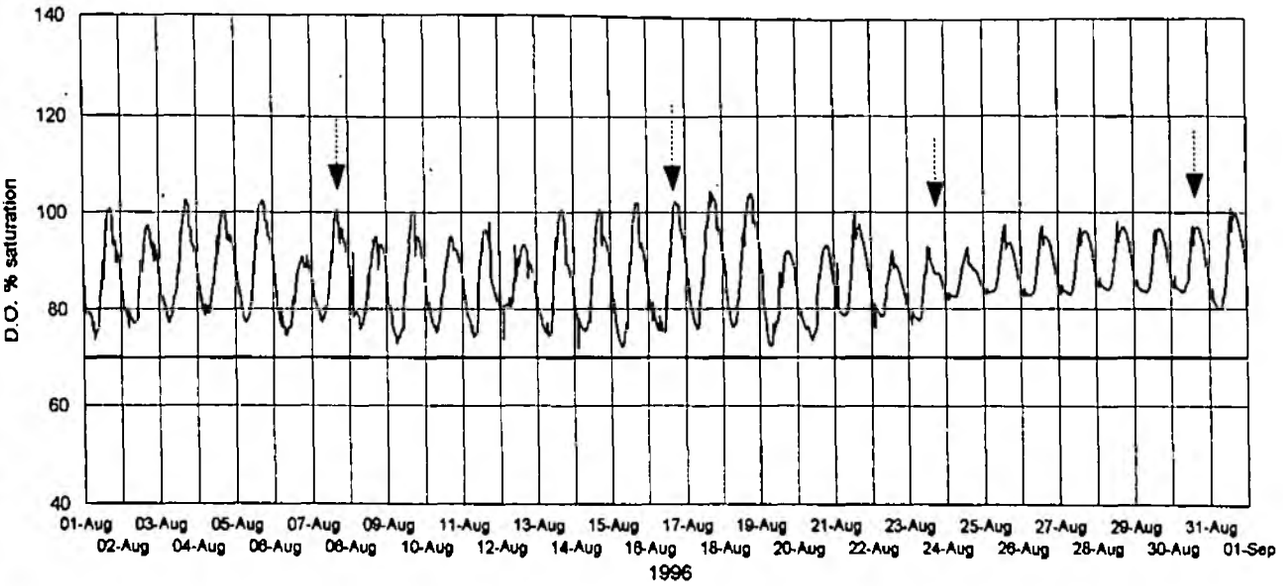
Key

Environmental Quality Standard

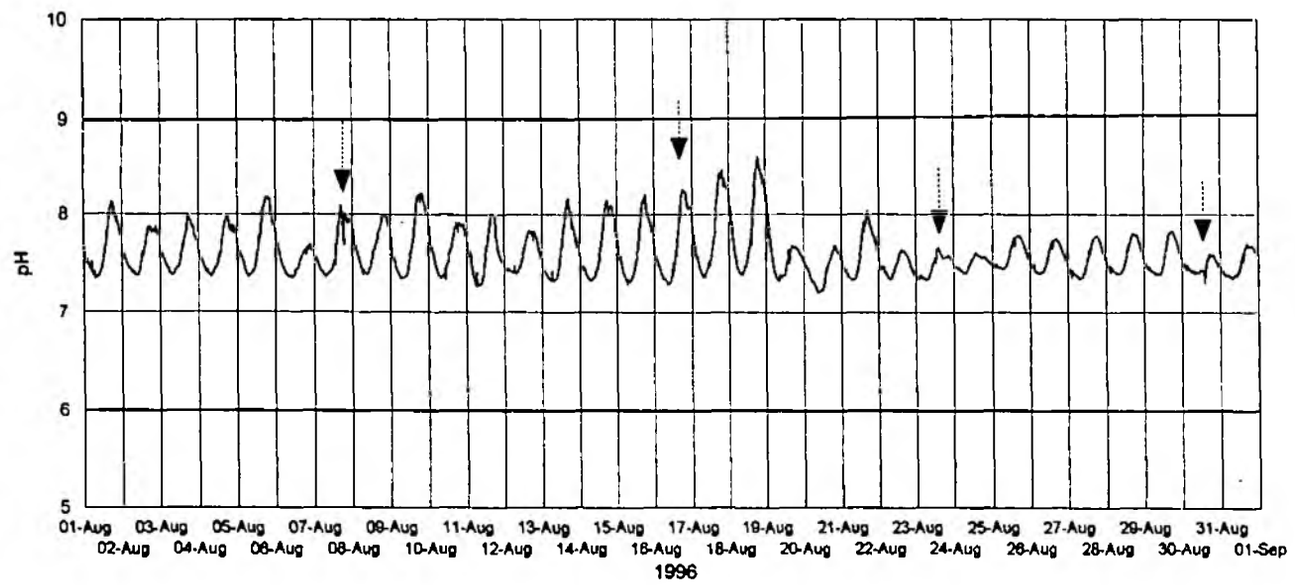
Calibration

River Torridge August 1996
Beam Bridge

D.O. % saturation August 1996



pH August 1996



Dissolved Oxygen % saturation

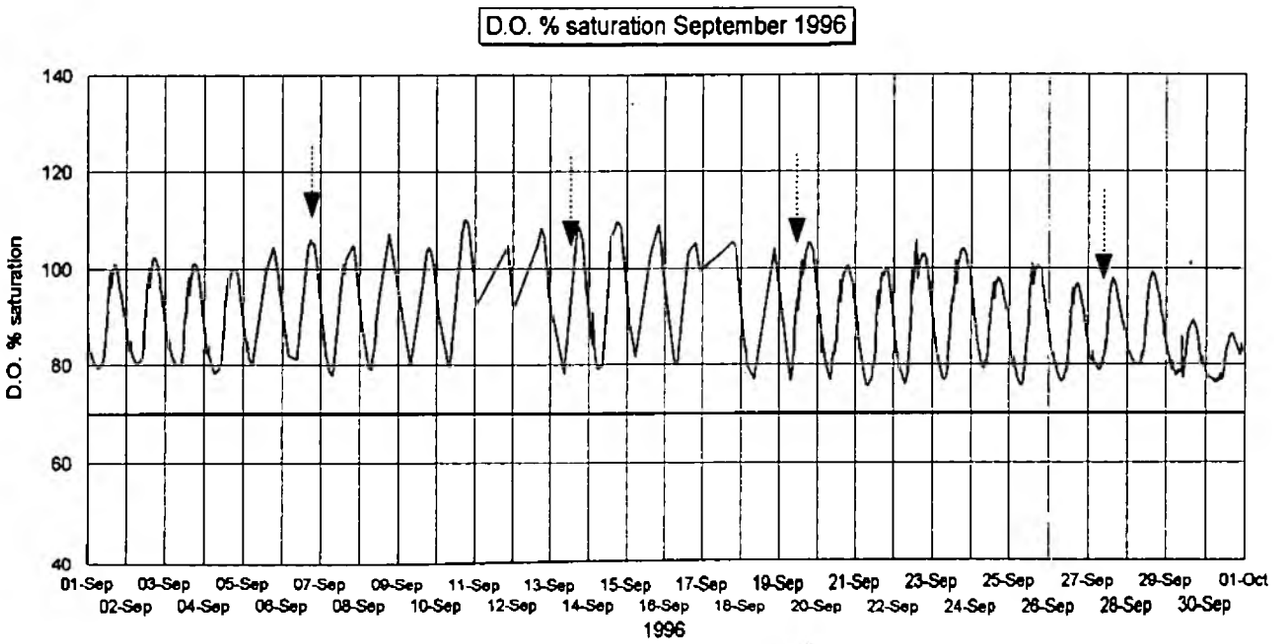
Number of readings	2955
Maximum	104.42
Minimum	71.67
Mean	86.91
Standard Deviation	7.46
No. exceeding DoE criteria	0

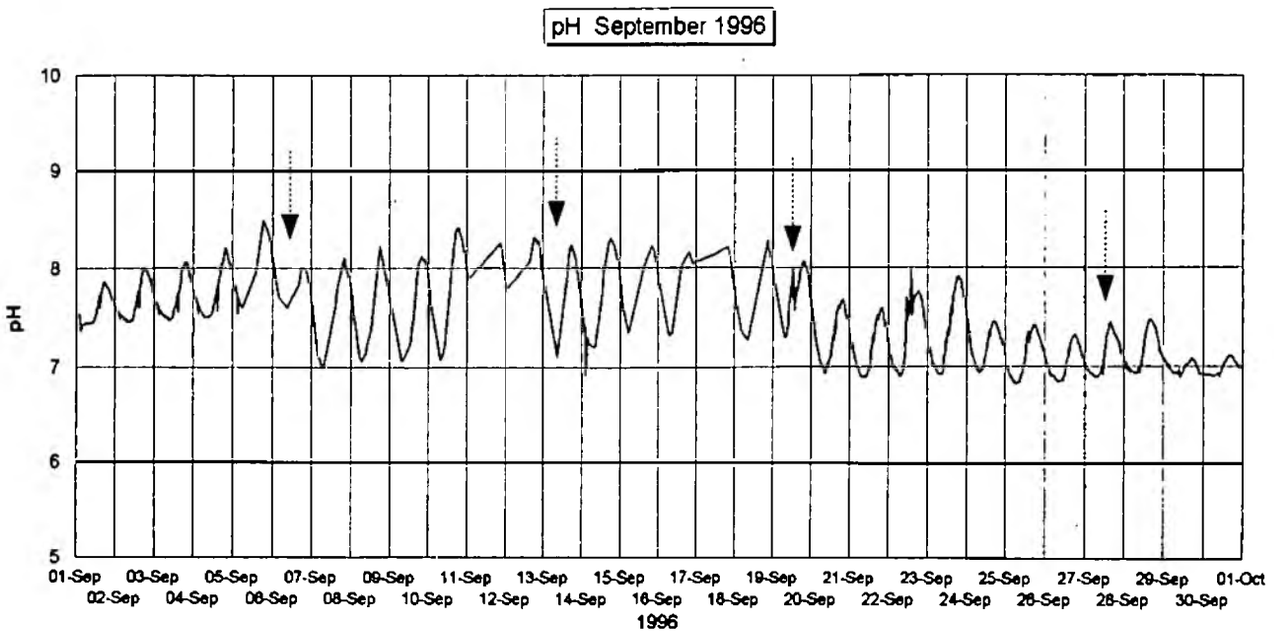
Key

Environmental Quality Standard

Calibration

River Torridge September 1996
Beam Bridge





Dissolved Oxygen % saturation

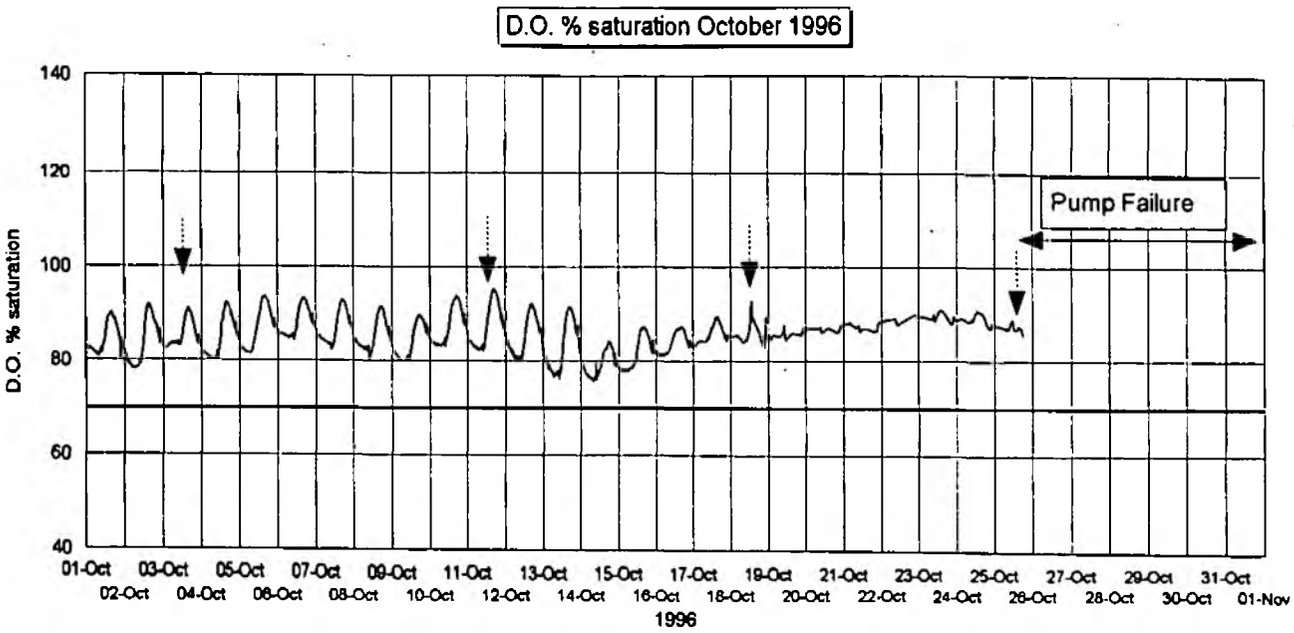
Number of readings	1760
Maximum	110.21
Minimum	75.55
Mean	89.27
Standard Deviation	9.02
No. exceeding DoE criteria	0

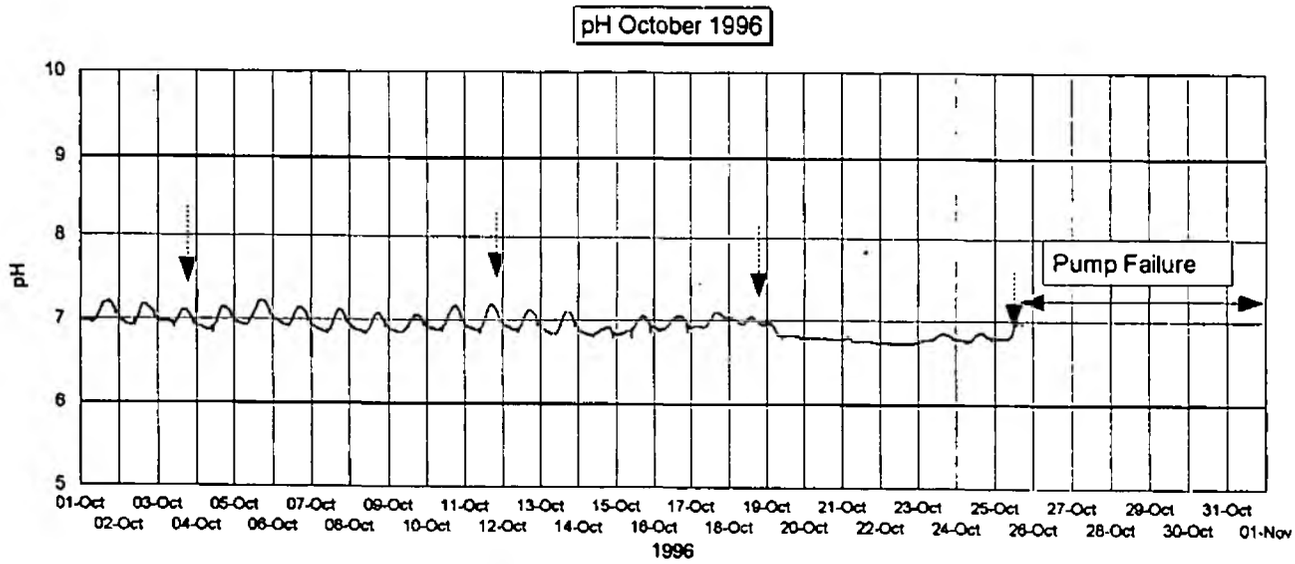
Key

Environmental Quality Standard

Calibration

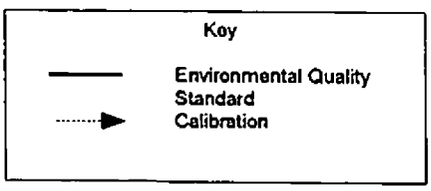
River Torridge October 1996
Beam Bridge



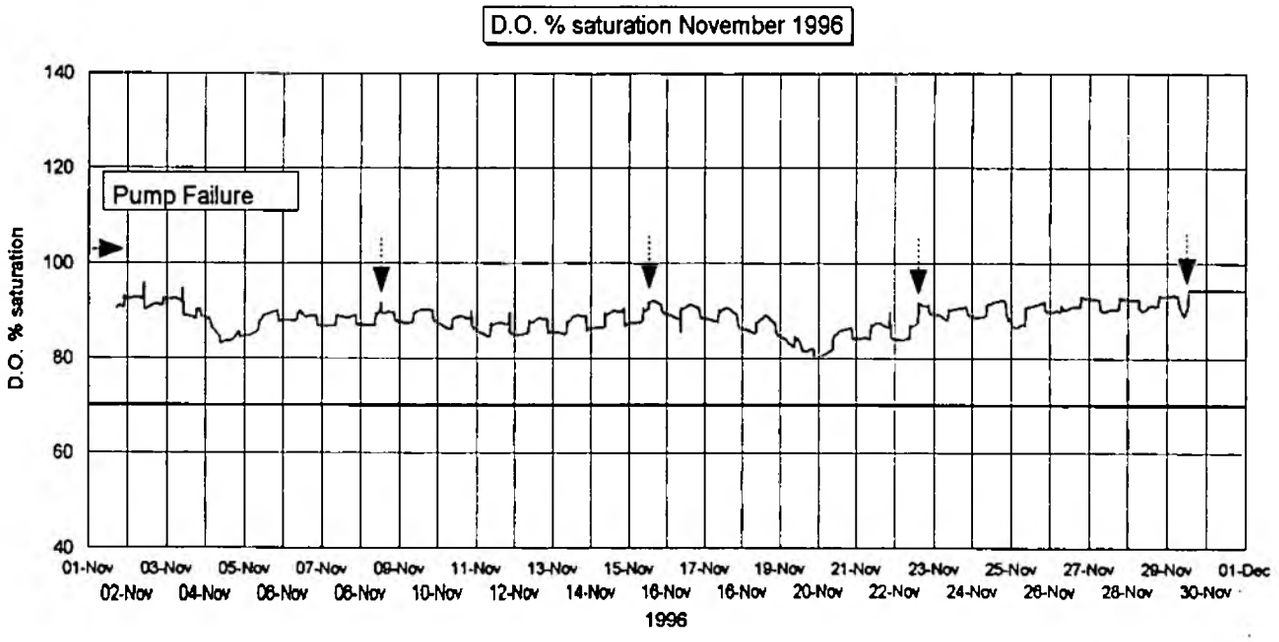


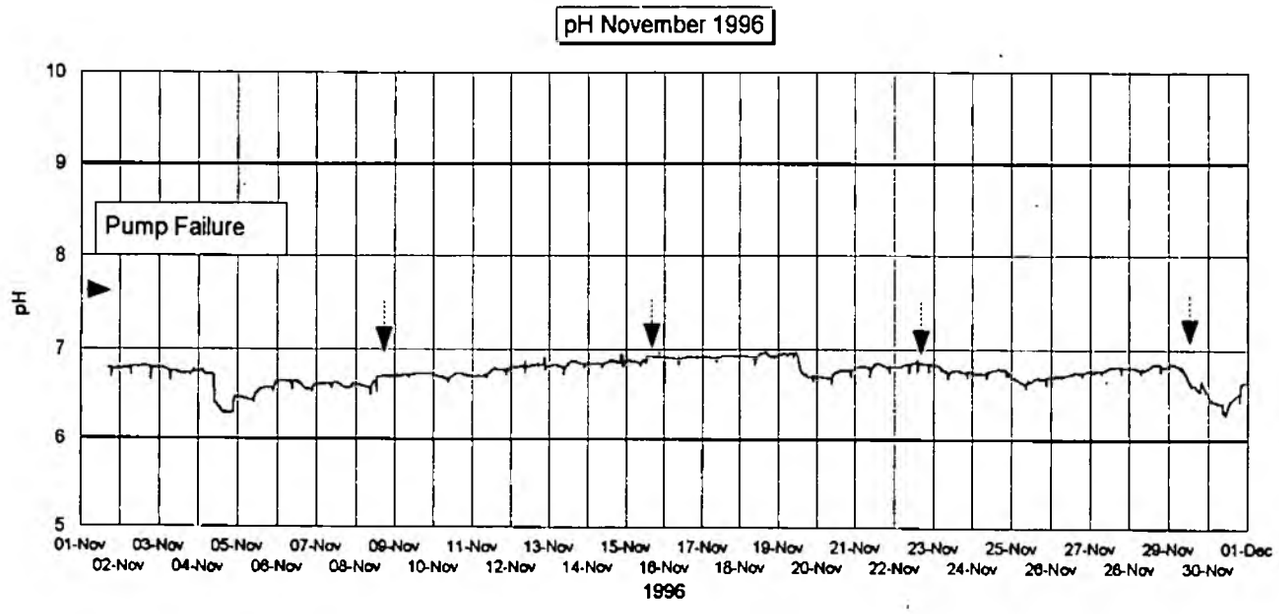
Dissolved Oxygen % saturation

Number of readings	2248
Maximum	95.52
Minimum	75.55
Mean	85.77
Standard Deviation	3.93
No. exceeding DoE criteria	0



River Torridge November 1996
Beam Bridge





Dissolved Oxygen % saturation

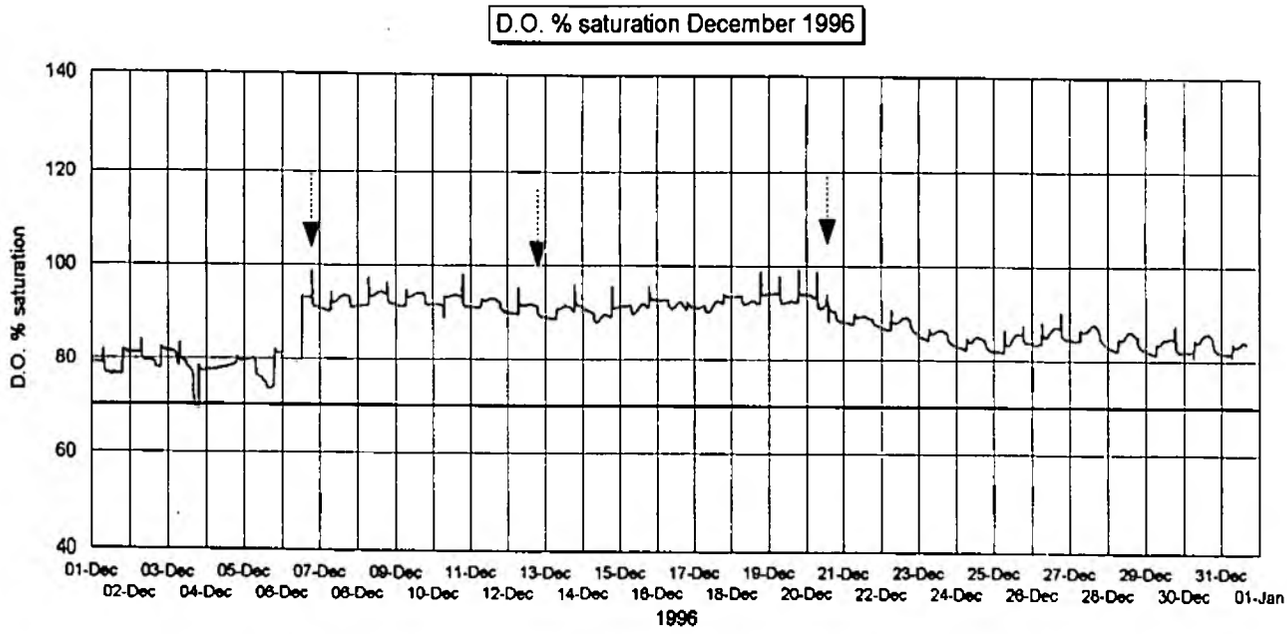
Number of readings	2774
Maximum	95.96
Minimum	79.62
Mean	88.74
Standard Deviation	3.04
No. exceeding DoE criteria	0

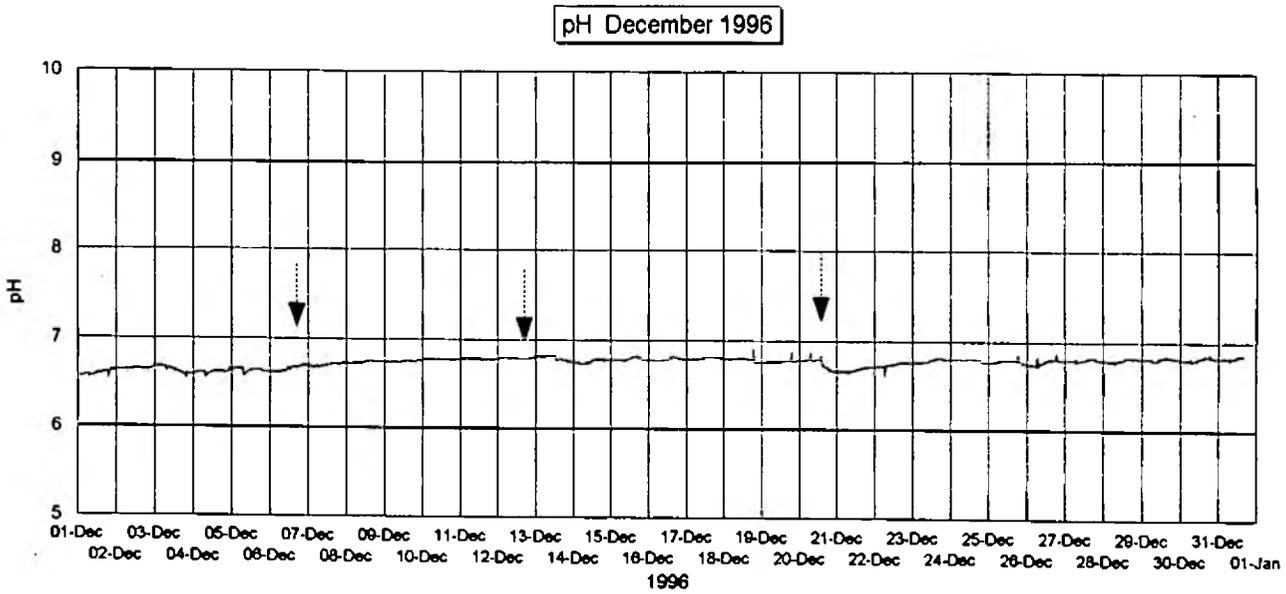
Key

Environmental Quality Standard

Calibration

River Torridge December 1996
Beam Bridge





Dissolved Oxygen % saturation

Number of readings	2936
Maximum	99.33
Minimum	69
Mean	87.06
Standard Deviation	5.37
No. exceeding DoE criteria	0

Key

Environmental Quality Standard

Calibration

CONTINUOUS WATER QUALITY MONITORING
COCKSHILHAY 1996

River Torridge January 1996
Cockshilhay

Monitor out of action all month

River Torridge February 1996
Cockshilhay

Monitor out of action all month

River Torridge March 1996
Cockshilhay

Monitor out of action all month

River Torridge April 1996
Cockshilhay

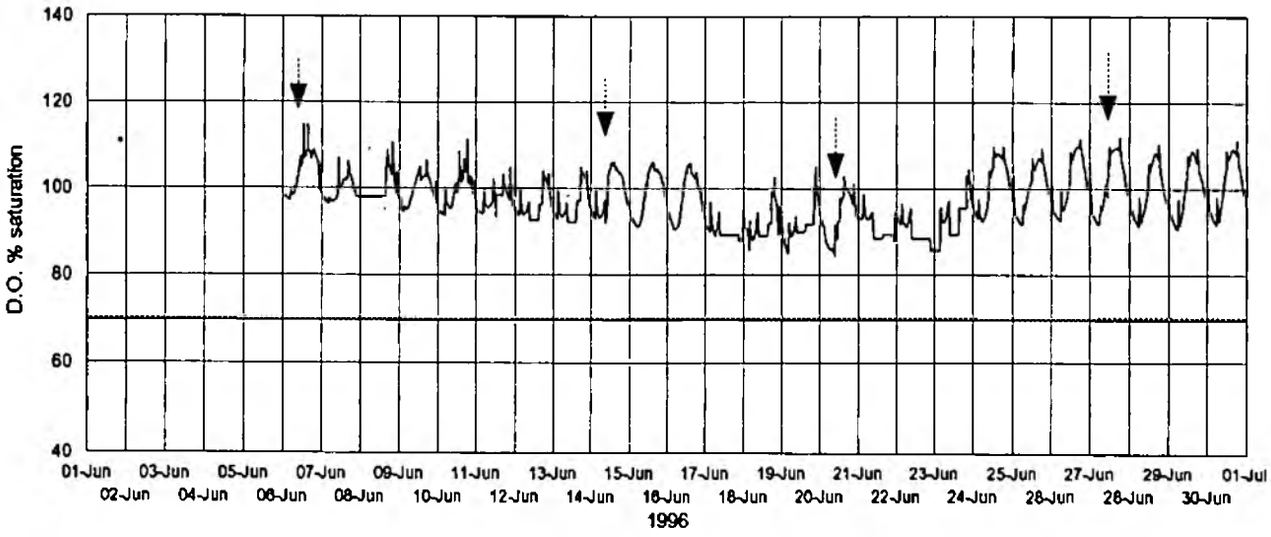
Monitor out of action all month

River Torridge May 1996
Cockshilhay

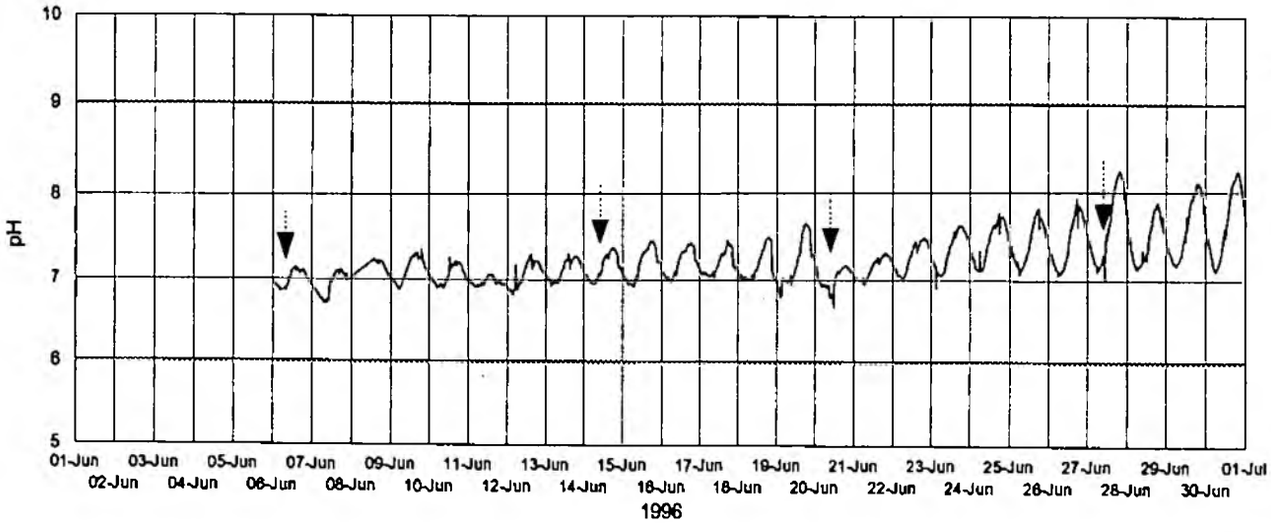
Monitor out of action all month

River Torridge June 1996
Cockshilhay

D.O. % saturation June 1996



pH June 1996



Dissolved Oxygen % saturation

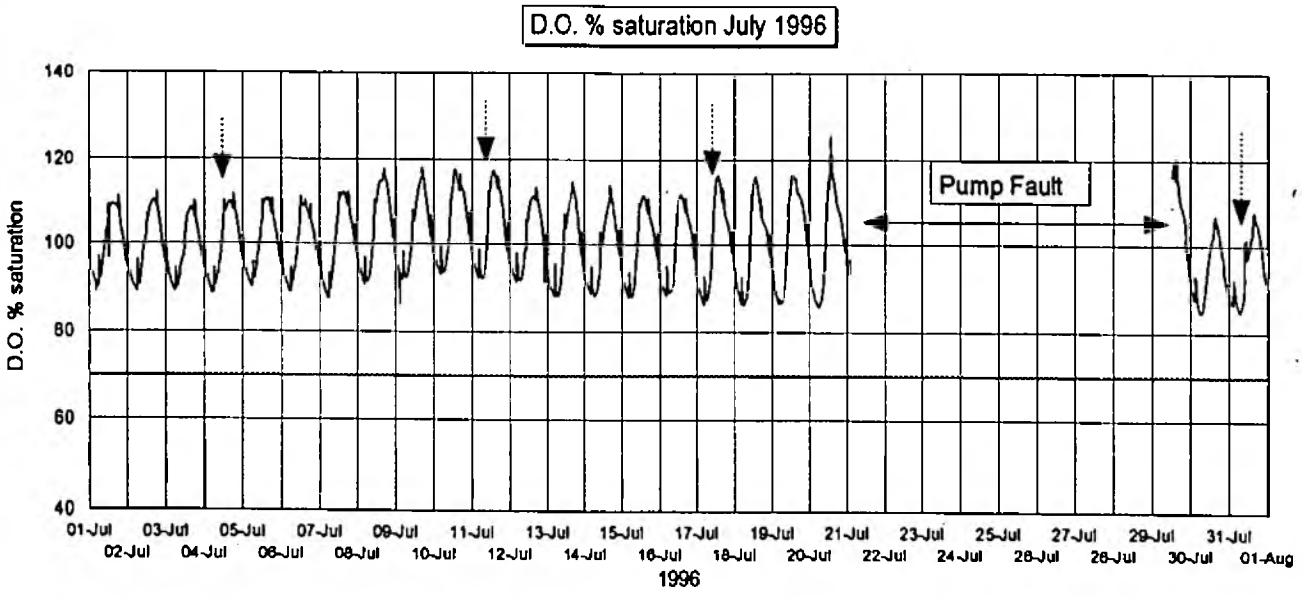
Number of readings	2220
Maximum	114.77
Minimum	84.39
Mean	97.17
Standard Deviation	6.13
No. exceeding DoE criteria	0

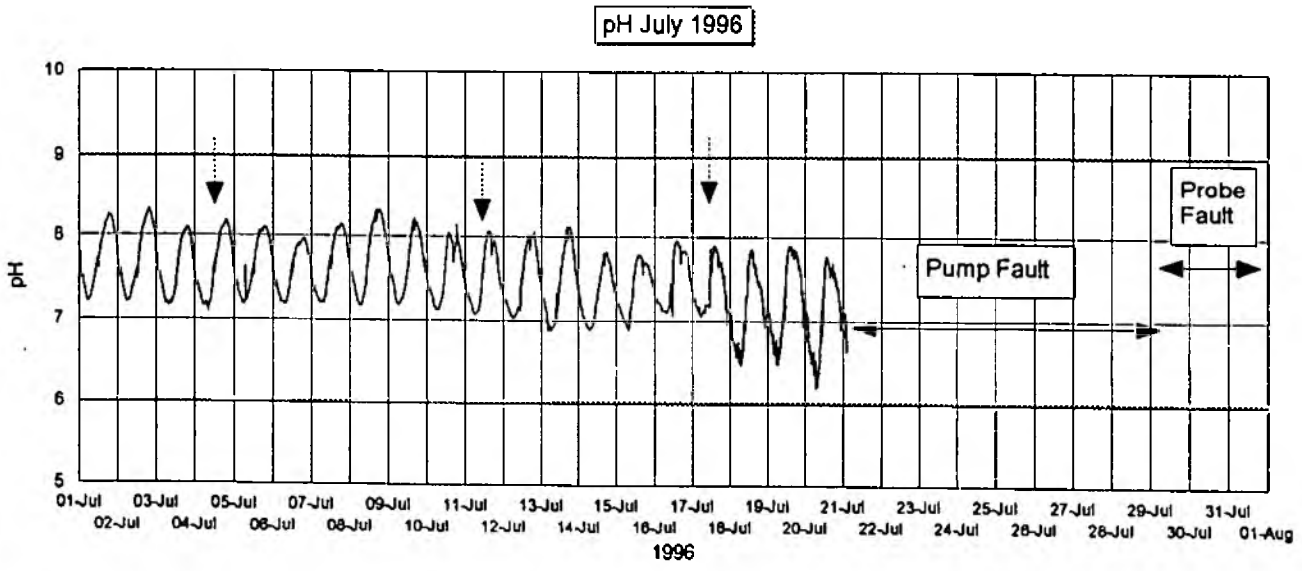
Key

Environmental Quality Standard

Calibration

River Torridge July 1996
Cockshilhay





Dissolved Oxygen % saturation

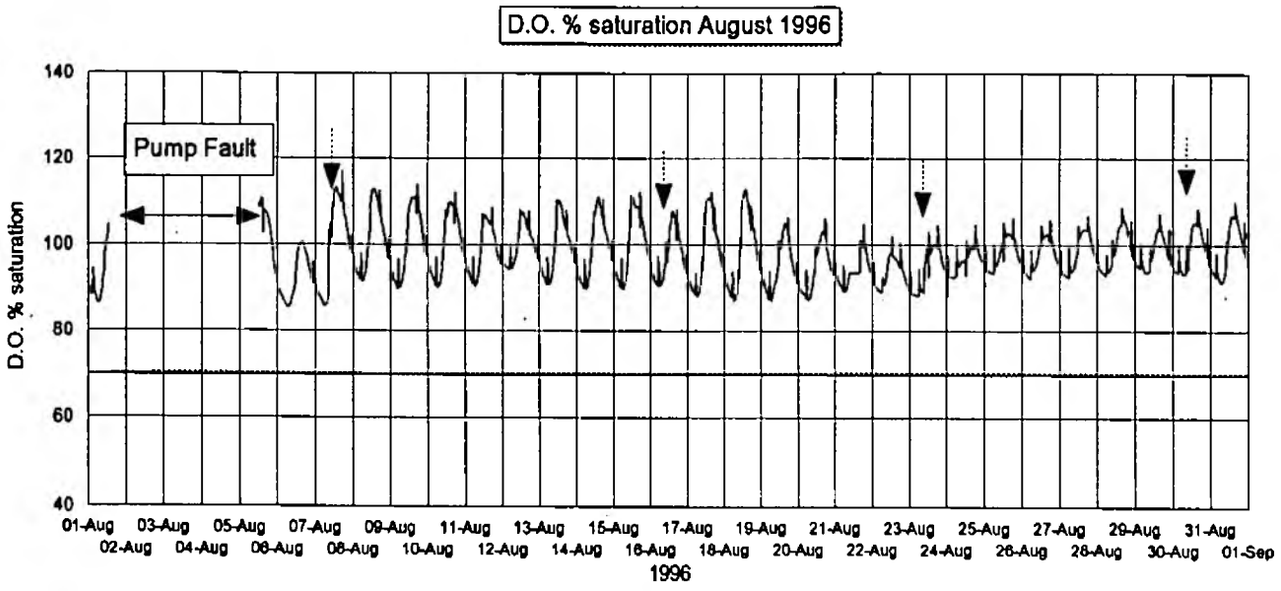
Number of readings	2140
Maximum	125.75
Minimum	84.88
Mean	100.45
Standard Deviation	8.81
No. exceeding DoE criteria	0

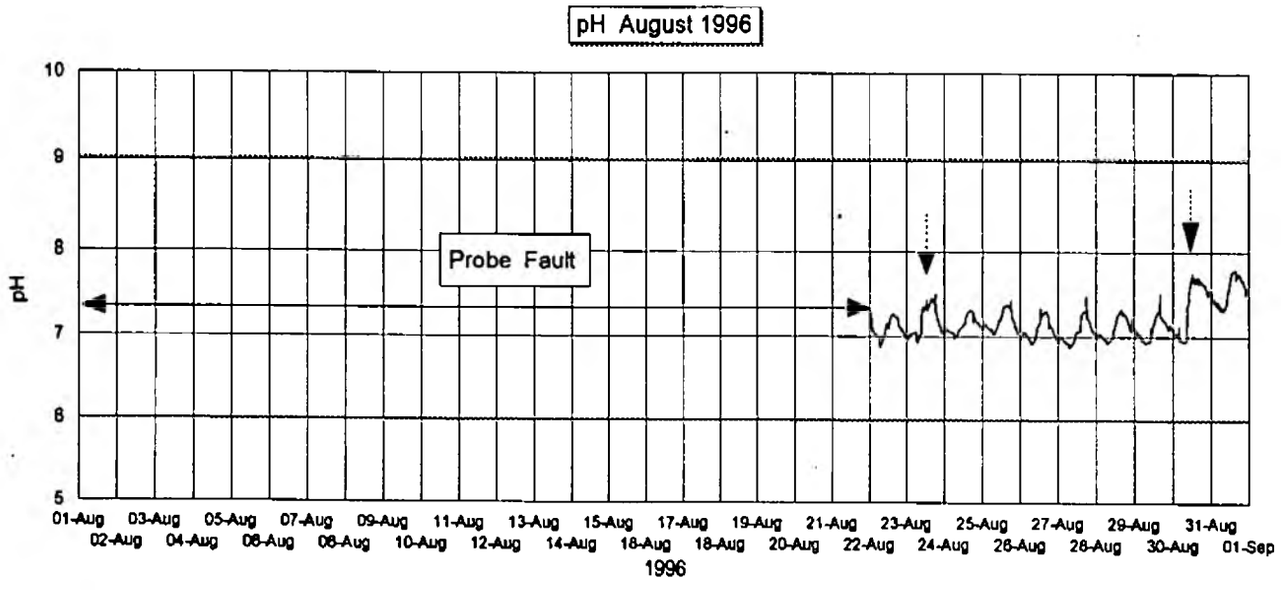
Key

Environmental Quality Standard

Calibration

River Torridge August 1996
Cockshilhay





Dissolved Oxygen % saturation

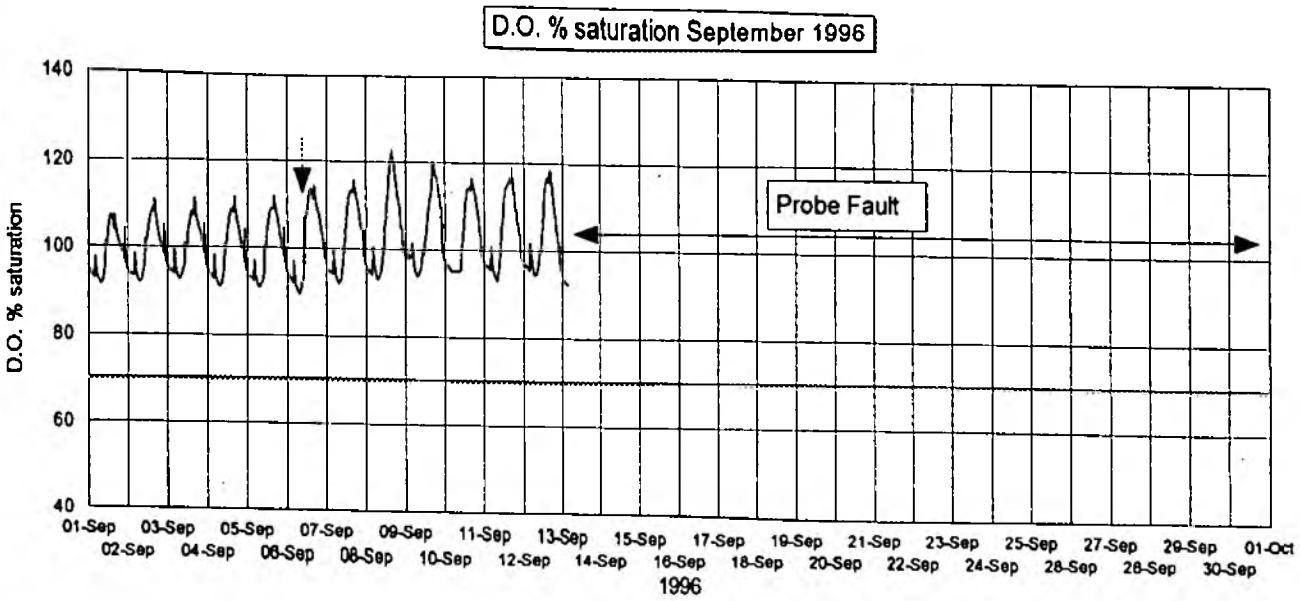
Number of readings	2579
Maximum	116.97
Minimum	85.43
Mean	97.86
Standard Deviation	6.38
No. exceeding DoE criteria	0

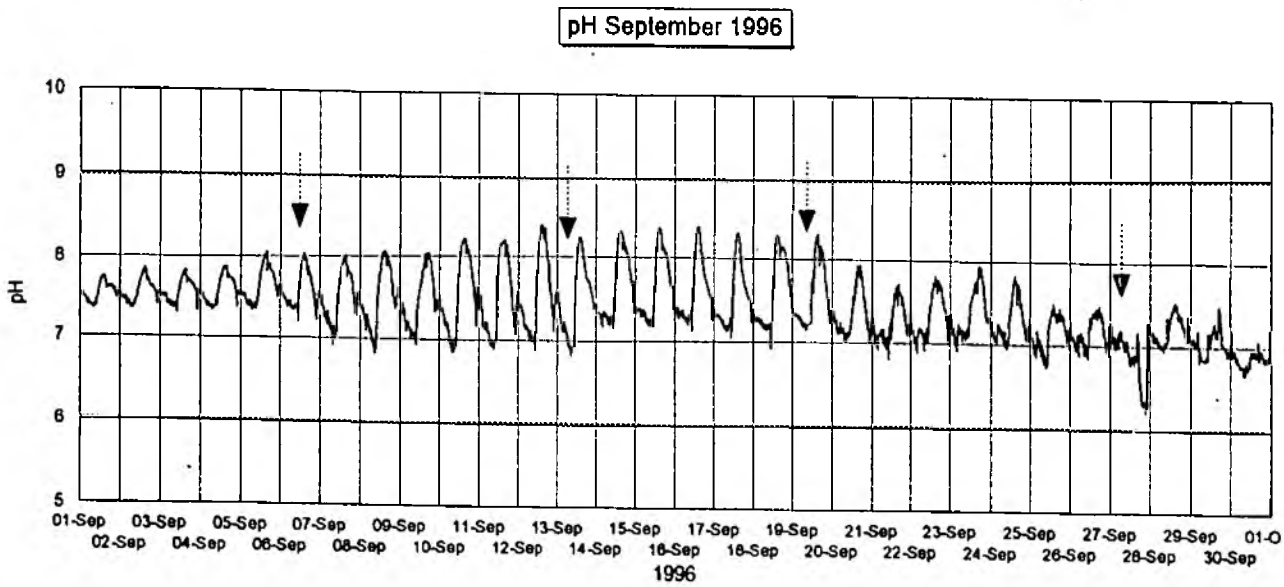
Key

Environmental Quality Standard

Calibration

River Torridge September 1996
Cockshilhay





Dissolved Oxygen % saturation

Number of readings	1157
Maximum	122.82
Minimum	89.4
Mean	101.43
Standard Deviation	7.76
No. exceeding DoE criteria	0

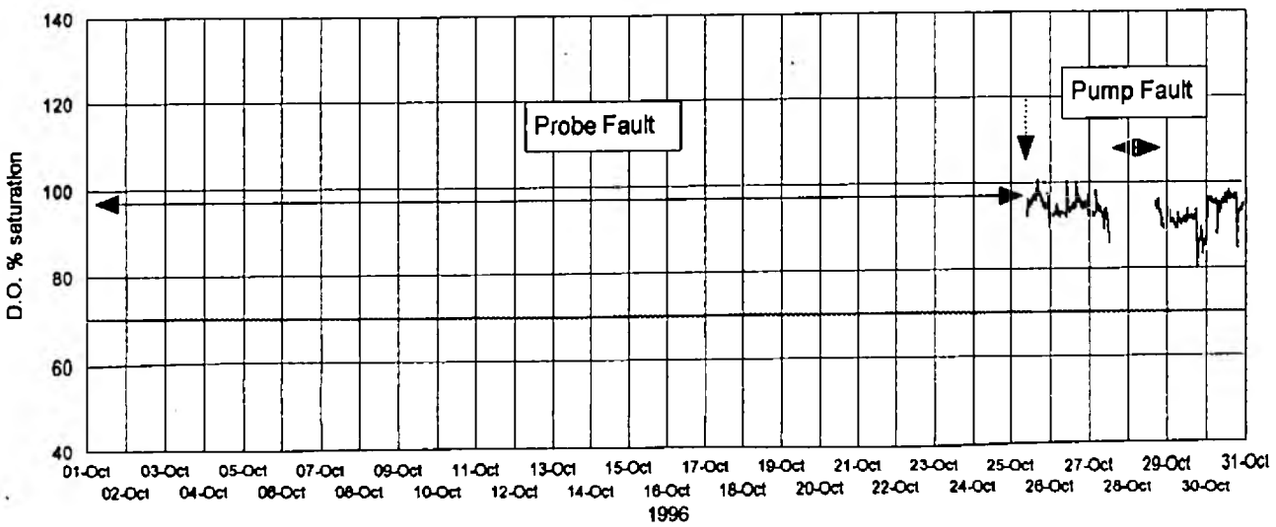
Key

Environmental Quality Standard

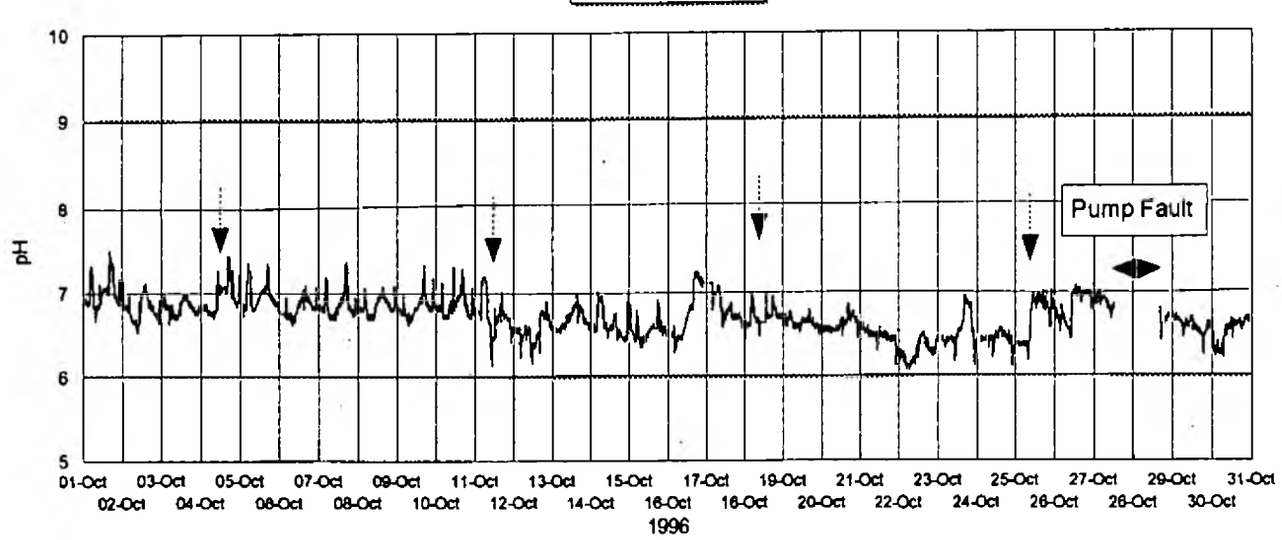
Calibration

River Torridge October 1996
Cockshilhay

D.O. % saturation October 1996



pH October 1996



Dissolved Oxygen % saturation

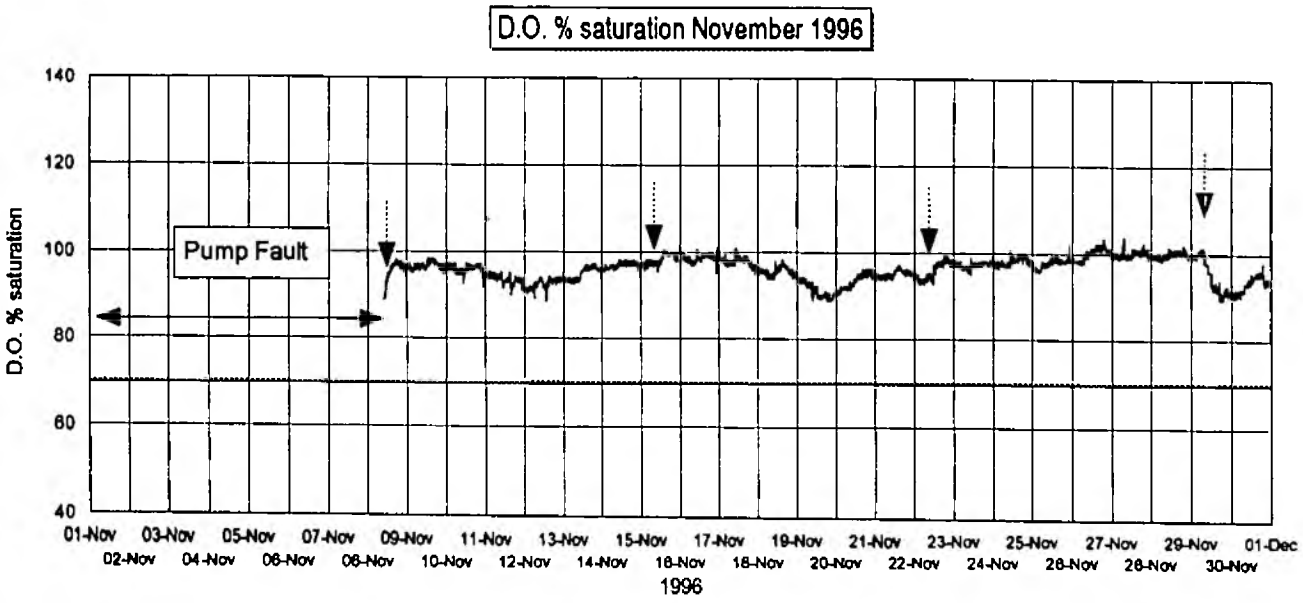
Number of readings	1099
Maximum	100.74
Minimum	80
Mean	93.49
Standard Deviation	2.84
No. exceeding DoE criteria	0

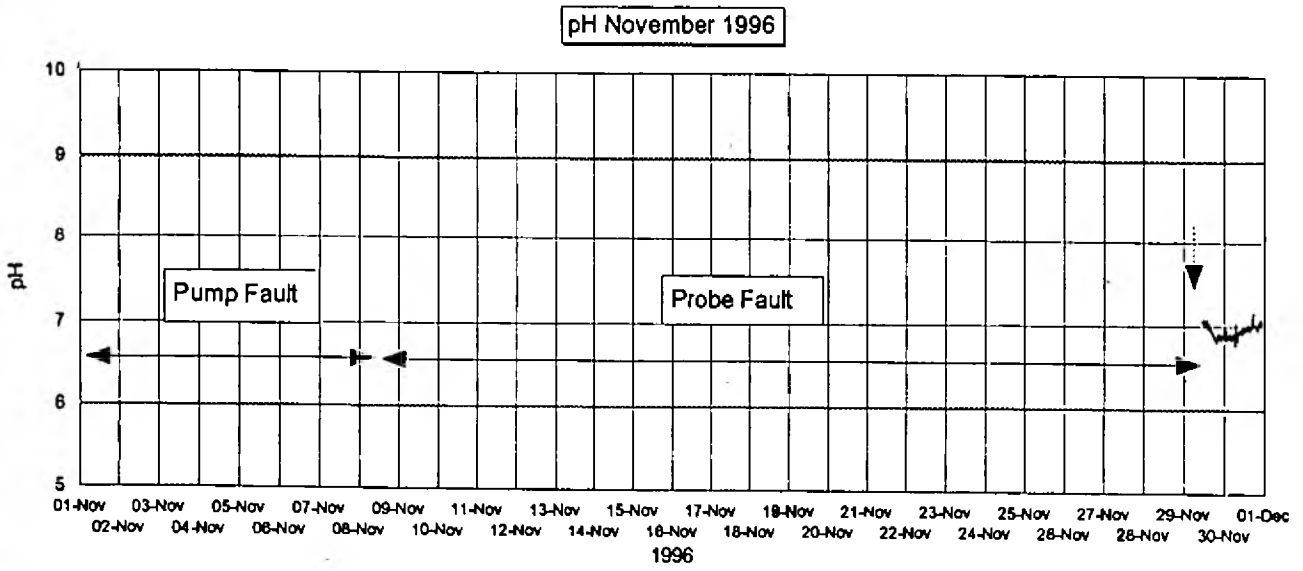
Key

Environmental Quality Standard

Calibration

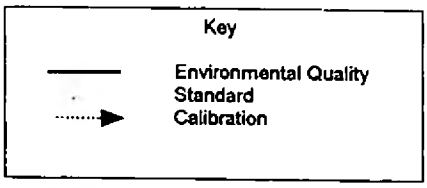
River Torridge November 1996
Cockshilhay



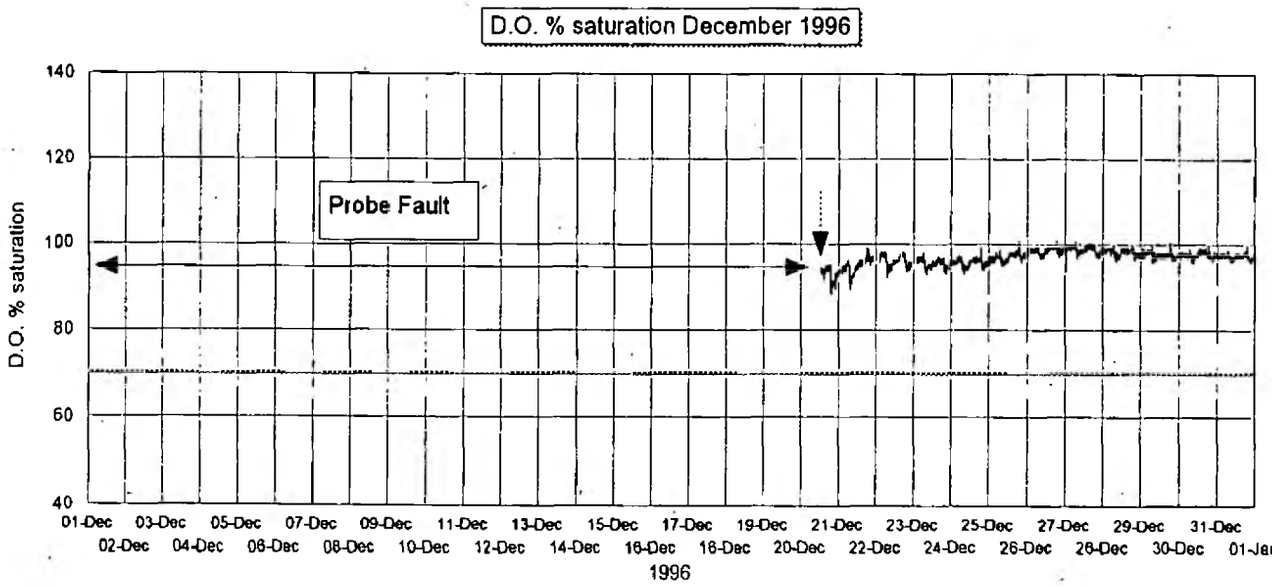


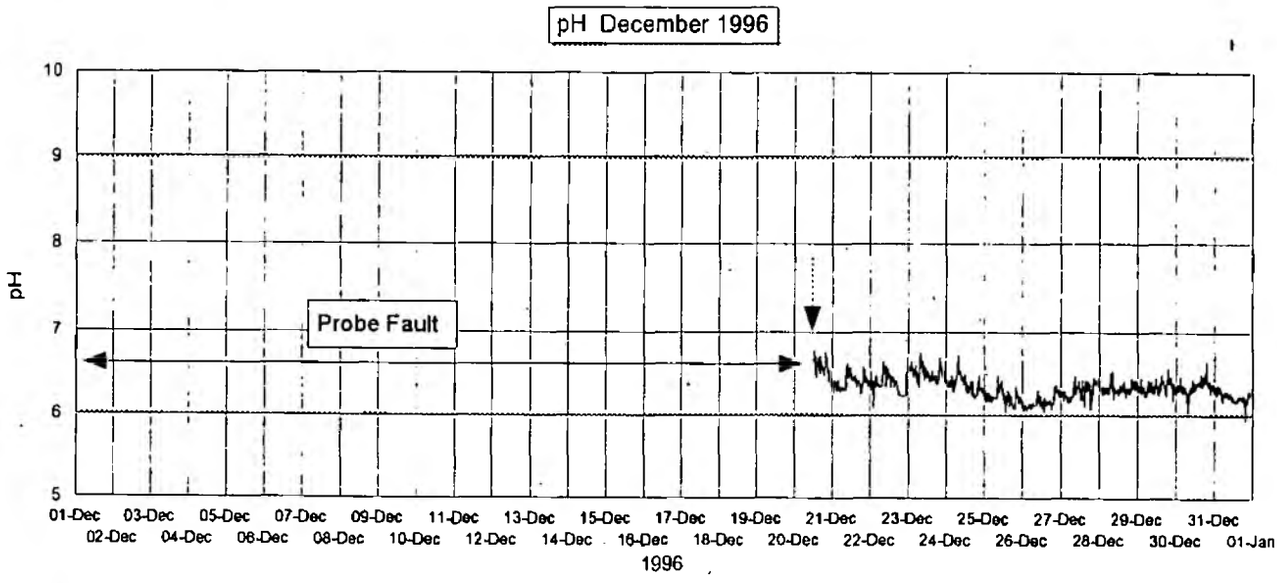
Dissolved Oxygen % saturation

Number of readings	2168
Maximum	103.67
Minimum	88.66
Mean	96.29
Standard Deviation	2.85
No. exceeding DoE criteria	0



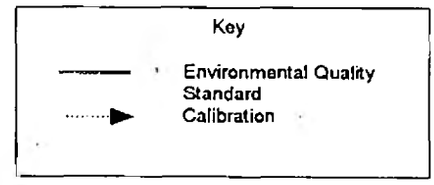
River Torridge December 1996
Cockshilhay





Dissolved Oxygen % saturation

Number of readings	1100
Maximum	101.05
Minimum	88.12
Mean	96.89
Standard Deviation	1.89
No. exceeding DoE criteria	0



APPENDIX II

Meteorburst Beam Bridge August 1996

Where possible major spikes due to interference / cleaning cycles have been removed

Time	Date	Date	EQS	RE2			DO %	Temp °C	pH	NTU	Total NH3 mg/l	Cond. µS/cm
00:01	01-Aug-96	35278	70	0.6	9	6	85.98	16.7	7.64	16.69	0.06	215.43
00:15	01-Aug-96	35278.01	70	0.6	9	6	85.15	16.74	7.62	16.56	0.04	216.06
00:30	01-Aug-96	35278.02	70	0.6	9	6	84.58	16.48	7.61	16.56	0.04	216.06
00:45	01-Aug-96	35278.03	70	0.6	9	6	79.05	16.63	7.58	17.33	0.04	216.06
01:00	01-Aug-96	35278.04	70	0.6	9	6	80.06	16.47	7.58	16.35	0.04	216.38
01:15	01-Aug-96	35278.05	70	0.6	9	6	81.08	16.48	7.55	16.44	0.04	216.69
01:30	01-Aug-96	35278.06	70	0.6	9	6	80.51	16.41	7.54	16.3	0.04	216.69
01:45	01-Aug-96	35278.07	70	0.6	9	6	80.38	16.18	7.52	16.22	0.04	216.69
02:00	01-Aug-96	35278.08	70	0.6	9	6	79.68	16.22	7.51	16.1	0.05	217.01
02:15	01-Aug-96	35278.09	70	0.6	9	6	80.06	16.15	7.5	16.03	0.05	217.01
02:30	01-Aug-96	35278.1	70	0.6	9	6	79.87	16.22	7.49	15.97	0.04	217.33
02:45	01-Aug-96	35278.11	70	0.6	9	6	79.68	16.13	7.48	15.96	0.05	217.33
03:00	01-Aug-96	35278.13	70	0.6	9	6	79.56	16.16	7.47	15.91	0.04	217.65
03:15	01-Aug-96	35278.14	70	0.6	9	6	79.3	16.12	7.46	15.83	0.05	217.65
03:30	01-Aug-96	35278.15	70	0.6	9	6	78.92	16.03	7.46	15.86	0.04	217.96
03:45	01-Aug-96	35278.16	70	0.6	9	6	79.11	15.94	7.45	15.83	0.05	218.28
04:00	01-Aug-96	35278.17	70	0.6	9	6	79.3	15.89	7.44	15.77	0.04	217.96
04:15	01-Aug-96	35278.18	70	0.6	9	6	79.05	16.04	7.43	15.71	0.05	218.28
04:30	01-Aug-96	35278.19	70	0.6	9	6	78.73	16.03	7.52	15.71	0.05	218.28
04:45	01-Aug-96	35278.2	70	0.6	9	6	78.47	15.33	7.43	15.77	0.04	216.06
05:00	01-Aug-96	35278.21	70	0.6	9	6	77.58	15.28	7.41	15.71	0.04	217.01
05:15	01-Aug-96	35278.22	70	0.6	9	6	76.63	15.14	7.39	15.77	0.04	217.33
05:30	01-Aug-96	35278.23	70	0.6	9	6	76.95	15.24	7.4	16.94	0.04	217.33
05:45	01-Aug-96	35278.24	70	0.6	9	6	76.25	15.1	7.39	15.88	0.04	217.01
06:00	01-Aug-96	35278.25	70	0.6	9	6	75.74	15.14	7.4	15.86	0.05	216.69
06:15	01-Aug-96	35278.26	70	0.6	9	6	75.29	15.07	7.38	15.94	0.04	216.38
06:30	01-Aug-96	35278.27	70	0.6	9	6	77.33	15.07	7.43	15.94	0.04	216.38
06:45	01-Aug-96	35278.28	70	0.6	9	6	73.7	15.14	7.35	17.34	0.05	215.74
07:00	01-Aug-96	35278.29	70	0.6	9	6	74.09	15.01	7.37	16.27	0.04	215.74
07:15	01-Aug-96	35278.3	70	0.6	9	6	74.59	15.01	7.37	16.1	0.05	215.74
07:30	01-Aug-96	35278.31	70	0.6	9	6	75.17	15.22	7.38	16.22	0.04	215.43
07:45	01-Aug-96	35278.32	70	0.6	9	6	74.85	15.24	7.37	16.44	0.04	215.11
08:00	01-Aug-96	35278.33	70	0.6	9	6	75.29	15.18	7.37	16.36	0.04	215.11
08:15	01-Aug-96	35278.34	70	0.6	9	6	75.1	15.28	7.37	16.39	0.04	215.11
08:30	01-Aug-96	35278.35	70	0.6	9	6	75.48	15.18	7.37	16.3	0.05	214.79
08:45	01-Aug-96	35278.36	70	0.6	9	6	75.87	15.19	7.38	16.31	0.04	214.47
09:00	01-Aug-96	35278.38	70	0.6	9	6	75.87	15.04	7.37	16.38	0.04	214.79
09:15	01-Aug-96	35278.39	70	0.6	9	6	76.38	15.4	7.37	16.14	0.04	214.79
09:30	01-Aug-96	35278.4	70	0.6	9	6	78.16	15.39	7.39	16.45	0.04	214.79
09:45	01-Aug-96	35278.41	70	0.6	9	6	78.86	15.48	7.41	15.96	0.04	214.47
10:00	01-Aug-96	35278.42	70	0.6	9	6	79.94	15.57	7.42	15.97	0.07	214.79
10:15	01-Aug-96	35278.43	70	0.6	9	6	80.32	15.59	7.42	16.19	0.06	214.79
10:30	01-Aug-96	35278.44	70	0.6	9	6	81.78	15.72	7.44	16.08	0.05	214.79
10:45	01-Aug-96	35278.45	70	0.6	9	6	83.56	15.87	7.47	16.08	0.04	214.47
11:00	01-Aug-96	35278.46	70	0.6	9	6	83.69	15.8	7.47	16.21	0.05	214.16
11:15	01-Aug-96	35278.47	70	0.6	9	6	83.56	15.59	7.47	16.25	0.05	214.16
11:30	01-Aug-96	35278.48	70	0.6	9	6	86.17	15.92	7.51	16.17	0.05	214.79
11:45	01-Aug-96	35278.49	70	0.6	9	6	85.98	15.78	7.51	16.66	0.11	214.47
12:00	01-Aug-96	35278.5	70	0.6	9	6	88.59	16.16	7.56	16.28	0.07	215.74
12:15	01-Aug-96	35278.51	70	0.6	9	6	89.67	16.32	7.57	16.33	0.07	216.06
12:30	01-Aug-96	35278.52	70	0.6	9	6	88.27	16.56	7.59	16.33	0.05	216.06
12:45	01-Aug-96	35278.53	70	0.6	9	6	86.11	16.66	7.62	17.81	0.05	216.06
13:00	01-Aug-96	35278.54	70	0.6	9	6	88.78	16.92	7.65	20.79	0.05	217.33
13:15	01-Aug-96	35278.55	70	0.6	9	6	90.94	17.26	7.68	16.83	0.05	217.33
13:30	01-Aug-96	35278.56	70	0.6	9	6	92.08	17.49	7.7	16.92	0.05	217.01
13:45	01-Aug-96	35278.57	70	0.6	9	6	92.02	17.14	7.7	17.08	0.05	216.38
14:00	01-Aug-96	35278.58	70	0.6	9	6	94.5	17.59	7.78	17.01	0.05	217.96
14:15	01-Aug-96	35278.59	70	0.6	9	6	95.77	17.56	7.83	17.14	0.05	218.6
14:30	01-Aug-96	35278.6	70	0.6	9	6	96.15	17.71	7.84	17.17	0.05	217.96
14:45	01-Aug-96	35278.61	70	0.6	9	6	97.24	17.76	7.89	17.26	0.05	218.6
15:00	01-Aug-96	35278.63	70	0.6	9	6	98.25	17.96	7.94	17.4	0.05	219.55
15:15	01-Aug-96	35278.64	70	0.6	9	6	98.7	18.17	7.97	17.47	0.05	219.55
15:30	01-Aug-96	35278.65	70	0.6	9	6	99.08	18.02	7.99	17.56	0.05	219.87
15:45	01-Aug-96	35278.66	70	0.6	9	6	99.72	18.22	8.03	17.73	0.05	220.19
16:00	01-Aug-96	35278.67	70	0.6	9	6	100.1	18.25	8.06	17.73	0.05	219.87