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PEARSON'S AND SCOTMAN'S FLASHES

A REVIEW OF WATER QUALITY 1996 to 1999

Distribution

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INTRODUCTION

Pearson's Flash and Scotman's Flash are two of many Flashes in the Wigan area and are a direct result of mining subsidence from Ince colliery (now disused).

Pearson's Flash attracts wildfowl and there has been recent landscaping of the old coal slag heaps that lie adjacent to the Flash. Bottom sediments comprise mainly of finely grained coal slag which provides little stable substrate for aquatic vegetation. Up until April 1998, Pearson's Flash inlet frequently received discharges from local storm tanks, even during dry periods. Improvements to the sewage works and connecting storm tanks were carried out in spring/summer 1998. Increased tank capacity should ensure that overflow incidences are now reduced to approximately four per annum.

Scotman's Flash is an intensively used recreation centre involving water contact sports. Periodically, the centre has had to be closed due to the presence of blue-green algae. Pearson's Flash drains into Scotman's Flash, as shown on the location map.

Water quality of Pearson's and Scotman's Flashes has been sampled and analysed by the Environment Agency since 1996. At each sampling site physico–chemical parameters (DO, temperature, pH, specific conductivity) were taken through the water column and samples of the surface and bottom waters were analysed for algal concentration and primary nutrients (N,P,S). Secchi disc transparency was also recorded.

During 1996 surveys, physico-chemical parameters were measured with a "Windermere Profiler". Specific conductivity measurements from this instrument are not considered representative of the Flash and so are not detailed here. From 1997, a "Hydrolab" sonde has been used on all surveys. It must also be noted that slight changes in analytical methods at Nottingham Laboratory may affect interpretation of any long term data set.

This report intends to provide a brief summary of water quality of the Flashes between 1996 and 1999, supporting individual survey reports (MSP-CME-96-02, 97-01, 97-03, 97-04, 98-03, 98-04, 98-05) that provide detailed accounts.

VISUAL OBSERVATIONS

An incident of sewage discharge during a dry weather period in May 1996 is highlighted by the low dissolved oxygen levels in Pearson's Flash, plus the high nutrient values in both Pearson's Flash and the inlet to Scotman's Flash. The survey in August 1997 appears to have been just after a sewage discharge as dissolved oxygen in the inlet was only 16 % saturation. This rose to 30 % mid way along the Flash and had reached 97 % at the outlet to Scotman's Flash. This gives a good example of how Pearson's Flash can be considered to act as a 'primary treatment pond' for sewage.

Since the reduction in storm overflow frequency, Pearson's Flash has visibly improved. Before improvements to the sewage works there was, on occasions, visible fungus growing in the channel and inlet water was a blue-grey colour. If disturbed, odour and bubbles rose from the black channel sediment and there was sewage litter on the sides.

After sewage works' improvements there was no longer obvious signs of sewage effluent. Inlet water was clearer and although channel sediment was still black, bank-side vegetation grew quickly and densely. During summer 1999, vegetation around the inlet channel had grown so much that safe access to the water was not possible. Weed density within the Flash also appears to have increased over the last two years, which may be attributed to water quality improvement.

In Scotman's Flash, aquatic vegetation has always been visible, particularly in summer months. However, 1999 surveys saw higher densities, and in July approximately over 80% of the waters surface was covered by floating mats.

Scotman's Flash is susceptible to annual blue-green algal blooms and 1996 was a particularly prolific year.

WATER COLUMN PROFILES

Pearson's Flash

Surveys of Pearson's Flash have shown that the water column does not stratify, principally due to its shallowness, maximum depth being 2 m.

Dissolved oxygen readings vary with the seasons, being lower in the spring month than the summer month of that year. However, it would appear that dissolved oxygen was more stable

in 1998 and 1999 than the two preceding years. This could indicate a reduction on the oxygen demand exerted in the water column by reduction in volume of decaying organic matter.

pH averaged 7.6 through the four years and, with the exception of July 1999, varied little (+/- 1 pH unit). pH readings around 8 would indicate a productive water so the noted pH readings are quite typical for this low lying, productive waterbody.

Specific conductivity was high for a freshwater body, averaging 970 µS/cm. Value varied little over the years yet the sustained high dissolved salt content could cause problems for some aquatic species.

Scotman's Flash

Scotman's Flash is known to stratify in the deepest parts during high ambient temperatures and therefore bottom waters are more susceptible to anoxic conditions.

Dissolved oxygen readings averaged 90 % saturation with a high of 113 % in July 1999. This super-saturation was in surface waters and probably a result of photo-synthetically produced oxygen from the prolific weed growth. Again, dissolved oxygen readings appeared to be more stable in 1998 and 1999 than previous years.

With the exception of July 1999, pH averaged 8.4 through the four years. Again, this would indicate a relatively productive waterbody. Specific conductivity is high averaging 950 µS/cm, although this is slightly lower than Pearson's Flash.

Scotman's Flash has consistently higher dissolved oxygen readings than Pearson's Flash when comparing same-day surveys. This would initially indicate water quality improves as it flows from Pearson's to Scotman's Flash, but can not be confirmed without studying the nutrient and algal content. The high ambient temperatues of July 1999 increased both pH and dissolved oxygen readings in both Scotman's and Pearson's Flashes.

WATER QUALITY

Pearson's Flash

Over the four years sechhi disc transparency averaged 1.7 m with a maximum of 2 m recorded in April 1998. The graph shows an apparent worsening of the water clarity over the four years. Suspended solids and chlorophyll a concentration cannot account for this low transparency as, although they increase in concentration over time, both parameters are still of low values (suspended solids averaged 4 mg/l, chlorophyll averaged 4.3 mg/m^3). Other cases, for example in the Cheshire meres, have also been found were a low transparency cannot be explained by other chemical factors.

Using the OECD trophic classification for stillwaters, Pearson's Flash would be classified as eutrophic / hyper-eutrophic using secchi disc transparency and mesotrophic using chlorophyll a concentration. Total phosphorus annual mean would classify the Flash as mesotrophic / eutrophic.

Although phosphorus showed a range of values, the high values of October '97 can be attributed to the observed sewage discharge. Removing this incident, overall phosphorus levels are low. Only October 1999 shows an increase from the preceding year though it must

be noted that this was inlet water and not Flash water. Nitrate levels are particularly high in Pearson's Flash; on most occasions reading over 500 µg/l. Although ammonia levels are also high (average 520 µg/l) it is not a dominant proportion of N. Silicate is consistently high throughout the four years and did show a slight decrease over the last two years excluding the high value in October 1999.

Scotman's Flash

Water clarity of Scotman's Flash appeared to decrease until the end of October 1997 and then increase again until present. Like Pearson's, chlorophyll a and suspended solids were relatively low (excluding October 1997) and cannot account for the low secchi disc readings.

Using secchi disc transparency and chlorophyll a in the OECD trophic classification, Scotman's Flash would be classified as eutrophic. Total Phosphorus would also classify the Flash as eutrophic / hyper-eutrophic.

Like Pearson's Flash there were ranging values of phosphorus in 1996/7 which level out in 1998/9 with the exception of October 1999. However, values are a lot higher in Scotman's Flash. Conversely nitrate levels are lower in Scotman's than Pearson's, averaging 500 µg/l compared to 1 000 µg/l in Pearson's Flash. Ammonia was present as a higher proportion of N, particularly in the spring 1998, and would indicate periods of low oxygen levels in the water column. The graph shows silicate has decreased over the last two years although it was still relatively high value at around 2 000 µg/l.

DISCUSSION

In Pearson's Flash the different measures do not give a consistent OECD classification, ranging from mesotrophic to hyper-eutrophic. Ignoring secchi disc readings, it is probably mesotrophic / eutrophic. Scotman's Flash is more consistent being classified as eutrophic – hyper-eutrophic.

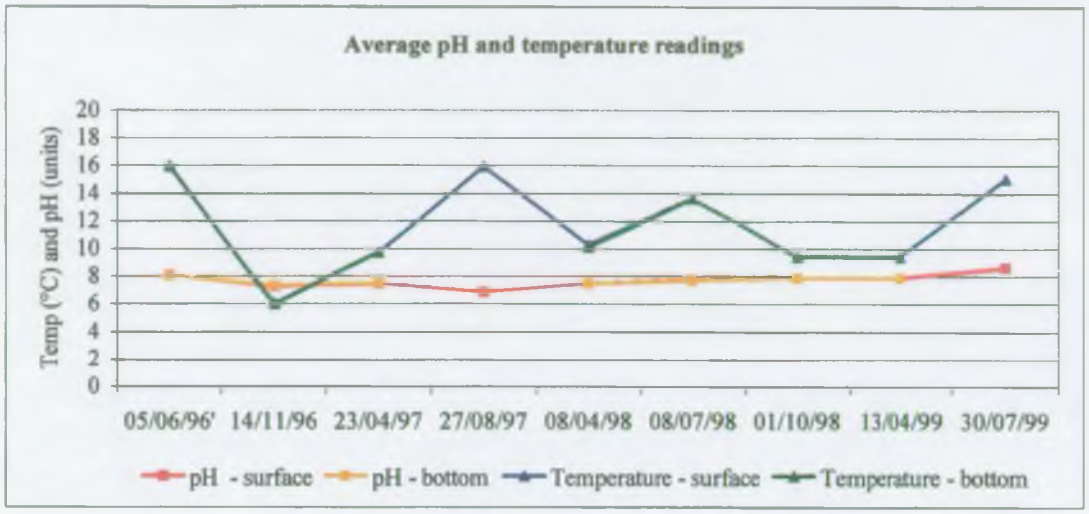
Phosphorus is a lot higher in Scotman's Flash than Pearson's with the reverse for Nitrogen. The N:P ratio would indicate Pearson's Flash as P limited and Scotman's Flash as N limited. This is rather surprising since Pearson's Flash directly receives crude sewage that is likely to be P rich.

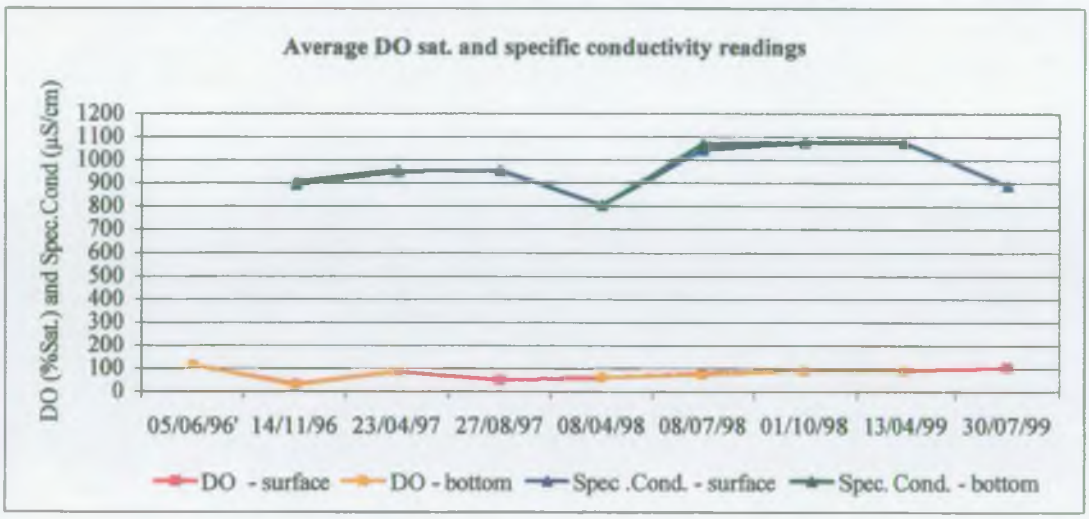
The water quality of Pearson's and Scotman's Flashes appears variable, particularly in 1996/7. However, over 1998/9 there does appear to be a more steady state to the values of parameters. These dates coincide with the sewage works improvements. Furthermore, prolific growth of vegetation around Pearson's Flash inlet and aquatic weed growth in Scotman's Flash in 1999 would indicate environmental quality is improving.

An improvement in the visual quality has followed the environmental improvement and we may expect to see a beneficial change in water quality. However, it must be stressed that the sediments will have become saturated with nutrients over the years. Water quality change is not expected to be immediate since the enriched sediments will themselves be a source of nutrient to the Flash for quite a few years. However, this internal loading will eventually diminish as nutrients are released from the sediment and low phosphorus sediments cover and bury the richer sediments.

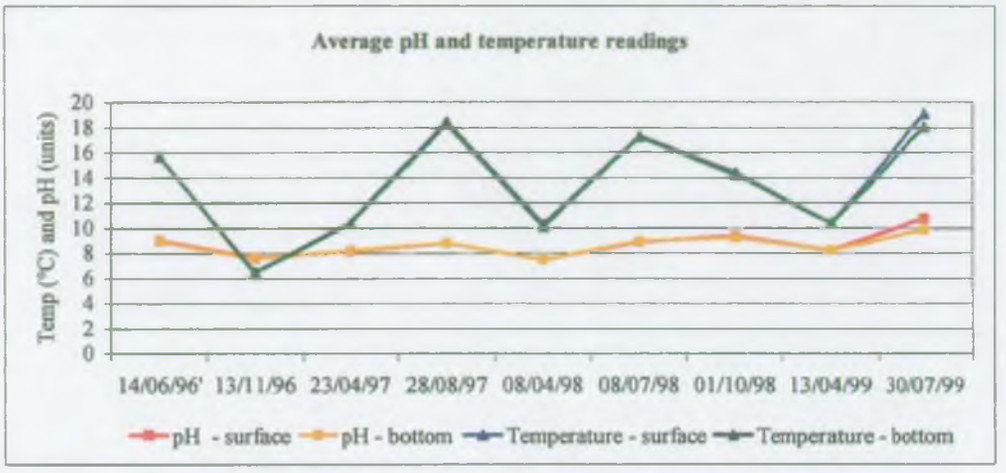
Pearson's and Scotman's Flashes

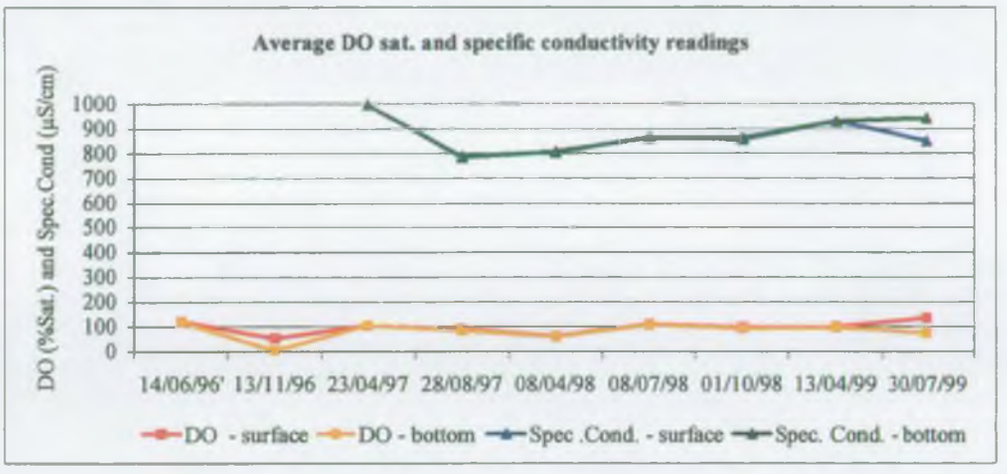
Pearson's Flash - Average physico-chemical profile readings in surface and bottom waters, 1996 to 1999.



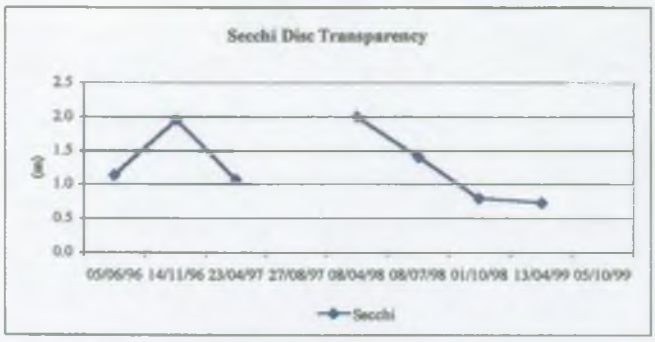


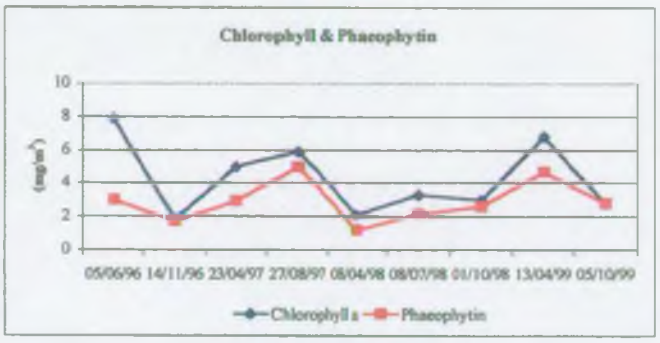
Scotman's Flash - Average physico-chemical profile readings in surface and bottom waters, 1996 to 1999.

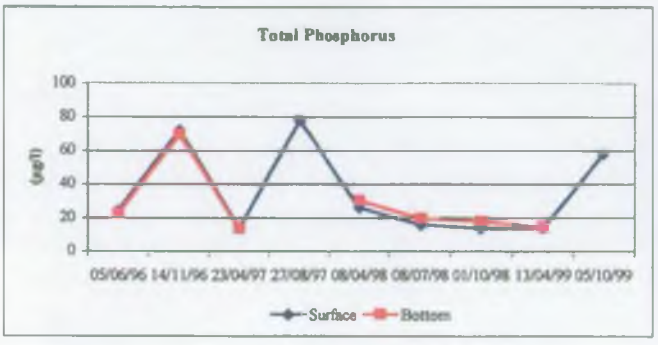


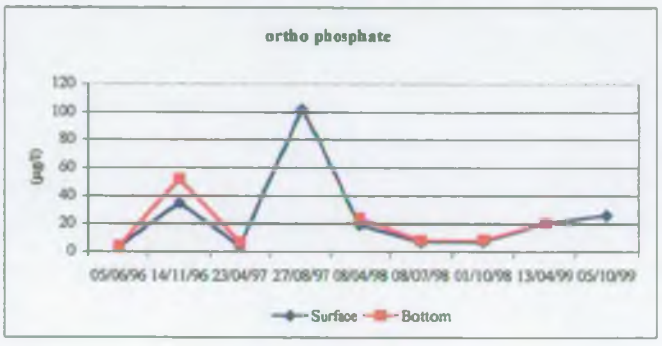


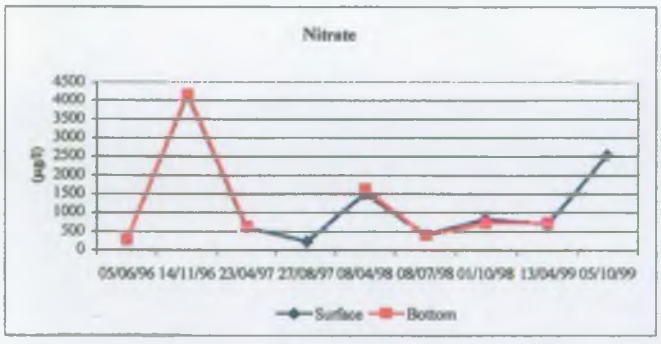
Pearson's Flash. Average nutrient readings in surface and bottom waters, 1996 to 1999.

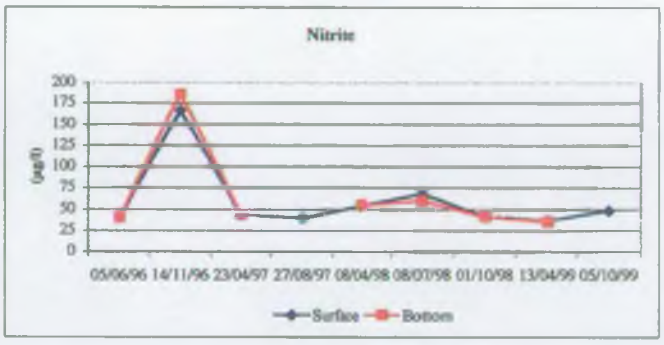


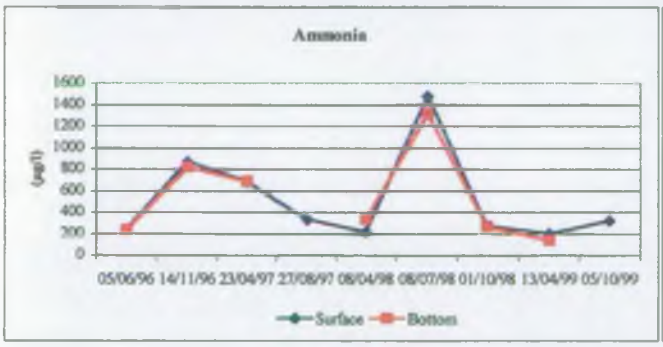


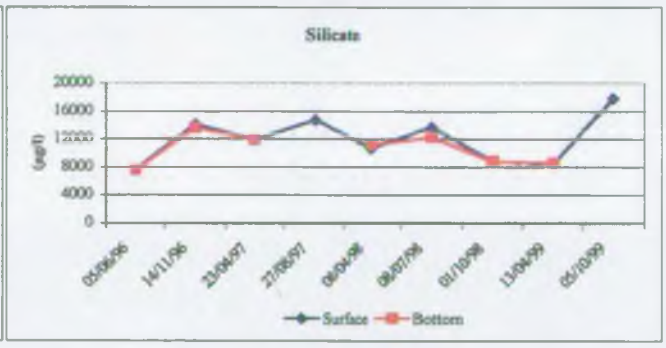




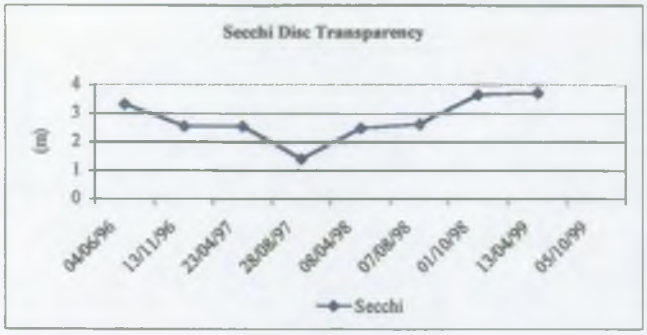


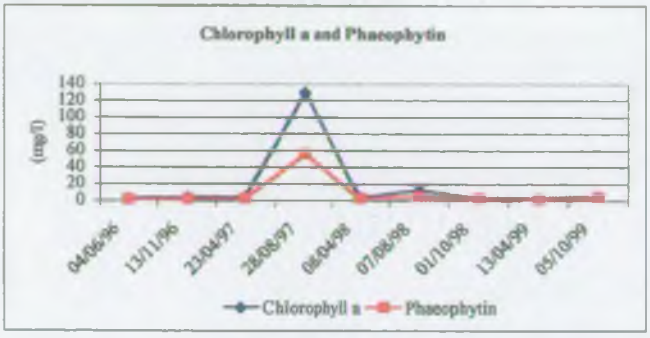


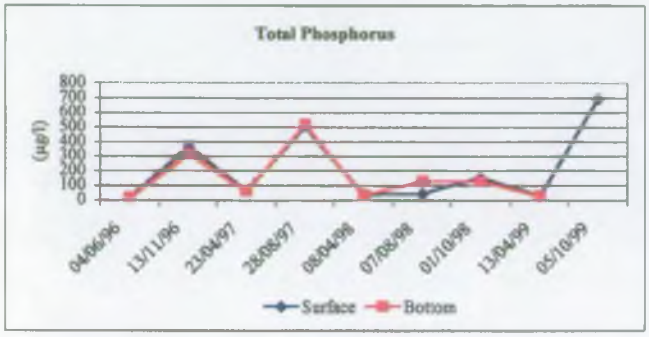


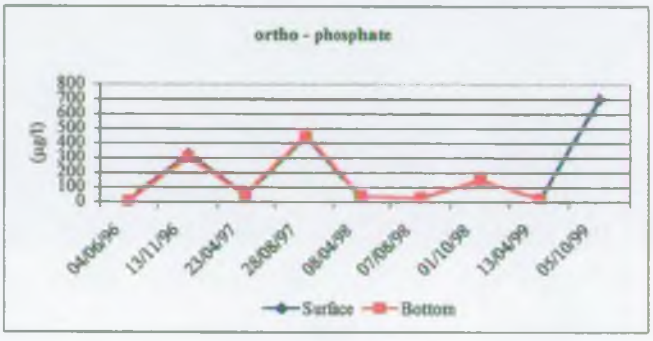


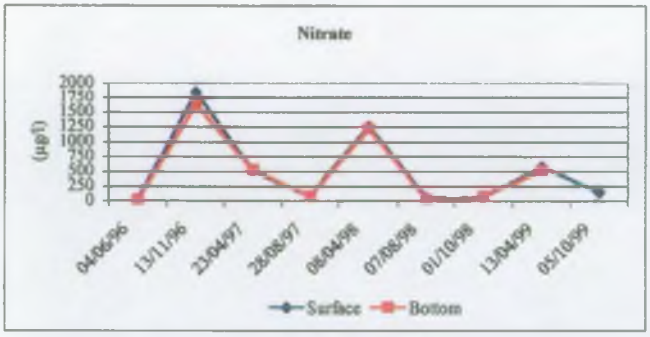
Scotman's Flash. Average nutrient readings in surface and bottom waters, 1996 to 1999.

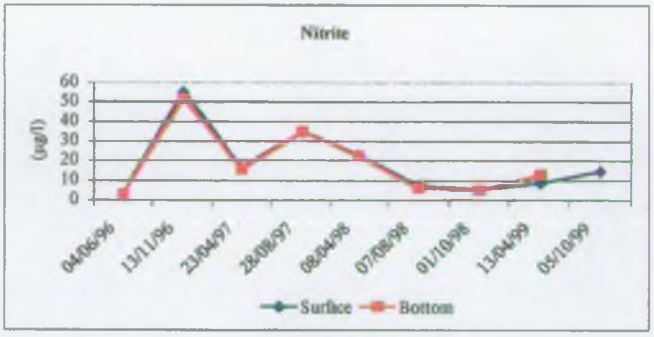


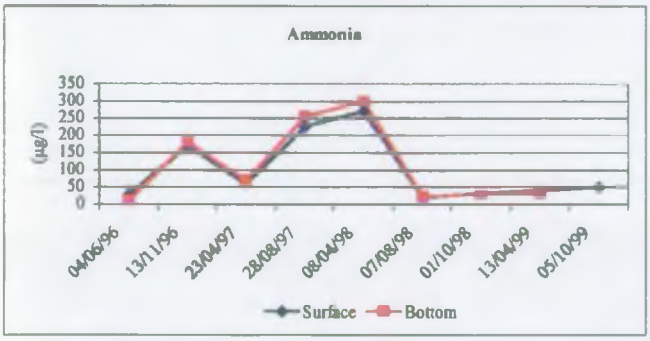


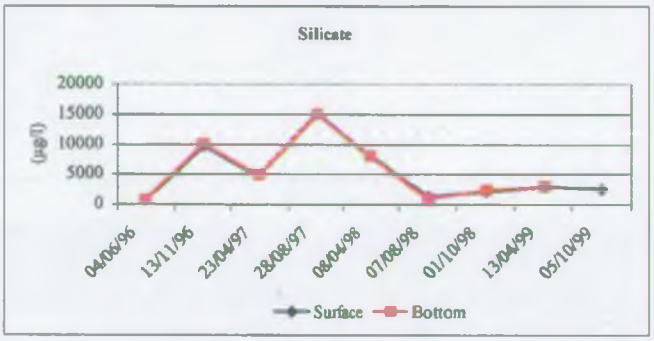












Pearson's Flash - Average readings in surface and bottom waters - 1996 to 1999

Date	Position	Temp °C	pH units	Sp.Cond. µS/cm	DO % sat.
05/06/96'	s	15.97	8.06		113.18
	b	15.92	8.02		112.45
14/11/96	s	5.97	7.27	893.42	28.38
	b	6.02	7.30	904.24	25.81
23/04/97	s	9.73	7.48	947.27	82.44
	b	9.73	7.48	953.40	82.11
27/08/97	s	15.94	6.87	954.50	47.97
08/04/98	s	10.30	7.45	803.60	58.49
	b	10.07	7.44	802.84	56.81
08/07/98	s	13.59	7.74	1042.99	74.08
	b	13.60	7.71	1067.58	72.92
01/10/98	s	9.39	7.87	1074.00	90.07
	b	9.40	7.86	1074.00	89.57
13/04/99	s	9.39	7.87	1074.00	90.07
	b	9.40	7.86	1074.00	89.57
30/07/99	s	15.04	8.60	889.30	103.04
Min		**5.97**	**6.8**	**802**	**25.81**
Max		**15.97**	**8.6**	**1074**	**113.18**
Ave		**11.22**	**7.6**	**968**	**76.06**

Scotman's Flash - Average readings in surface and bottom waters - 1996 to 1999

Date	Position	Temp °C	pH units	Sp.Cnd µS/cm	DO% % sat.
14/06/96'	s	15.67	8.94		119.23
	b	15.64	8.89		115.17
13/11/96	s	6.50	7.58		50.88
	b	6.45	7.54		3.61
23/04/97	s	10.39	8.12	993.82	102.83
	b	10.33	8.15	994.42	103.71
28/08/97	s	18.42	8.78	780.37	87.20
	b	18.29	8.77	785.67	82.24
08/04/98	s	10.30	7.45	803.60	58.49
	b	10.07	7.44	802.84	56.81
08/07/98	s	17.27	8.89	862.44	106.96
	b	17.27	8.92	862.71	106.65
01/10/98	s	14.36	9.32	853.72	95.45
	b	14.23	9.22	861.00	90.66
13/04/99	s	10.39	8.23	928.11	96.52
	b	10.38	8.22	928.67	95.60
30/07/99	s	19.11	10.73	848.95	133.86
	b	18.03	9.84	942.06	72.36
Min		**6.45**	**7.44**	**780**	**3.6**
Max		**19.11**	**10.73**	**944**	**133.86**
Ave		**13.5**	**8.61**	**874.88**	**87.68**

Pearson's Flash - Average nutrient readings in surface and bottom waters

Date	Position	Secchi m	Susp. Solids mg/l	Chlorophyl mg/m3	Phaeophyti mg/m3	Total P µg/l
05/06/96	s	1.13	6.33	7.87	2.97	24.00
	b					22.33
14/11/96	s	1.95	2.33	1.84	1.69	72.00
	b					69.33
23/04/97	s	1.07	3.33	5.00	2.90	13.33
	b					13.33
27/08/97	s		4.67	5.86	4.92	78.00
	b					
08/04/98	s	2.00	2.00	2.08	1.14	26.00
	b					30.00
08/07/98	s	1.40	4.00	3.30	2.14	15.56
	b					19.44
01/10/98	s	0.80	4.67	2.98	2.59	13.33
	b					17.56
13/04/99	s	0.73	5.33	6.78	4.68	13.67
	b					14.03
05/10/99	s		3.00	2.77	2.77	58.00
Min		**2**	**2**	**1.84**	**1.14**	**13 (Lod)**
Max		**0.73**	**6.33**	**7.87**	**4.92**	**78**
Average		**1.3**	**3.96**	**4.27**	**2.87**	**31.24**

ortho-P µg/l	Nitrate µg/l	Nitrite µg/l	Ammonia µg/l	Silicate µg/l
3.00	264.00	38.90	235.33	7520.00
3.67	260.00	38.73	226.33	7533.33
35.00	4154.00	166.00	864.00	14022.00
51.67	4177.67	185.67	809.33	13575.67
3.61	591.33	42.60	683.33	11874.67
6.18	608.00	42.60	679.00	11801.33
101.90	227.07	38.99	329.70	14713.33
18.60	1495.67	53.47	213.33	10633.33
23.87	1616.00	54.33	330.00	11066.67
6.77	403.00	67.60	1476.67	13700.00
7.87	379.33	59.03	1310.00	12206.67
7.33	816.00	40.30	266.67	8830.00
8.33	710.33	40.60	260.67	8773.33
20.00	678.33	36.00	198.33	8480.00
20.00	711.00	34.67	130.00	8490.00
26.10	2531.70	48.30	318.00	17807.00
3	**227**	**34.67**	**130**	**7520**
101.9	**4177**	**185.67**	**1476.67**	**17807**
21.49	**1226**	**61.74**	**520.67**	**11314**

Scotman's Flash - Average nutrient readings in surface and bottom waters

Date	Position	Secchi m	Susp. Solids mg/l	Chlorophyl mg/m3	Phaeophyti mg/m3	Total P µg/l
04/06/96	s	3.30	4.33	1.97	0.71	18.78
	b					13.30
13/11/96	s	2.53	7.33	3.69	1.57	368.00
	b					314.00
23/04/97	s	2.53	2.00	4.28	2.48	65.00
	b					60.67
28/08/97	s	1.40	11.00	129.53	55.70	506.33
	b					517.67
08/04/98	s	2.47	2.67	3.54	2.09	34.67
	b					32.33
07/08/98	s	2.60	4.33	12.24	4.46	45.33
	b					128.00
01/10/98	s	3.63	2.00	2.65	2.50	151.00
	b					128.00
13/04/99	s	3.70	3.00	2.23	1.15	24.37
	b					28.27
05/10/99	s		3.00	4.82	3.52	692.00
Min		**1.4**	**2**	**1.97**	**0.71**	**13(LoD)**
Max		**3.7**	**11**	**129.53**	**55.7**	**692**
Ave		**2.77**	**4.41**	**18.33**	**8.24**	**183.98**

ortho-P µg/l	Nitrate µg/l	Nitrite µg/l	Ammonia µg/l	Silicate µg/l
3.77	17.17	2.17	26.97	682.67
5.70	11.50	2.53	10.17	646.67
325.00	1851.00	55.10	170.33	9654.33
305.00	1629.00	51.40	180.33	9913.00
47.63	507.00	15.90	58.43	4780.00
49.03	515.00	15.30	67.27	4769.67
444.33	67.07	34.50	225.33	15011.00
451.67	68.27	34.43	254.33	14910.00
39.73	1253.00	22.73	269.33	8033.33
41.10	1208.67	21.93	297.67	7933.33
26.87	42.33	7.03	19.60	1200.33
27.47	26.87	5.90	20.00	846.00
146.33	50.43	5.23	29.80	2076.67
145.67	61.20	4.83	27.67	2230.00
21.33	574.00	8.33	38.67	2866.67
20.00	504.67	12.67	30.00	2883.33
702.00	138.90	14.70	49.40	2419.00
3.77	**11.5**	**2.17**	**10.17**	**646**
702	**5851**	**55.1**	**297.67**	**15011**
164.86	**501.53**	**18.51**	**104.43**	**5344.47**