DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Tasmania

Natural Heritage Trust

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A Commonwealth Government Initiative

Water Quality of Rivers in the Duck River Catchment

A Report Forming Part of the Requirements for 'State of Rivers' Reporting

PART 4

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The Department of Primary Industries, Water and Environment

The Department of Primary Industries, Water and Environment provides leadership in the sustainable management and development of Tasmania's resources. The Mission of the Department is to advance Tasmania's prosperity through the sustainable development of our natural resources and the conservation of our natural and cultural heritage for the future.

The Water Resources Division provides a focus for water management and water development in Tasmania through a diverse range of functions including the design of policy and regulatory frameworks to ensure sustainable use of the surface water and groundwater resources; monitoring, assessment and reporting on the condition of the State's freshwater resources; facilitation of infrastructure development projects to ensure the efficient and sustainable supply of water; and implementation of the *Water Management Act 1999*, related legislation and the State Water Development Plan.

2.5 Diurnal Water Quality Variations

During the study, continuous monitoring equipment was deployed at three sites within the Duck River. The sites investigated were:

DR1 – Duck River at Bass Highway;
DR4 – Duck River at Scotchtown Rd; and
DR20 – Duck River at Roger River

On one occasion, two multi-parameter loggers were deployed simultaneously to compare diurnal changes at a location in the upper reaches of the Duck River (DR20) with that occurring lower down the river (DR4), where nutrient input to the river was likely to be higher. The following section presents the data collected during these logging events and discusses the time series in relation to the nutrient data discussed in earlier sections.

The diurnal pattern of change in water temperature, dissolved oxygen and pH at DR1 was recorded in February 1999. The traces from this logging event are shown in Figure 2.40 and Figure 2.41, and were recorded during stable weather conditions. These data can be compared to a similar (but longer) logging event carried out site DR4 in February the following year (Figures 2.42 & 2.43). These traces show that the daily variation in water temperature in the lower reaches of the river during the middle of summer are typically about 2 ^{o}C. The traces also clearly show that the pattern and scale of daily changes is influenced by the prevailing weather conditions (Figure 2.42), and this also has some influence on changes in other parameters.

The scale of daily variation in dissolved oxygen saturation is similar at both DR1 and DR4, with diurnal changes of about 10-15%. The minimum saturation levels at both sites tended to occur in the early hours of the morning (between 2AM and 6AM), although the minimum saturation level at DR4 was much lower than at DR1 downstream. Daily minimum saturation levels at DR4 fell below 70% on all four days of monitoring, and may be an indication of the impact of the heavy siltation and nutrient enrichment that has occurred at this site. There is a stream-gauging weir at this site that has encouraged the deposition of silt at this site, and prolific growth of Cumbungi (*Typha* spp.) and stock access immediately upstream are likely to have compounded this problem.

The pH at both sites is alkaline, with daily changes mirroring that of changes in dissolved oxygen. Peaks in pH levels tend to coincide with peaks in dissolved oxygen.

The data from all three logging events carried out in the upper Duck River at DR20 (Roger River) are plotted together to better illustrate seasonal changes as well as the diurnal variations at this site. These data were collected in January, February and March of 2000, when low flows and warm water temperatures were likely to have resulted in 'high stress' conditions. The data from this site (Figure 2.45) indicates that oxygen levels during the logging periods are consistently lower than those found downstream at site DR1 and DR4, with peak saturation only reaching about 68% and minimum levels of about 56%. The dissolved oxygen data from this site is confusing when considered in terms of riparian cover and instream condition, both of which are in a moderately healthy state (see other chapters of the 'State of Rivers' report). Unlike the two downstream sites that were examined (DR1 & DR4), there is no evidence of excessive deposition of silt at this site, and there appears to be a good input of native large woody debris to the river here. However, these data do corroborate the monthly monitoring data recorded at this site (see Figure 2.12), which shows that dissolved oxygen at this site is generally depressed compared to other sites in the catchment that were examined. Further examination of this situation may be warranted, though there is no indication that the low dissolved oxygen levels at this site are impacting on the health of the aquatic macroinvertebrate community.

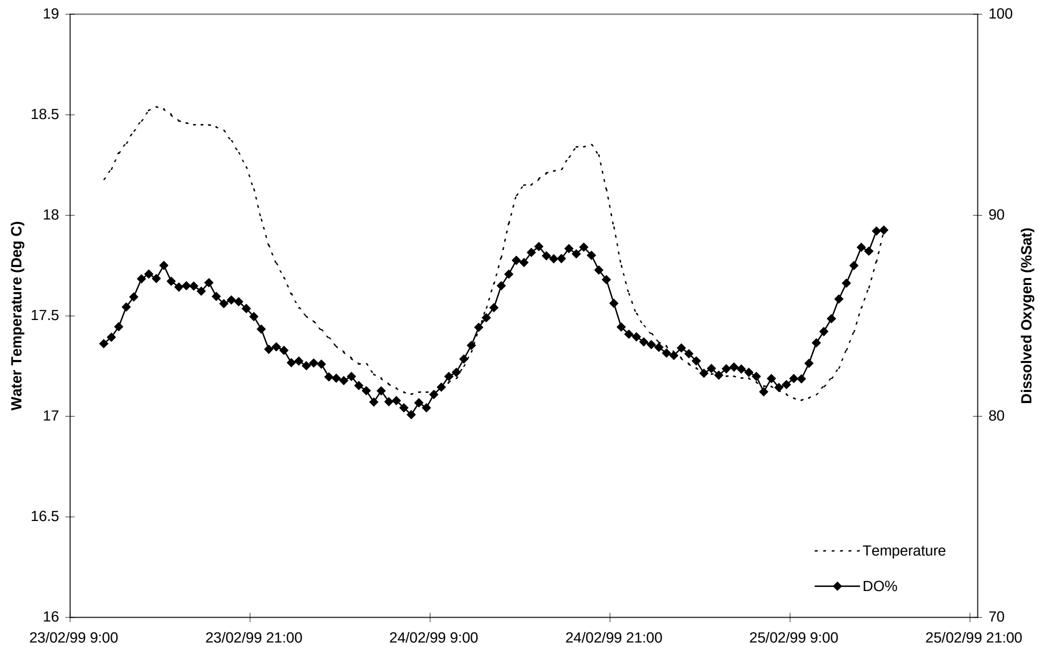

Figure 2.40: Diurnal variation in temperature and dissolved oxygen during late February 1999 in the Duck River at Bass Highway (DR1).

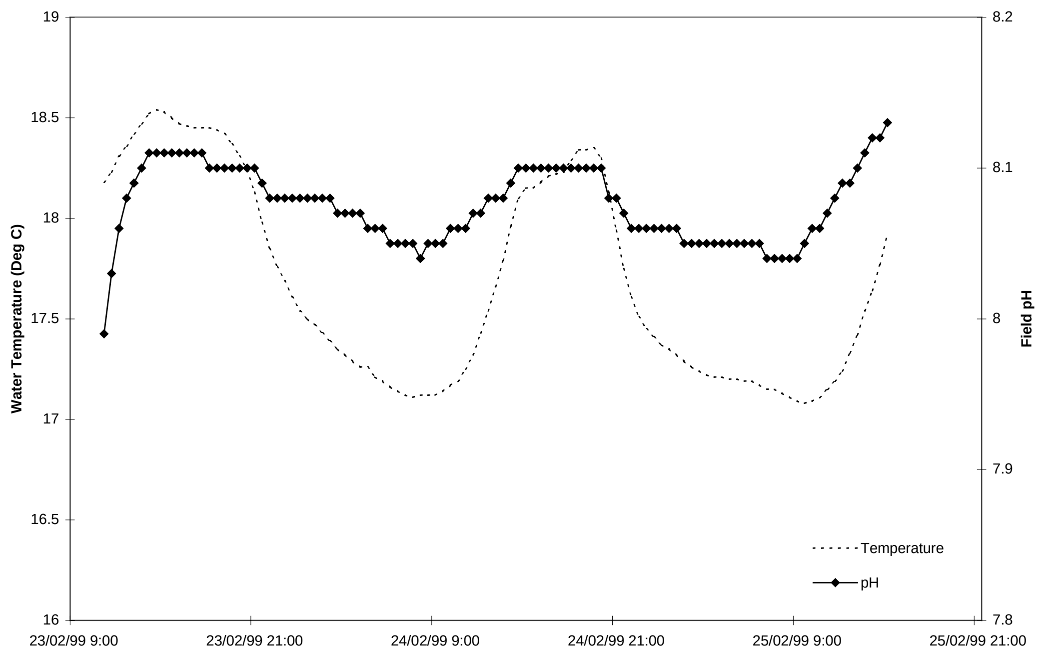

Figure 2.41: Diurnal variation in temperature and pH during late February 1999 in the Duck River at Bass Highway (DR1).

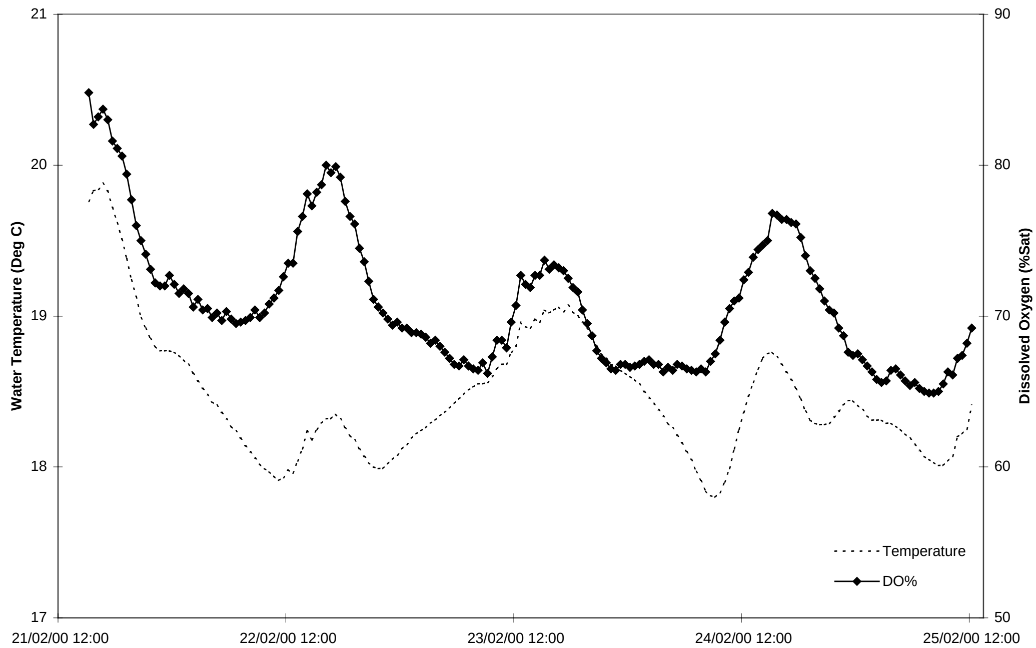

Figure 2.42: Diurnal variation in temperature and dissolved oxygen during late February 2000 in the Duck River at Scotchtown (DR4).

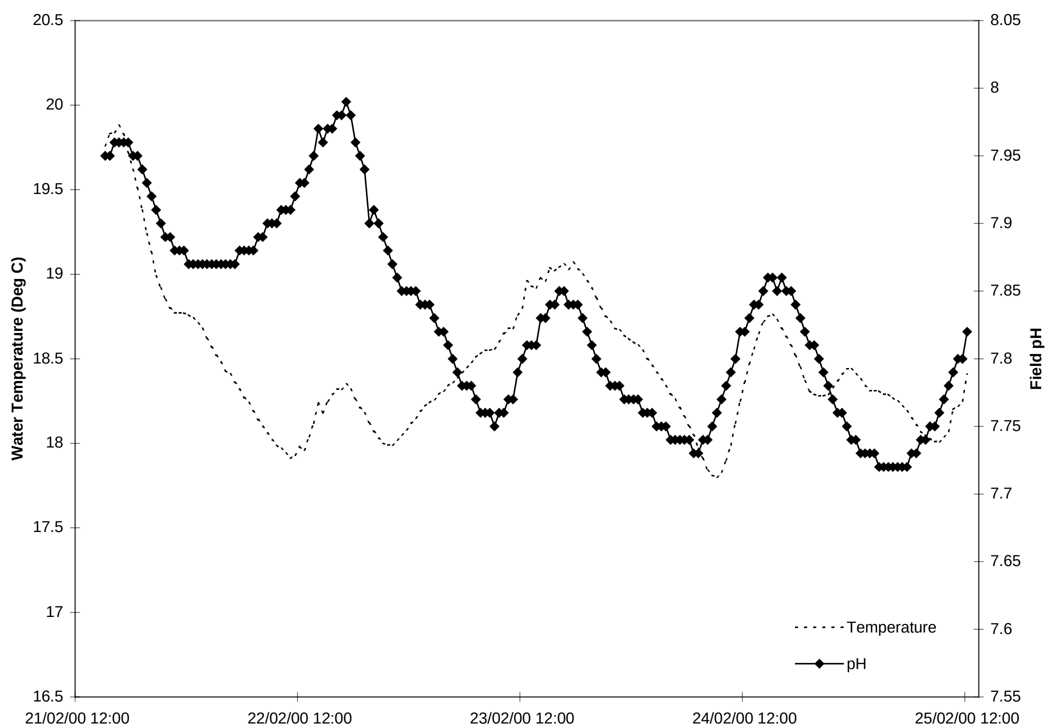

Figure 2.43: Diurnal variation in temperature and pH during late February 2000 in the Duck River at Scotchtown (DR4).

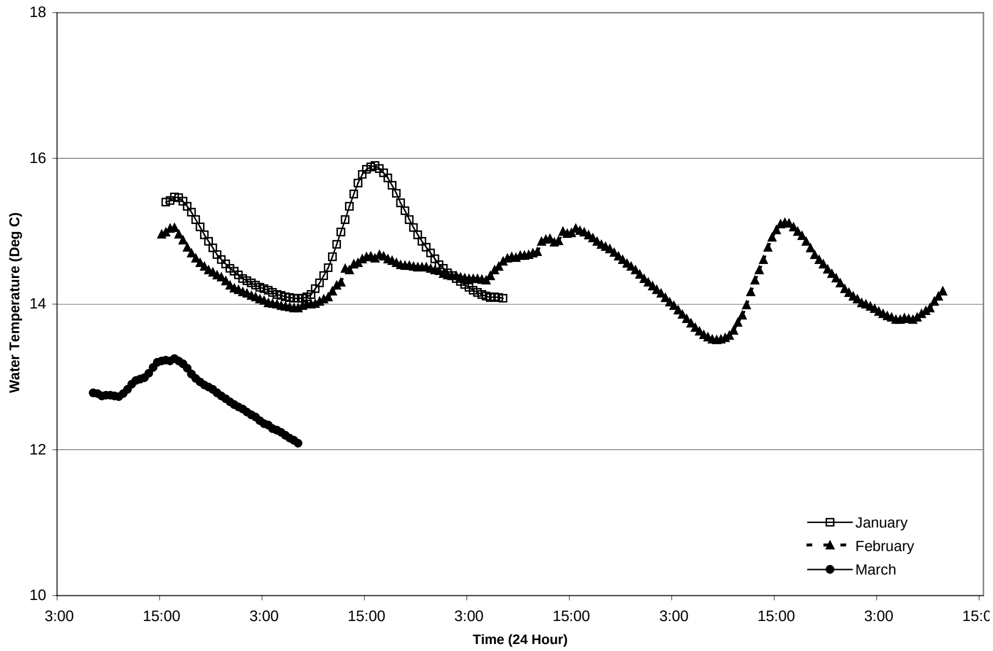

Figure 2.44: Diurnal variation in water temperature in the Duck River at Roger River (DR20) recorded during temporary deployment of monitoring equipment in January, February and March 2000.

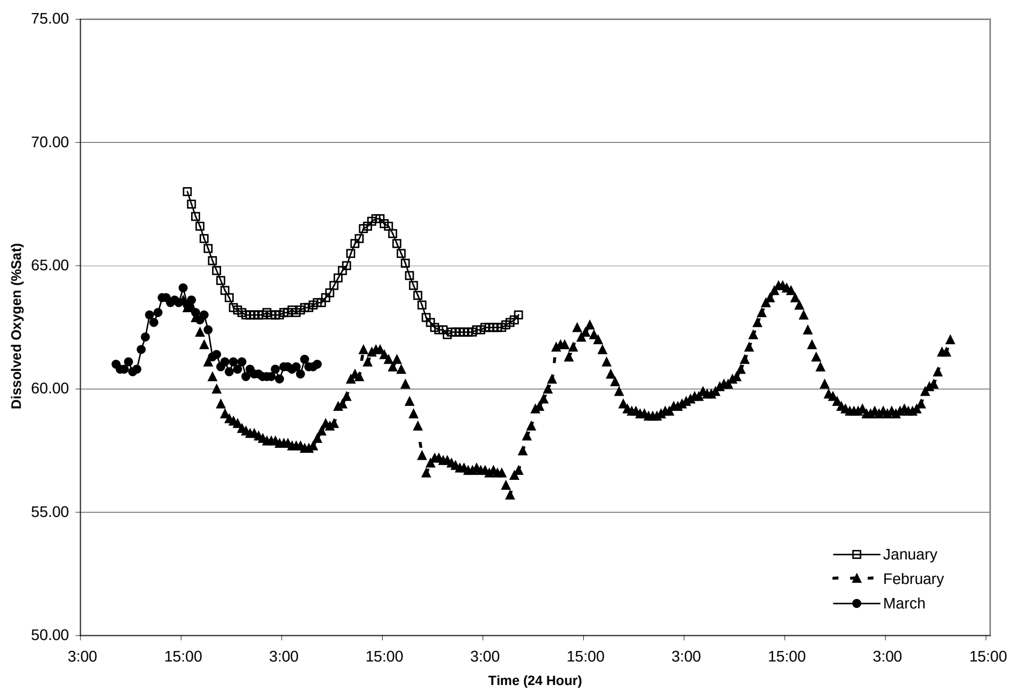

Figure 2.45: Diurnal variation in dissolved oxygen saturation in the Duck River at Roger River (DR20) recorded during temporary deployment of monitoring equipment in January, February and March 2000.

3 Nutrient Load Estimates

3.1 Background

Nutrient load estimates were derived from nutrient, suspended solids, turbidity and flow data collected from the Duck River at the Scotchtown Rd stream gauging site, 8 km upstream of the Smithton township (DR4). Nutrient data was collected by two methods; through regular monthly sampling and opportunistic sampling targeting flood events. Turbidity data was collected manually during monthly and flood sampling in addition to being logged continuously in conjunction with flow data from the site.

Thirty five monthly nutrient samples were collected from DR4 between March 1999 and December 2001 in addition to 13 trimonthly general ions samples. Flood flow nutrient samples were collected using a Sigma programmable automated water sampler. The sampler was triggered by events exceeding about 10 cumecs in magnitude, and samples were collected in either hourly or two hourly intervals depending upon the duration of the flow event. The in situ logging station at this site provided a near continuous record of discharge and turbidity covering the 3-year survey period.

3.2 Monthly samples

Table 3.1 shows a summary of nutrient, turbidity and total suspended solids concentrations collected on a monthly basis from DR4. Total suspended solids levels were generally low, with 8 of the 13 samples equal to or below the laboratory detection limit of 10 mg/L. Mean and median turbidity levels were moderate, falling within the lower range specified for Australian lowland rivers in the ANZECC (2000) guidelines, but were slightly higher than those recorded for the nearby Inglis and Montagu Rivers.

Monthly data is discussed in previous sections, however brief comments on these data are useful in establishing the baseline against which flood data can be compared.

Total nitrogen concentrations exceeded the ANZECC (2000) trigger levels by almost 100%. Mean annual and median levels were almost twice as high as those recorded from the Inglis River, but were slightly below levels recorded from the Montagu River.

Total phosphorus concentrations were highly variable over the study period when compared to total nitrogen. Median and particularly mean annual total phosphorus levels exceeded the 0.05 mg/L ANZECC (2000) trigger level and fell between mean annual concentrations recorded for the Inglis and Montagu Rivers during State of Rivers reporting for these catchments.

Interestingly, nitrate concentrations were elevated, exceeding ANZECC (2000) levels by an order of magnitude and also exceeding concentrations recorded from both the Inglis and Montagu Rivers. Nitrite and ammonia concentrations were similar to those from the Montagu, with ammonia levels exceeding ANZECC (2000) triggers by >300%.

Dissolved reactive phosphorus concentrations were also elevated in comparison to ANZECC (2000) trigger levels, falling midway between mean annual concentrations recorded from the Inglis and Montagu Rivers.

Table 3.1: Summary statistics for nutrients and suspended solids collected from the Duck River at Scotchtown during **monthly** sampling conducted between March 1999 and August 2001.

	Total suspended solids (mg/L)	Turbidity (NTU)	Total N (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	Total P (mg/L)	DRP (mg/L)
N=	13	35	34	34	34	34	34	34
Mean	18.00	14.17	0.909	0.387	0.008	0.082	0.129	0.053
95% conf. Int.	7.73	3.41	0.143	0.069	0.001	0.040	0.129	0.046
Median	10	13.40	0.917	0.370	0.007	0.061	0.066	0.014
Minimum	10	3.35	0.346	0.072	0.002	0.014	0.018	0.003
Maximum	52	40.40	1.690	0.869	0.018	0.690	0.690	0.730

3.3 Flood sampling

Figure 3.1 shows a time series record of river flow at DR4 between January 1999 and December 2001. Seasonal patterns in discharge are distinctive, with flows increasing in May or June each year and subsequently falling to low levels in December. A maximum flow of 99.6 cumecs was recorded on 21 July 2000, while 2001 recorded the highest total annual discharge of the study period of 158 006 ML. Total annual discharges of 116 609 ML and 148 889 ML were recorded in 1999 and 2000.

Table 3.3 shows a summary of monthly discharges at the Duck River at Scotchtown site between January 1999 and December 2001. A maximum monthly discharge of 52 061 ML was recorded in August 2001, while the second largest monthly discharge (45 993 ML) was recorded in July 2000, coinciding with the maximum discharge recorded for the study period.

24 elevated flow events were manually sampled between March 1999 and July 2000, and nutrient samples were analysed from 10 of these events. Three events, occurring on 19-20 July 2000, 8-10 August 2001 and 19-21 August 2001, were automatically sampled for nutrient and/or turbidity levels by the Sigma autosampler. The largest event, which occurred between 19-30 July 2000, is shown in detail in Figure 3.2 together with turbidity levels recorded during this event. Turbidity levels increased rapidly in response to the increase in discharge showing a typical flood flow response reflecting the increased mobilisation of particulate matter from within the catchment. Following this initial rapid increase, turbidity levels declined in conjunction with the decreasing availability of transportable material approximately 12 hours prior to a decrease in flows.

Table 3.2 shows a summary of the nutrient concentrations collected during elevated flow events at DR4. As expected, concentrations of all parameters are much higher than those recorded during monthly monitoring (Table 3.1). Mean and median flood TSS levels were moderate, and were similar to concentrations recorded in the Inglis, Montagu and Pipers Rivers during similar ‘State of Rivers’ studies. Flood turbidity levels averaged 41 NTU over the study period, which was also similar to levels recorded from Pipers River and Inglis River.

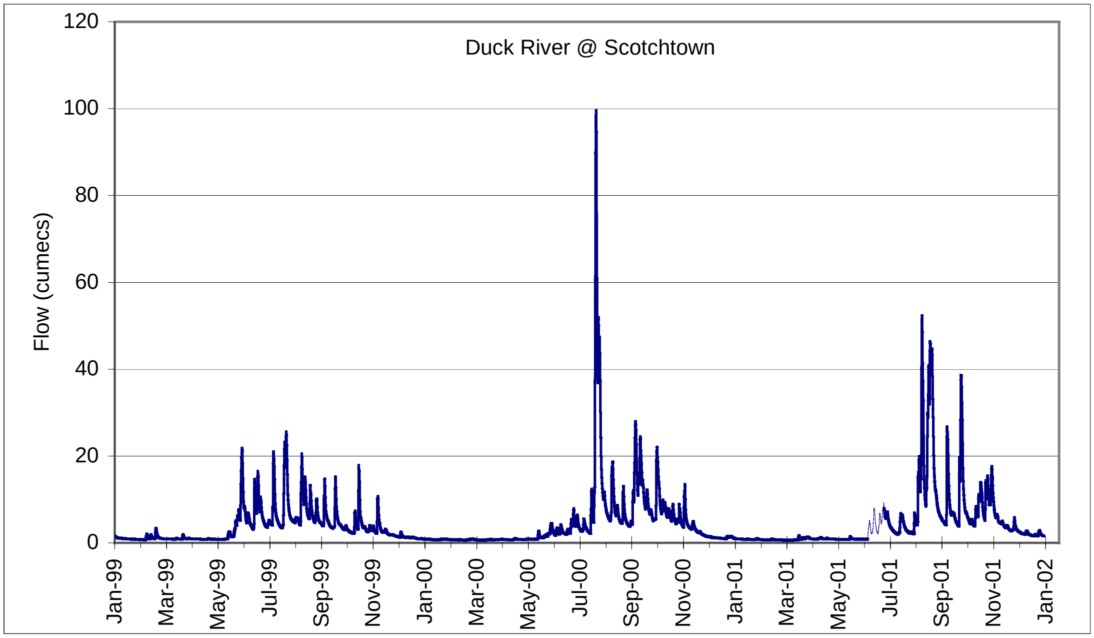

Figure 3.1: Flows at the Duck River at Scotchtown between January 1999 and December 2001.

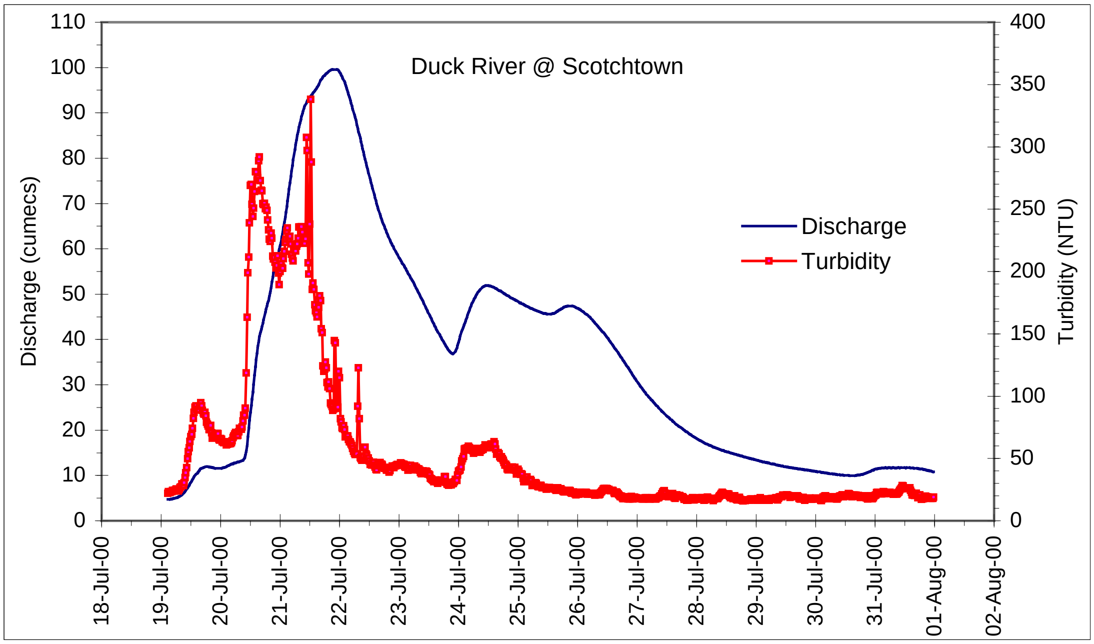

Figure 3.2: Graph of discharge and turbidity collected from the Duck River at Scotchtown during the largest event of the study, which occurred between 19-30 July 2000.

Flood flow nutrient levels were generally elevated when compared to flood flow nutrient levels recorded in comparable rivers elsewhere in Tasmania. Mean total nitrogen concentrations averaged 2.25 mg/l, which was marginally higher than flood concentrations recorded from the Montagu River, but almost 100% higher than recorded in both the Inglis and Pipers Rivers. Similarly nitrite and ammonia measured during flood conditions were similar to levels recorded from the Montagu, but higher than those reported for the Inglis during corresponding studies. Flood nitrate concentrations were elevated but were similar to levels recorded from the Inglis and Montagu.

Flood total phosphorus levels were relatively high in the Duck River, exceeding those recorded from the Montagu by over 100%, and exceeding Inglis and Pipers Rivers concentrations by an order of magnitude. Similarly, dissolved reactive phosphorus concentrations were over 50% greater than those collected from the Montagu and over an order of magnitude greater than Inglis River levels.

Table 3.2: Summary statistics for nutrients and suspended solids collected from the Duck River @ Scotchtown Rd during **flood** sampling conducted between March 1999 and August 2001.

	Total suspended solids (mg/L)	Turbidity (NTU)	Total N (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	Total P (mg/L)	DRP (mg/L)
N=	46	99	46	22	22	22	46	22
Mean	42.65	41.17	2.254	0.563	0.013	0.264	0.843	0.275
95% conf. Int.	6.63	4.81	0.166	0.044	0.002	0.044	0.129	0.090
Median	35	37.10	2.325	0.568	0.013	0.273	0.870	0.266
Minimum	15	4.14	0.930	0.370	0.008	0.099	0.058	0.026
Maximum	109	195.00	3.340	0.717	0.025	0.402	2.460	0.727

3.4 Load estimation

With the exception of a few minor gaps in the turbidity record, a continuously logged hydrographic and turbidity dataset was available for DR4 for the duration of the study. This enabled calculation of load estimates to be based on the development of turbidity/nutrient relationships for total nitrogen, total phosphorus and total suspended solids. Nutrient concentrations that were determined from samples collected during events were related to turbidity levels at the time of sampling. Once these relationships had been verified, load estimates for each parameter were derived by calculating nutrient concentrations from the turbidity record and relating these to coincident discharge volumes. Continuous data was aggregated into 20 minute blocks to simplify the calculation of load estimates for the study period. Figures 3.3-3.5 show correlations determined for turbidity versus total suspended solids, total nitrogen and total phosphorus respectively for the Duck River at Scotchtown (DR4).

This method of load estimation is fairly accurate, however the collection of good quality continuous turbidity data and collection of nutrient samples at a range of flows is pivotal to the reliability of load estimates calculated using this method. While the turbidity record from DR4 is extensive, it is quite spiky, showing high levels of short-term variability not reflected in the hydrological record for this site. Turbidity spikes of this nature can probably be attributed to disturbance of the river-bed and banks upstream of the logging site by cattle and occasional fouling of the turbidity sensor by aquatic plants or algae.

Inspection of the turbidity data indicated that turbidity data collected between late March and mid May was of poor quality, as was data collected between October and December 2001. Data from these two periods was removed from the record and was subsequently replaced with turbidity data synthesised from the flow record using linear extrapolation methods.

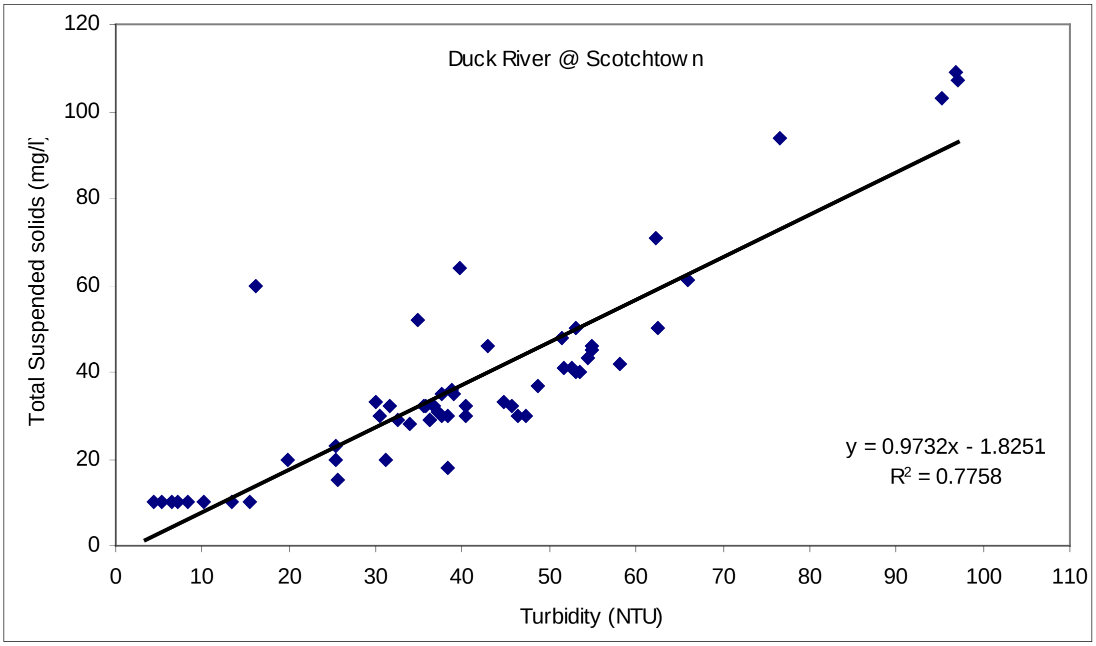

Figure 3.3: Correlation between turbidity and total suspended solids concentrations at the Duck River at Scotchtown (DR4).

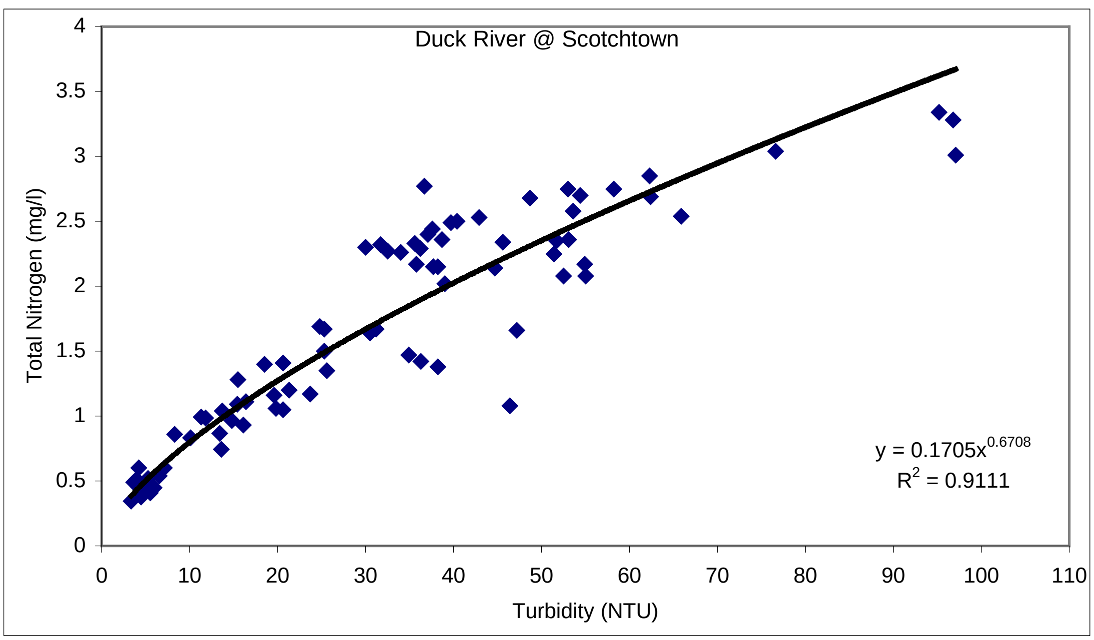

Figure 3.4: Correlation between turbidity and total nitrogen concentrations at the Duck River at Scotchtown (DR4).

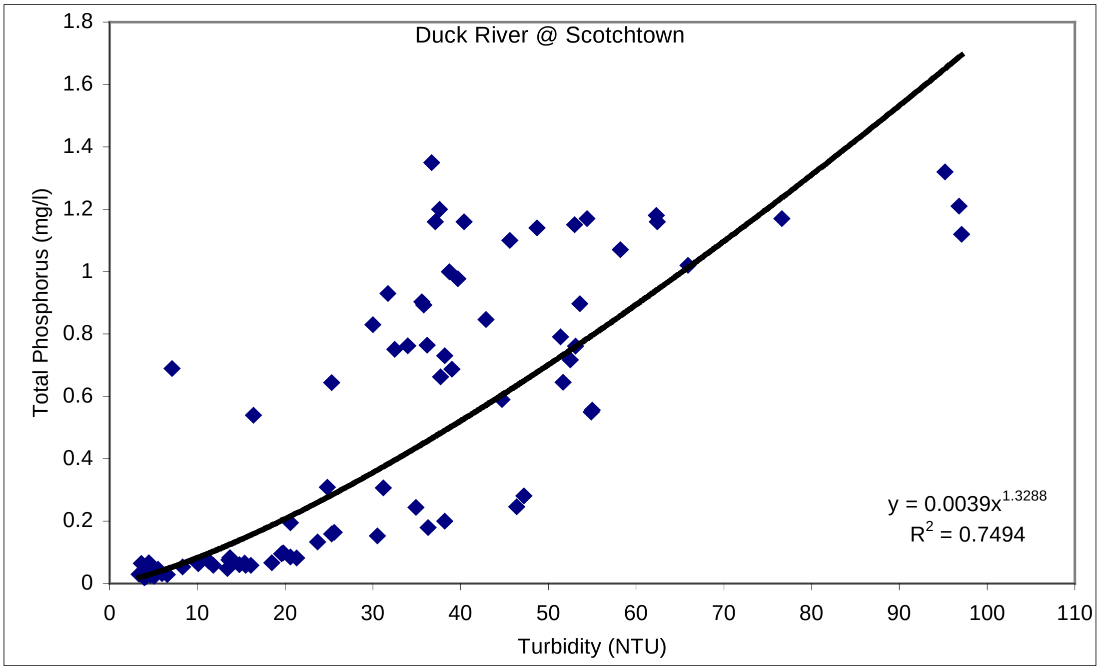

Figure 3.5: Correlation between total phosphorus and turbidity levels at the Duck River at Scotchtown (DR4).

Table 3.3 shows monthly load estimates and mean monthly total suspended solids, total phosphorus and total nitrogen concentrations from the Duck River at DR4 for the period January 1999 to December 2001. Total discharge was 423 515 ML over the 36 month study period. During this time 14 138 687kg of suspended solids, 727 806kg of nitrogen and 235 215kg of phosphorus were transported past DR4. Maximum monthly nutrient loads occurred in July 2000, the month when the largest flood event of the monitoring period was recorded (99 cumecs). A total of 3 115 272kg of suspended solids, 125868kg of total nitrogen and 61643kg of total phosphorus were transported past the logging site during July 2000. Although the monthly discharge for August 2001 was greater than that for July 2000, it is interesting to note that loads during that month were actually less than occurred in July 2000. While base-flow in the river during August 2001 was generally high, peak flow in the river only barely exceeded 50 cumecs. Peak flow during July 2000 was almost 100 cumecs, reflecting the significance of large flood events in the transport of nutrients and suspended material from the catchment.

Highest total annual suspended solids, nitrogen and phosphorus loads were recorded in 2001 (total SS= 6,677,128 kg, total N= 329,398 kg and total P= 109,993 kg), followed by 2000 (total SS= 5,491,742 kg, total N= 271,381 kg and total P= 95,929 kg) and 1999 (total SS= 1,969,817 kg, total N=127,027 kg and total P= 31,292 kg).

3.5 Export coefficients

The calculation of export coefficients for catchments enables valid comparisons of nutrient loads to be drawn between catchments with different surface areas and yield characteristics, by standardising load estimates to take these variables into account. The equations used in the determination of export coefficients are included in the glossary at the beginning of this report.

Table 3.3: Estimated monthly loads of suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) for the Duck River at DR4 between January 1999 and December 2001.

Date	Monthly discharge (ML)	Mean turbidity (NTU)	Mean monthly TSS (mg/L)	Monthly TSS (tonnes)	Mean monthly TN (mg/L)	Monthly TN (tonnes)	Mean monthly TP (mg/L)	Monthly TP (tonnes)
Jan-99	2,587	9	6.5	17.0	0.710	1.87	0.070	0.18
Feb-99	2,933	11	8.5	27.1	0.800	2.43	0.110	0.34
Mar-99	2,599	8	5.9	15.5	0.684	1.78	0.062	0.16
Apr-99	2,243	6	4.1	9.2	0.571	1.28	0.043	0.10
May-99	9,511	12	10.0	120.6	0.885	9.85	0.113	1.36
Jun-99	17,950	37	34.5	610.1	1.580	28.81	0.730	12.09
Jul-99	22,562	25	22.3	365.2	1.250	23.61	0.390	5.92
Aug-99	20,782	19	16.6	393.8	1.140	26.17	0.232	5.37
Sep-99	13,739	7	4.9	70.2	0.610	8.49	0.050	0.77
Oct-99	10,987	7	4.8	52.9	0.580	6.44	0.060	0.61
Nov-99	7,407	37	33.7	265.0	1.780	13.83	0.530	4.14
Dec-99	3,309	9	6.7	23.2	0.730	2.46	0.070	0.25
Jan-00	2,127	6	3.6	7.7	0.540	1.14	0.040	0.08
Feb-00	1,816	8	5.6	10.2	0.630	1.14	0.070	0.13
Mar-00	1,871	9	7.2	13.5	0.750	1.39	0.080	0.15
Apr-00	2,017	25	22.6	46.0	1.390	2.81	0.320	0.66
May-00	4,154	13	11.3	63.9	0.940	4.71	0.130	0.78
Jun-00	8,628	25	22.6	251.6	1.430	14.35	0.310	3.66
Jul-00	45,993	41	38.4	3115.3	1.920	125.87	0.650	61.64
Aug-00	19,166	23	20.3	472.8	1.340	28.75	0.270	6.61
Sep-00	29,602	25	22.4	808.2	1.400	46.55	0.320	12.25
Oct-00	21,214	21	18.8	493.8	1.250	29.91	0.260	7.33
Nov-00	9,078	18	15.9	176.0	1.175	11.90	0.190	2.26
Dec-00	3,232	12	10.3	32.9	0.892	2.87	0.120	0.38
Jan-01	2,269	5	3.3	7.6	0.520	1.17	0.040	0.08
Feb-01	1,704	8	5.6	9.7	0.600	1.02	0.080	0.14
Mar-01	2,315	6	3.9	10.1	0.550	1.35	0.040	0.11
Apr-01	2,416	8	5.9	14.6	0.680	1.65	0.060	0.15
May-01	2,330	4	2.1	5.0	0.410	0.96	0.030	0.07
Jun-01	8,290	39	36.0	404.1	1.900	19.54	0.550	6.42
Jun-01	10,469	38	35.2	471.4	1.880	23.46	0.530	7.33
Jul-01	8,885	38	35.3	387.1	1.840	18.55	0.560	6.59
Aug-01	52,061	36	33.6	1987.7	1.820	102.97	0.500	30.84
Sep-01	27,164	46	43.3	1439.4	2.132	66.46	0.707	24.44
Oct-01	22,052	58	54.3	1412.0	2.539	62.51	0.884	23.98
Nov-01	12,539	30	27.2	458.9	1.596	24.03	0.386	7.05
Dec-01	5,512	14	12.2	69.8	1.017	5.73	0.136	0.78
Totals	**423,515**			**14,139**		**728**		**235**

Table 3.4 shows export coefficients for the Duck River at DR4 for data collected during 1999, 2000 and 2001. Catchment discharge increased over successive years, with a corresponding increase in total suspended solids, total phosphorus and total nitrogen export coefficients. Large increases in total suspended solids and total phosphorus loads occurred between 1999 and 2000, however increases in total phosphorus coefficients were disproportionately high in comparison to increases in catchment discharge, indicating that increased flows mobilised high levels of available phosphorus from the catchment. The reasons for these large increases are difficult to confirm without additional information, but may be the results of changes in land-use (eg. land cleared for agriculture or forest harvesting) or river management practices (eg. increased drainage activities) combined with greater rainfall.

Table 3.4 Annual export coefficients for the Duck River at Scotchtown from 1999 to 2001.

Year	Catchment area (km^2)	Discharge (ML)	Total SS (kg/mm/km^2)	Total P (kg/mm/km^2)	Total N (kg/mm/km^2)
1999	339	116,609	16.89	0.269	1.09
2000	339	148,899	36.88	0.644	1.82
2001	339	158,006	46.26	0.683	2.22

Table 3.5 shows export coefficients for 11 Tasmanian rivers monitored over the last decade as part of the State of Rivers program. The Duck River has a relatively small catchment, and the intensive agricultural practices in the area are reflected in the extremely high phosphorus export coefficient for the catchment, which were second only to those recorded from the Montagu catchment. Nitrogen export is also elevated, but not to the same extent as total P, and were also only exceeded by levels in the Montagu River. The nitrogen to phosphorus export coefficient ratio was extremely low (approximately 3:1) which was similar to the N:P ratio from the Montagu, reflecting the high levels of phosphorus in these catchments, where dairy farming is the predominant agricultural activity.

Table 3.5 Export coefficients for 11 Tasmanian rivers monitored as part of the State of Rivers program over the last decade. Results for rivers where data has been collected over several years have been averaged.

Catchment	Years of data	Catchment area (km^2)	Mean annual dishcharge (ML)	Total P (kg/mm/km^2)	Total N (kg/mm/km^2)
Duck River @ Scotchtown	3	339	141,172	0.532	1.71
Montagu River @ Stuarts Rd	3	323	98,778	0.800	2.66
Inglis River @ railway bridge	3	175	116,030	0.081	1.16
Pipers River	1	298	96,700	0.083	1.17
Brid River	1	136	40,986	0.066	1.13
Meander River @ Strath Bridge	3	1,012	427,904	0.058	0.67
Liffey River	3	224	80,661	0.052	0.78
South Esk @ Perth	3	3,280	624,508	0.034	0.66
Break O'Day River	3	240	53,177	0.065	0.94
Huon River above Judbury	1	2,097	2,562,475	0.010	0.33
Kermandie River	1	130	36,760*	0.122	1.42

* Estimated flow data used. Historical data was obtained from previous 'State of River' reports – see Section 6 (References).

3.6 Summary

Nutrient load estimates for the Duck catchment were based on continuously logged turbidity and discharge data collected at the Duck River at Scotchtown (DR4), together with monthly and flood nutrient concentration data. During the three year study period, 14 138 687kg of suspended solids, 727 806kg of nitrogen and 235 215kg of phosphorus were exported past the Duck River at Scotchtown stream gauging site (DR4). Maximum monthly nutrient loads were recorded in July 2000, when a very large flood event occurred. A total of 3,115,272kg of suspended solids, 125,868kg of total nitrogen and 6,1643kg of total phosphorus were transported past the logging site during this month.

Export coefficients derived from the study data indicate that export loads from the Duck River catchment, particularly that for total phosphorus, were high within the Tasmanian context and were similar to levels calculated for the Montagu River. While the export of phosphorus from these two catchments is likely to be influenced by the high level of discharge typical of catchments on the northwest coast, it is also very likely that the high level of phosphorus export is a reflection of the level of dairy farming that characterises these two catchments.

4 Special Investigations

4.1 Mella Acid Drainage

During the course of the study period, an unexplained fish kill was reported in the Mella area. Subsequent investigations by DPIWE officers using hand-held meters found that the water of Scopus Creek was very acidic (pH <4), and this sparked further investigation of pH in streams in and around Mella. Flow in the creeks and drains of this area at this time was very low. While this field work was undertaken as part of the 'State of River' project, the resulting data was more comprehensively assessed and incorporated into an independent and separate study into acid drainage in Tasmania (Gurung, 2001).

Following notification of fish kills in Scopus Creek, hand-held instruments were used to examine the conduct local surveys on acidity in Scopus Creek, Fentons Creek, Blairs Outlet and Purions Outlet (Figure 4.1). All of these sites are in the vicinity of the Smithton Aerodrome, to the west of Smithton.

Two surveys were conducted in the winter of 2000, the results of which are presented in Table 4.1 below. The table shows that pH levels as low as 2.57 were recorded in Scopus Creek and that lowest pH tended to occur at sites S3 and B2 higher in the drainage system. Conditions were markedly worse in lower Scopus Creek during the first survey, which followed an extended dry period. Rainfall in late June may have moderated conditions in this creek, with much more neutral readings for pH resulting during the July survey. Conditions at S3 were still very high, highlighting this area as the source of acid.

Table 4.1: Field water quality data collected during investigations into fish kills in the Mella area during June 2000.

SITE NAME	Site	Date / Time	EC @ 25	Temp.	pH	DO
		(EST)	(μS/cm)	(°C)		%
Trip 1						
Scopus Creek @ Montagu Rd	S1	06/06/2000 09:10	661	7.5	4.95	82.8
Scopus Creek @ Hardmans Rd	S2	06/06/2000 09:40	852	8	4.68	81.1
Scopus Creek @ Malugas Rd	S3	06/06/2000 10:10	2620	9.6	2.57	1.5
Purions Outlet @ Mella Rd	P1	06/06/2000 10:00	1037	12.5	6.67	63.1
Blairs Outlet @ Batts Rd	B1	06/06/2000 09:50	839	11.4		71.7
Blairs Outlet @ Mella Rd	B2	06/06/2000 10:20	825	10.1	3.45	30.3
Fentons Creek @ Montagu Rd	F1	06/06/2000 09:25	961	7.2	7.68	72.9
Trip 2						
Scopus Creek @ Montagu Rd	S1	12/07/2000 09:50	600	9.5	7.07	90
Scopus Creek @ Hardmans Rd	S2	12/07/2000 10:30	595	9.8	7.08	85.4
Scopus Creek @ Malugas Rd	S3	12/07/2000 10:50	2230	10.6	2.79	4.2
Purions Outlet @ Mella Rd	P1	12/07/2000 10:40	855	15.3	7.36	73.6
Blairs Outlet @ Batts Rd	B1	12/07/2000 10:10	786	13.6	7.28	76.8
Blairs Outlet @ Mella Rd	B2	12/07/2000 11:00	547	10.4	4.57	43
Fentons Creek @ Montagu Rd	F1	12/07/2000 10:00	962	9.7	7.97	77.8

Ground Water / Acid Drainage Project – Mella

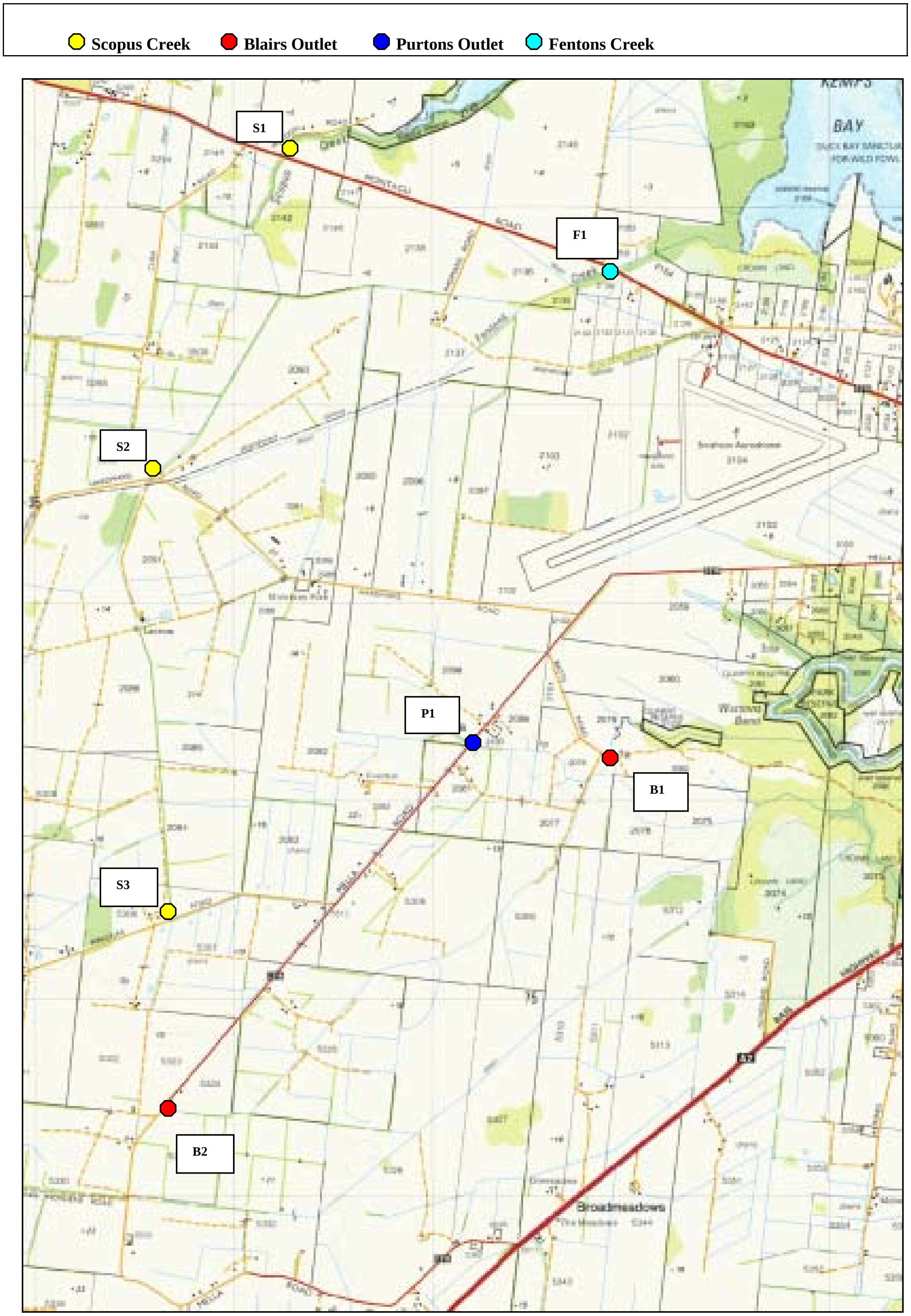

Figure 4.1: Map showing locations of sites tested during investigations into acid drainage in the Mella area.

At the time of the first survey, automated logging equipment was deployed in Scopus Creek at site S1, where the fish kill occurred, to examine whether pH was consistently low, or whether there was some pattern of change. The data from this logging event is shown in Figure 4.2. It shows that pH levels at the start of the deployment were quite low (~5.2), but it appears that significant rain that evening caused a major moderation of conditions, with pH raising to just over 7. Over the following 2 days pH gradually decreased (dropping to about 5.5) before once again rising over the last 2 days of the deployment. These data indicate that the creation of acid drainage in Scopus Creek is periodic and can change quite rapidly, with pH declining over a period as short as a single day. This has obvious implications for aquatic life, especially those biota that cannot avoid the area within that short time-frame.

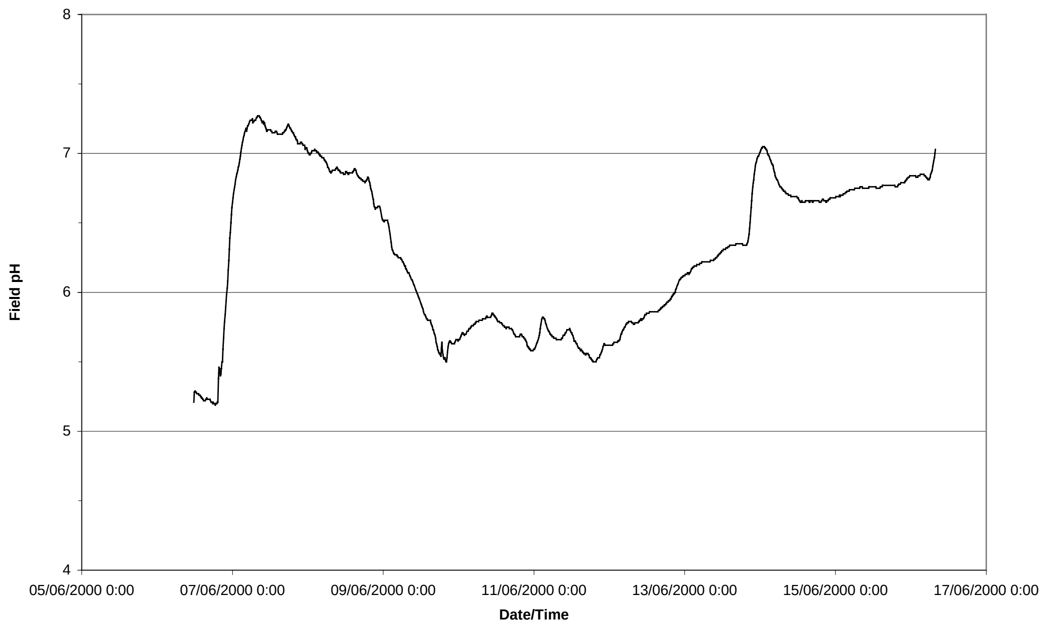

Figure 4.2: Time series plot showing change in pH in Scopus Creek (site S1) as recorded by continuous monitoring equipment between 6-16 June 2000.

The data collected during the study indicates that the area generating the acid water is centred on upper Scopus Creek (S3) and Blairs Outlet (B2). Gurung (2001) states that Holocene sediments in the Smithton area have the potential to host pockets of pyritic sediment. When these pockets of sediment are drained, and exposed to oxygen, they generate acid drainage water that can have serious downstream impacts. When the drainage water from the Mella area was analysed, sulphate concentrations in excess of 12, 000 mg/L were found. In the Mella area, it is postulated that the periodic high level of extraction of groundwater may result in lowering of the water table, exposing the pyritic sediment and causing acid generation. Precipitation is then able to ‘flush’ this acid water into local waterways, causing possible fish kills before sufficient dilution occurs. As well as the Mella area, acid sulphate soils are likely to exist in Togari, Montagu, Harcus and the Brittens Swamp areas. Identification and appropriate management of drainage activities in these areas may need to be considered.

5 Summary and Discussion

A number of water quality issues have been highlighted during the 'State of River' investigations in the Duck catchment between 1999 and 2001. The most serious water quality issue to arise from the monitoring program has been the very high nutrient concentrations (nitrogen and phosphorus) that are present at many sites throughout the catchment, and consequently the very large export loads that these sustain. The baseline concentrations of nutrients are high relative to other rivers that have been investigated in Tasmania, and while these nutrient concentrations are likely to lead to excessive in-stream plant growth during the summer, sampling of aquatic fauna communities suggests that these high concentrations may not be having a long-term deleterious impact on aquatic life. However, the export loads that have been estimated as leaving the catchment may have substantial impacts on conditions in the estuary, where there is some aquaculture development (DHHS, 2001).

This export of sediment and nutrients from the catchment also equates to the loss of a valuable resource, and efforts to retain these nutrients (and soil) should be considered in economic terms as well as environmental. In the longer term, retaining nutrients in the catchment has the potential to reduce the need for fertiliser application and increase farm profitability, in addition to producing better water quality in the catchment.

Some of the factors that are thought to be leading to the high nutrient concentrations and large nutrient export loads are intensive dairy farming in the catchment (particularly in the Edith Creek area), and the extensive development of drainage improvements that facilitate the transport of suspended material and nutrients from these areas. Widespread access by stock to these drainage systems is likely to further exacerbate this situation, particularly through continual disturbance of drain and creek beds and banks. This issue has been highlighted in the recently completed Rivercare plan for the Duck Catchment (Rabjohns, 2001), which also lists weed infestation and impacted riparian zones as issues that are also likely to lead to poor water quality. Better management of these issues, particularly the management of drains and stock access, should be the main focus for future activities, as changes in the way these are managed are likely to yield greatest improvements in water quality.

Another important finding from this study has been the impact of acid sulphate soils on water quality in Scopus Creek, and the threat this can pose to fish and other aquatic life in this drainage system. Investigations under this program have shown that exposure of these soils has the potential to generate extremely acidic water, and that groundwater in the Scopus Creek area must be monitored and water extraction managed to reduce the risk of this in the future. Additional work conducted at the time of the study (Gurung, 2001) has indicated that acid sulphate soils may also be present in the Togari, Brittens Swamp, Montagu and Harcus areas and suggests that this may be a wider issue for management.

While broader land-use activities are having an obvious impact on the quality of water in this catchment, it must be emphasised that industrial activities also have the potential to impact on water quality long after operations cease. This was highlighted in Coventry Creek, where leachate from a closed abattoir continues to have a significant impact on the quality of water in this small stream. It is estimated that 500 000 tonnes of waste material was buried at this site during its 50 years of operation, and this is likely to continue to be a source of pollutants to Coventry Creek and the lower reaches of the Duck River well into the future.

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