WATER QUALITY OF THE WOORI YALLOCK CATCHMENT

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EXECUTIVE SUMMARY

This study summarises water quality data collected from the Woori Yallock catchment between December 1997 and April 1998, as part of the Melbourne Water Healthy Waterways Program.

This study has found that McCrae Creek has excellent water quality in its headwaters. Cockatoo, Sassafras, Emerald, Menzies and Shepherd Creeks all have fairly good water quality. Woori Yallock Creek has good water quality throughout its length. Water quality is only fair in Macclesfield and Wandin Yallock Creeks and poor in Wattle Creek.

Water quality in lowland areas of the Woori Yallock catchment is mostly influenced by clearing of riparian strips, agricultural practices and effluent discharges. Replanting of riparian zones with native vegetation could be adopted to improve the water quality of surface inflows. This practice would also assist in the stabilising of streambanks.

The implementation of the Emerald-Cockatoo Wastewater Strategy will reduce poor quality effluent discharges to waterways in the Cockatoo area and will provide a significant improvement to the water quality of many of the creeks of the Woori Yallock catchment.

1.0 INTRODUCTION

The purpose of this report is to summarise water quality data for the Woori Yallock catchment collected between December 1997 and April 1998 as part of the Melbourne Water Healthy Waterways Program . This report offers background material that will be utilised in a summary report of the health of the waterways in the Woori Yallock catchment to be produced by Melbourne Water Corporation. The summary report will overview the stream assessment, water quality, diatoms, macroalgae, fish and macroinvertebrates of the Woori Yallock catchment.

2.0 WATER QUALITY SURVEILLANCE

2.1 Woori Yallock catchment

For the purpose of this report, the Woori Yallock catchment has been divided into two distinct drainage regions.

The first region comprises Cockatoo Creek and its major tributaries; Wattle, Shepherd, Macclesfield and McCrae Creeks. The drainage area of these streams stems from the slopes of the Great Dividing Ranges on the eastern side of Woori Yallock Creek. The confluence of Cockatoo and Woori Yallock Creeks is situated at Yellingbow (between Sites WOY08 and WOY05).

The second region includes Woori Yallock Creek and other tributaries that include Sassafras, Emerald, Menzies and Wandin Yallock Creeks. These streams drain from the slopes of the Dandenong Ranges.

2.2 Sampling Sites

Table 1 lists the 21 sites selected for water quality sampling in the Woori Yallock catchment. Sampling sites have been allocated codes in an upstream direction from the Yarra River; which is the opposite to the way material is presented in this report. For each creek, headwater sites are listed first, followed by sites in a downstream order. This procedure makes it possible to track the effect of water quality from upstream sites upon downstream sites.

Table 1. Water quality sampling sites in the Woori Yallock catchment.

Code	Waterway	Location	Reference	StreamWatch Code
COC21	Cockatoo Ck.	Tymon Rd.	311J9	
COC19	Cockatoo Ck.	Upstream of Wattle Ck.	311G3	UY32
COC18	Cockatoo Ck.	Tschampions Rd.	310E1	
COC14	Cockatoo Ck.	Kookaburra Lane	307 H1	UY12
WTL20	Wattle Ck.	Gembrook-Belgrave Rd.	311G3	UY52
SHE17	Shepherd Ck.	Beenak Rd.	712 D12	
SHE16	Shepherd Ck.	Koo Wee Rup-Healesville Rd.	308 F11	
MAC15	Macclesfield Ck.	Coopers Rd.	307 H10	
MCCO7	McCrae Ck	Gembrook Rd.	712 G10	
MCCO6	McCrae Ck	Koo Wee Rup-Healesville Rd.	305 K10	
SAS11	Sassafras Ck.	Downstream of Moxhams Rd.	124 H3	UY20
EME12	Emerald Ck	Upstream of Cavey Rd.	125 D2	UY39
MEN13	Menzies Ck.	Emerald-Monbulk Rd.	125 E6	UY18
WOY10	Woori Yallock Ck.	Old Emerald Rd.	125 E6	UY19
WOY09	Woori Yallock Ck.	O'Neill's Rd.	123 J10	
WOY08	Woori Yallock Ck.	Macclesfield Rd.	305 K8	UY11
WOY05	Woori Yallock Ck.	Parslows Bridge	305 K8	UY10
WOY04	Woori Yallock Ck.	Warburton Hwy.	286 A10	UY09
WOY01	Woori Yallock Ck.	Kylie Lane	286 A2	
WAY03	Wandin Yallock Ck.	Queens Rd.	G121 F5	
WAY02	Wandin Yallock Ck.	Sunnyside Rd.	285 G4	UY04

Water quality at each site was monitored on 7 occasions between December 1997 and April 1998. Base flows were sampling at 3 weekly intervals over this period.

Historical water quality data from the Streamwatch Monitoring Program (StreamWatch) was available for 11 of the study sites. The most comprehensive data included weekly monitoring for several chemical parameters between January 1992 and January 1994. The StreamWatch sites used in this report are listed in Table 1.

A map of the Woori Yallock catchment and site locations is shown in Figure 1.

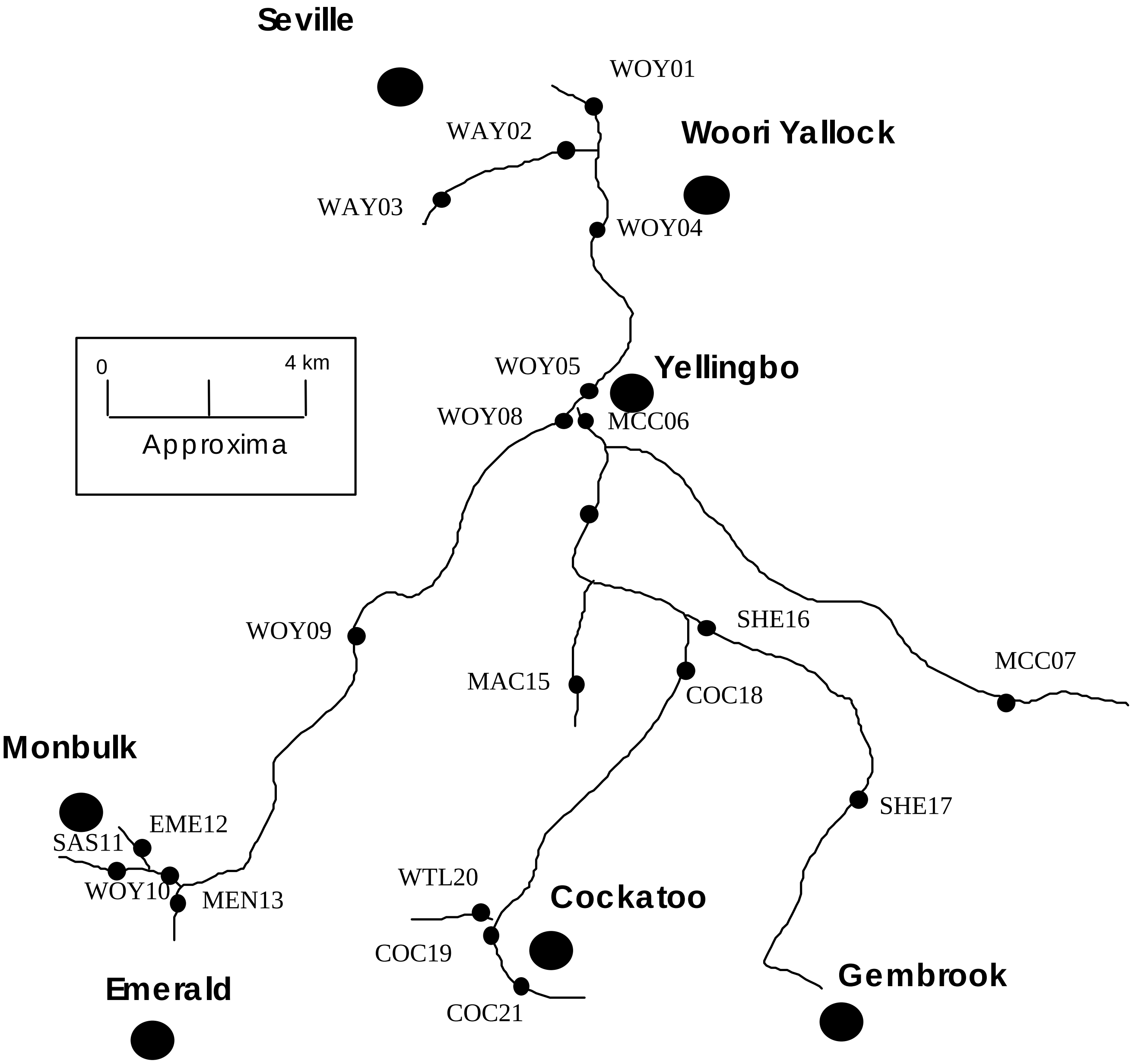


Figure 1. Map of the Woori Yallock catchment and site locations.

3.0 FIELD SAMPLING AND ANALYSIS

In situ field measurements were made with an Orion 230A pH meter, an Orion Model 130 conductivity meter, a YSI Model 51 B dissolved oxygen meter and a Orbeco Model 966 turbidity meter. All sampling was conducted by Streamline Research in accordance with NATA protocols. Australian Laboratory Services P/L conducted the analytical processing of fluoride, biochemical demand, suspended solids, total phosphorus, reactive phosphorus, ammonia, nitrate and nitrite, and total Kjeldahl nitrogen. Microtech provided the microbiological analysis for *E.coli*.

3.1 Surface Water Temperatures

Figures 2 and 3 show the surface water temperatures at sites monitored during this study. Surface water temperatures ranged between 11.4–17.5^{O} C, with notable variations between sampling runs. However, little variation in temperature was noted between sites on any sampling day. Peak stream temperatures were noted in December 1997 and January 1998, with minimum temperatures recorded in April 1998. The seasonal fluctuations are considered normal for this catchment. No marked increase in stream temperature was noted between the headwater and lowland parts of the catchment.

The median temperature ranged between 14-16^{O} C at all sites, which meets the objective of the draft State environment protection policy (SEPP) for the Yarra catchment (Environment Protection Authority (EPA), 1995). These surface water temperatures are considered acceptable for aquatic biota (ANZECC, 1992; EPA, 1995).

3.2 Levels of pH

Figures 4 and 5 show the levels of pH at sites monitored during this study. The majority of pH readings are between the lower limit (6.5) and the upper limit (9.0) of the range that is considered acceptable for waterways in the Yarra Basin (EPA, 1995). One pH reading (6.2) was below the lower SEPP limit, it was recorded in Woori Yallock Creek at the Warburton Highway (WOY04), on 29 January 1998. No pH values were recorded above the upper SEPP limit.

Fluctuations in pH occurred at all sites between sampling runs, however, the median pH was similar at most sites and ranged between 7.0-7.5. Several of the smaller streams; Wattle Creek (WTL20), Macclesfield Creek (MAC15) and Sassafras Creek (SAS11) were slightly more acidic, with median values of between 6.5-7.0. The overall median values of all sites are considered to be acceptable for aquatic communities (EPA,1995).

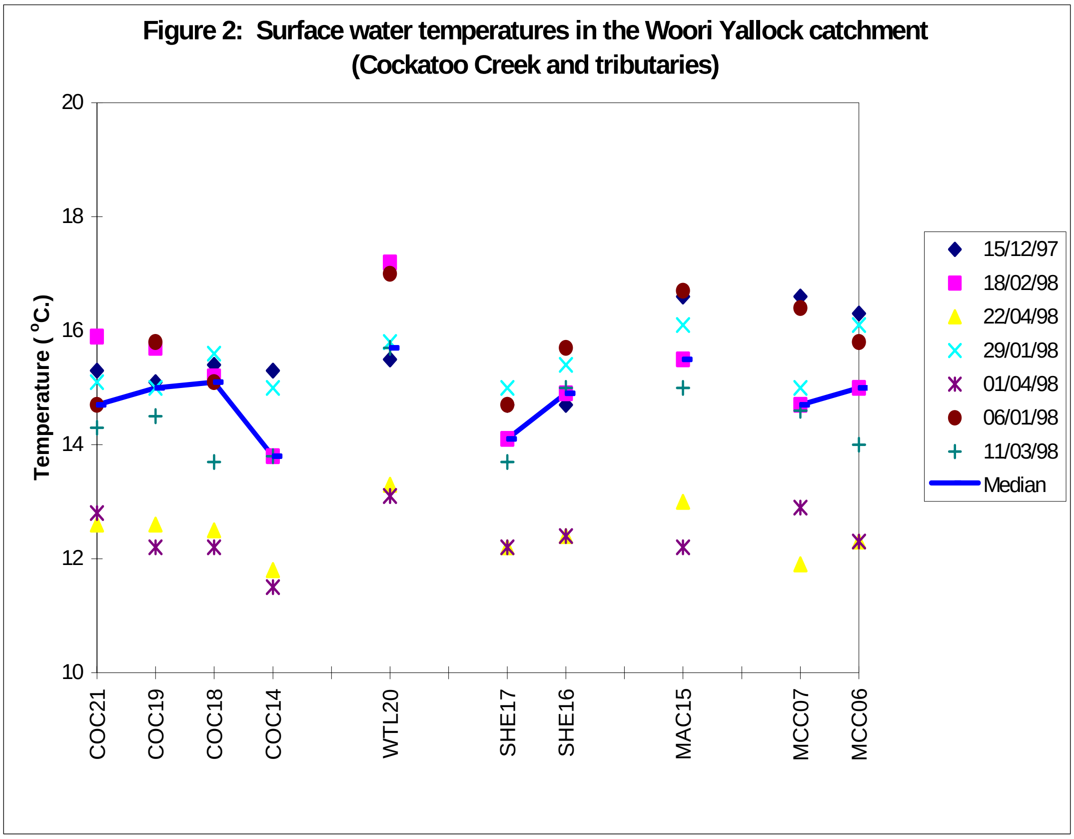


Figure 2: Surface water temperatures in the Woori Yallock catchment
(Cockatoo Creek and tributaries)
Temperature (°C.)
20
18
16
14
12
10
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
15/12/97
18/02/98
22/04/98
29/01/98
01/04/98
06/01/98
11/03/98
Median

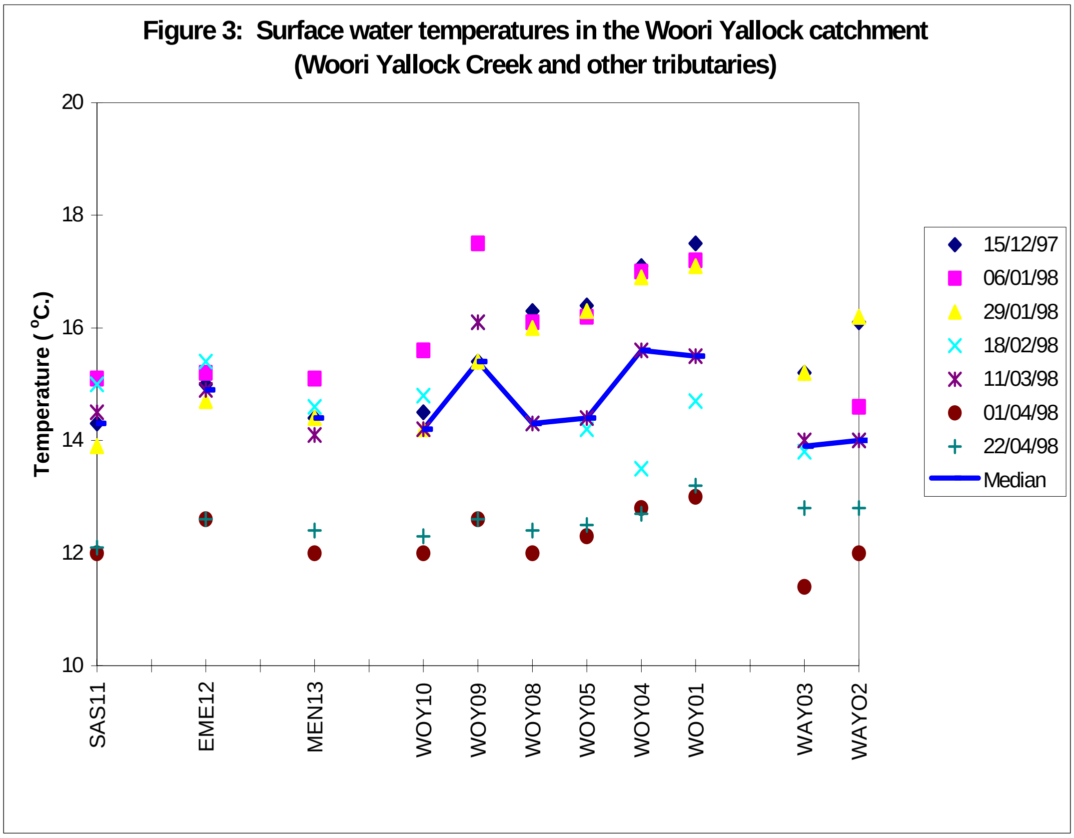


Figure 3: Surface water temperatures in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)
Temperature (°C.)
20
18
16
14
12
10
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

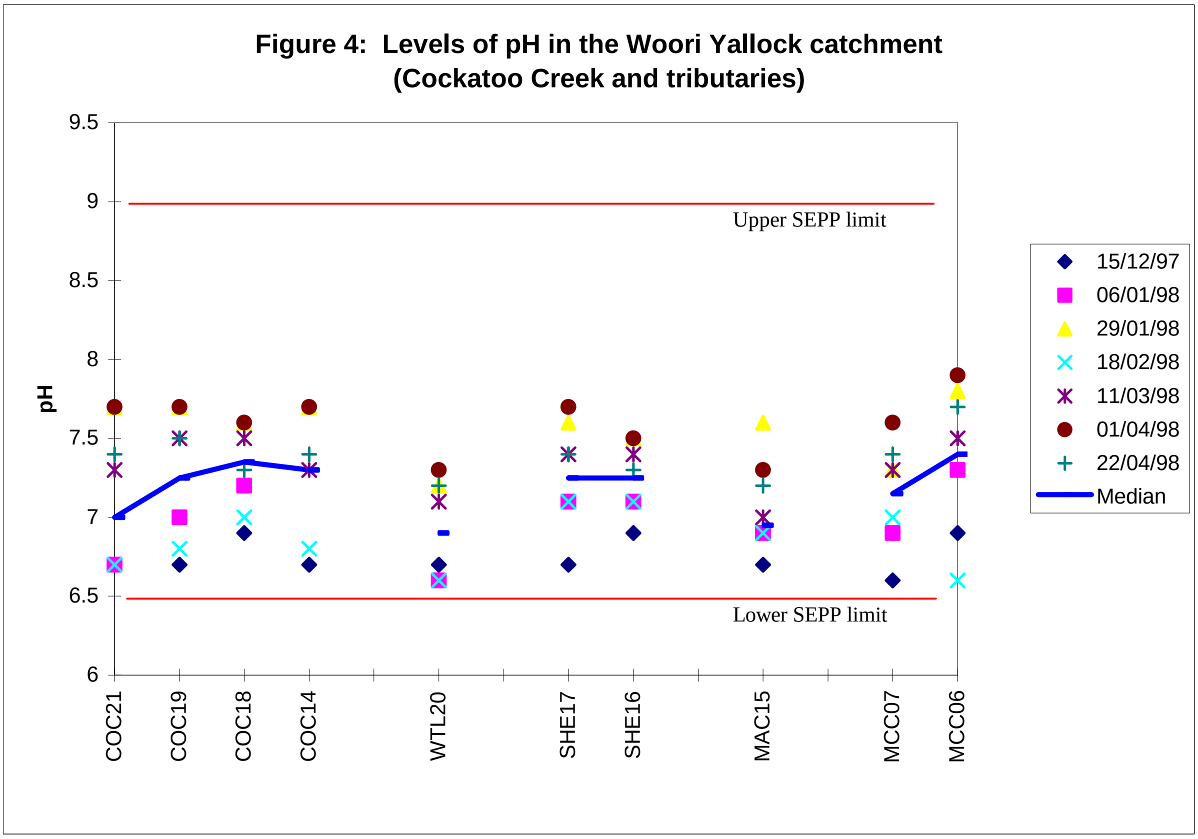


Figure 4: Levels of pH in the Woori Yallock catchment
(Cockatoo Creek and tributaries)
9.5
9
8.5
8
7.5
7
6.5
6
pH
Upper SEPP limit
Lower SEPP limit
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

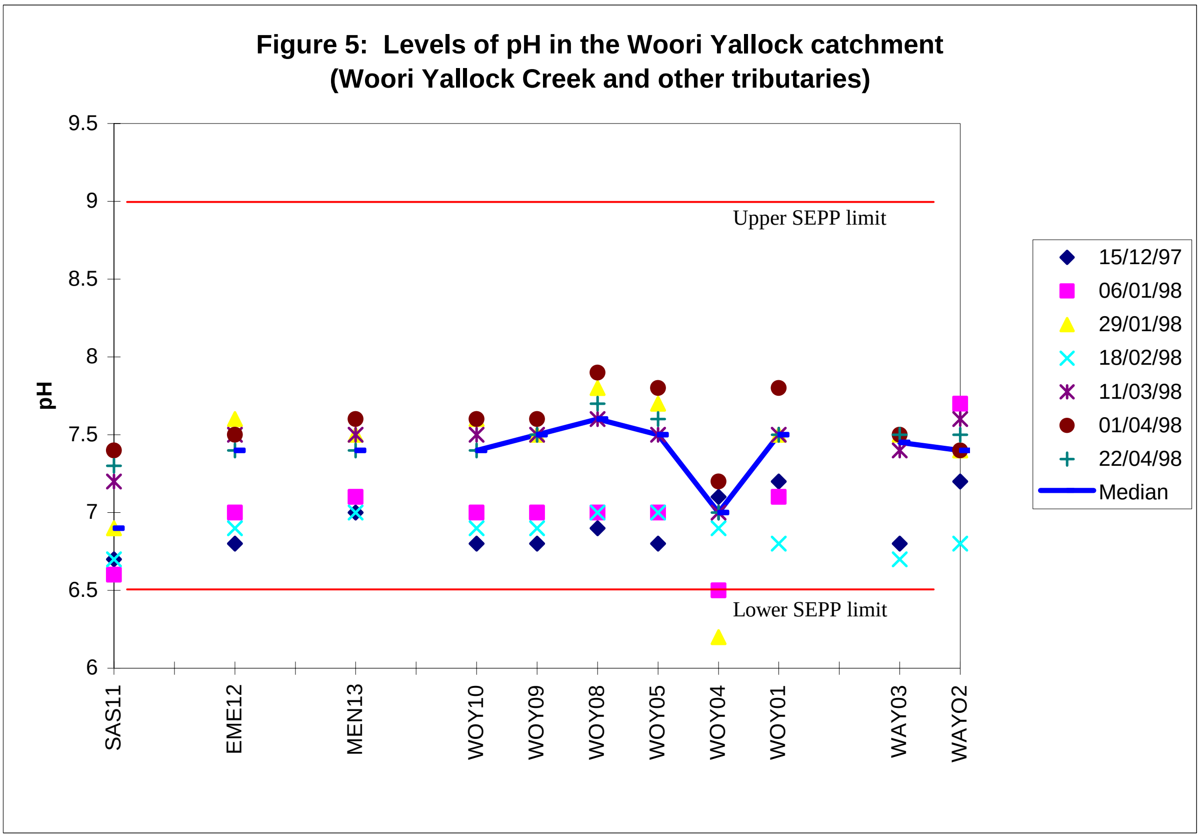


Figure 5: Levels of pH in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)
9.5
9
8.5
8
7.5
7
6.5
6
pH
Upper SEPP limit
Lower SEPP limit
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

3.3 Fluoride

Recent studies conducted by Melbourne Water as part of the Rolling Tributary program have measured fluoride concentrations as a method of monitoring the amount of water coming from domestic sources (eg. Coleman and Pettigrove, 1998). Streams in the Yarra catchment naturally have fluoride concentrations less than 0.1 mg/L (Brizga *et al.*, 1994 in Pettigrove and Coleman, 1998).

Figures 6 and 7 show the fluoride levels (mg/L) in the Woori Yallock Creek catchment. A maximum value of 0.6 mg/L was recorded in Shepherd Creek (SHE16) on 11 March 1998. Apart from Shepherd Creek, a fluoride concentration of 0.2 mg/L was recorded in McCrae Creek (MCC06) and Wandin Yallock Creek (WAY02 and WAY03). Overall, fluoride concentrations were low in the Woori Yallock catchment.

The fluoride levels found in the Woori Yallock catchment are consistent with findings from other studies conducted within the Yarra Basin. Farming areas generally have lower levels of fluoride than urban environments. Background fluoride levels found in the upper portion of the Woori Yallock catchment are similar to those noted for the Watts River (Coleman and Pettigrove, 1998) and for the Diamond Creek catchment (McGuckin, 1998). Fluoride levels of between 0.2-1.0 mg/L as noted in this study, appear to be fairly typical within urban streams and have also been found in Anderson and Jumping Creeks (Pettigrove and Coleman, 1998). Since Melbourne Water supplies are fluoridated to maintain an average concentration of around 1.0 mg/L (Haydon pers. comm. in Pettigrove and Coleman, 1998), it would appear that domestic water is only a minor contributor to base streamflow in the Woori Yallock catchment.

3.4 Conductivity

Figures 8 and 9 show the conductivity (uS/cm) at sites monitored during this study. Conductivity at most sites was fairly consistent for each of the sampling runs. No significant increase in conductivity was noted between upland and lowland sites. All conductivity readings were well below the 1500 uS/cm SEPP objective (EPA, 1995). All sites had conductivities close to 100 uS/cm, with the exception of Macclesfield and Wandin Yallock Creeks which had intermittent flows during the study period. At Macclesfield Creek, the conductivity ranged between 250-500 uS/cm. The highest conductivities were recorded in Wandin Yallock Creek (WAY03 and WAY02) and averaging 600-700 uS/cm.

Groundwater is known to vary greatly in quality throughout the Yarra catchment (EPA, 1995) and is likely to be the source of the higher salinities found in Macclesfield and Wandin Yallock Creeks. The elevated conductivity in Macclesfield and Wandin Yallock Creeks is likely to favour the survival of salt tolerant biota which may not occur in other less saline streams of the Woori Yallock catchment.

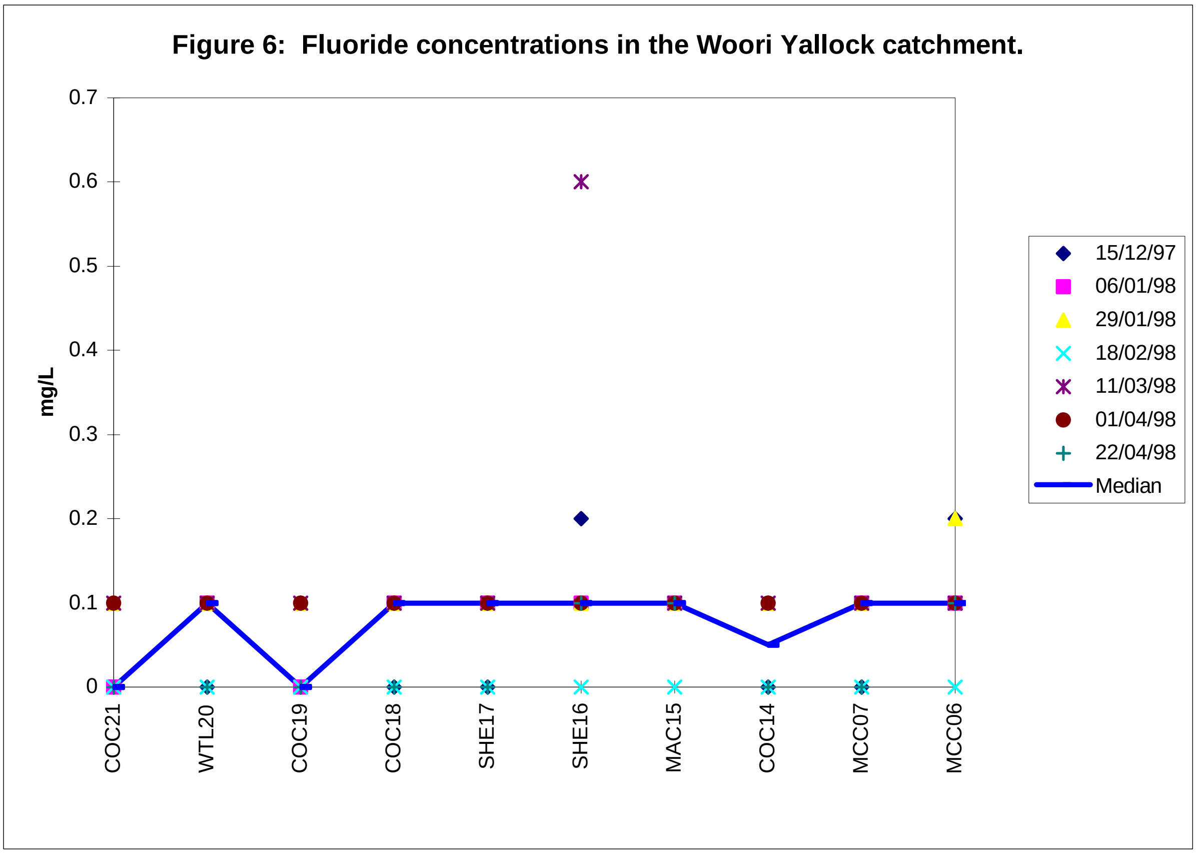


Figure 6: Fluoride concentrations in the Woori Yallock catchment.
mg/L
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
COC21
WTL20
COC19
COC18
SHE17
SHE16
MAC15
COC14
MCC07
MCC06
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

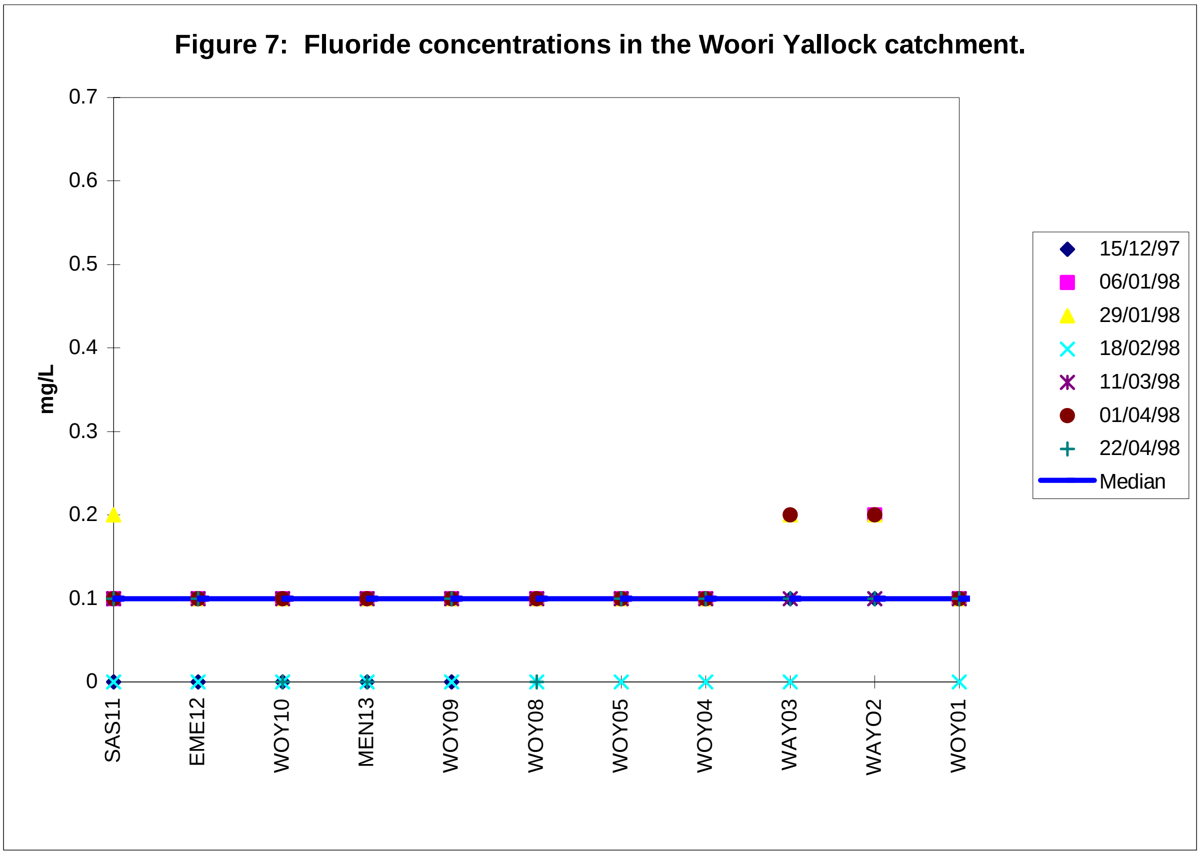


Figure 7: Fluoride concentrations in the Woori Yallock catchment.
mg/L
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
SAS11
EME12
WOY10
MEN13
WOY09
WOY08
WOY05
WOY04
WAY03
WAYO2
WOY01
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

Figure 8: Conductivity in the Woori Yallock catchment (Cockatoo Creek and tributaries)

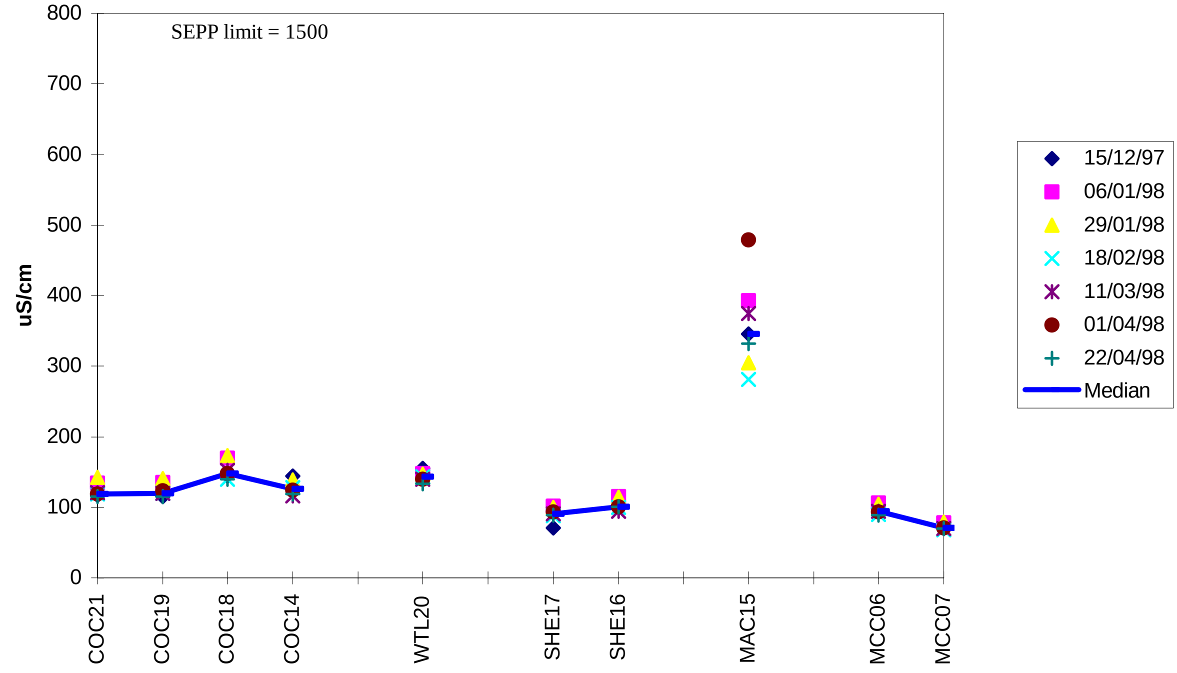
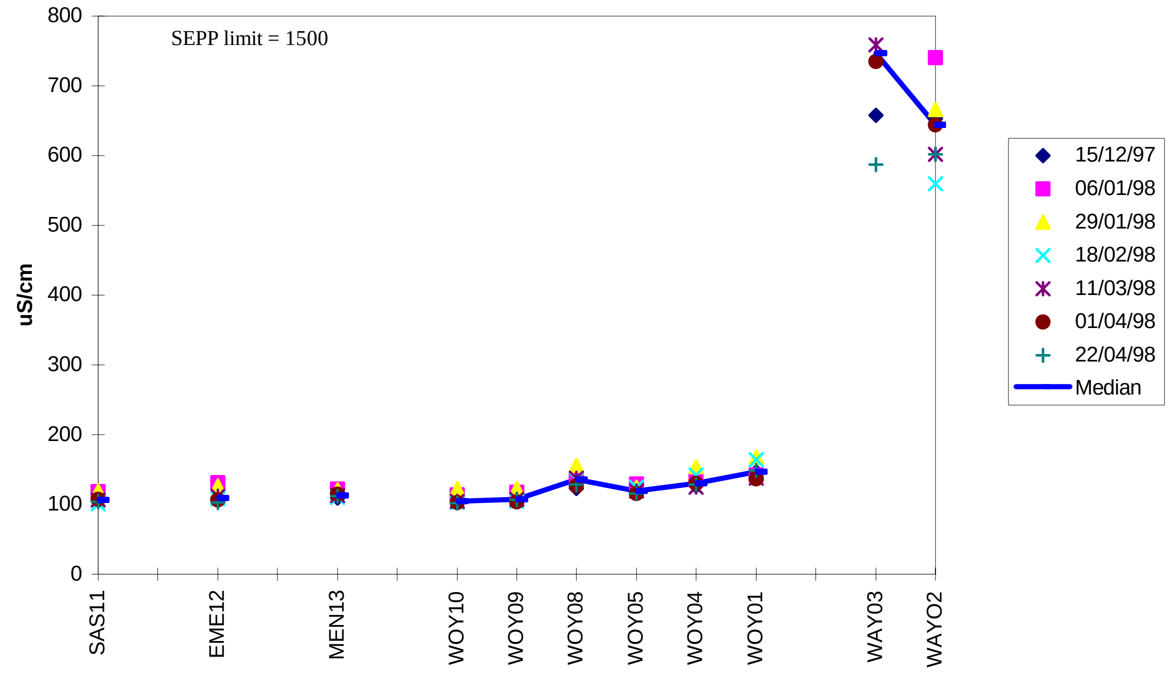


Figure 9: Conductivity in the Woori Yallock catchment (Woori Yallock Creek and other tributaries)



3.5 Biochemical Oxygen Demand

Figures 10 and 11 show the Biochemical Oxygen Demand (BOD) at sites monitored during this study. At most sites, the BOD was found to be less than 8 mg/L, except for concentrations of 20 mg/L recorded in Shepherd (SHE17), Woori Yallock (WOY01) and Wandin Yallock Creeks (WAY02) on 22 April 1998. Median values were consistent throughout the catchment and in the range of 2-6 mg/L.

BOD is considered a measure of pollution and values less than 6 mg/L would appear to be acceptable for aquatic life. The BOD values in the Woori Yallock catchment are similar to those of the Watts catchment (Coleman and Pettigrove, 1998), Anderson and Jumping Creeks (Pettigrove and Coleman, 1998) and the Diamond Creek catchment (McGuckin, 1998).

Table 2 shows StreamWatch BOD data for the Woori Yallock catchment between 1992 and 1994. Table 2 shows that low BOD values are typical for most sites in the Woori Yallock catchment. Wattle Creek (WTL20) has the highest BOD based on this historical data.

Table 2. Biochemical Oxygen Demand (mg/L) at StreamWatch sites in the Woori Yallock catchment.

StreamWatch Site	Study Site	Period of record	No.	Min	Max	Mean	Percentile				
							10	25	50	75	90
UY32	COC19	04/03/92-10/01/94	90	0.2	5.2	1.6	0.4	0.8	1.2	2.0	3.2
UY12	COC18	22/01/92-10/01/94	98	0.4	6.4	1.7	0.6	1.0	1.4	2.0	2.8
UY52	WTL20	01/04/92-10/01/94	83	4.4	70.0	13.4	5.0	6.6	10.0	14.0	20.0
UY20	SAS11	22/01/92-11/10/93	82	0.2	7.0	1.5	0.5	0.8	1.0	1.6	3.0
UY39	EME12	04/01/93-10/01/94	51	0.2	5.0	1.5	0.4	0.6	1	1.8	3.2
UY18	MEN13	22/01/92-10/01/94	97	0.2	4.6	1.5	0.6	0.8	1.2	2.0	3.4
UY19	WOY10	22/01/92-10/01/94	96	0.2	7.6	1.6	0.5	0.8	1.2	2.0	4.0
UY11	WOY08	22/01/92-10/01/94	99	0.2	4.8	1.5	0.6	1.0	1.2	1.8	2.2
UY10	WOY05	22/01/92-10/01/94	96	0.2	3.6	1.3	0.6	0.8	1.2	1.6	2.0
UY09#	WOY04	22/01/92-29/05/97	118	0.2	5.6	1.5	0.6	1.0	1.2	1.8	2.6
UY04	WAY02	22/01/92-10/01/94	98	0.4	7.0	2.1	1.0	1.4	1.8	2.2	4.2

data between 1992 and 1997.

3.6 Dissolved Oxygen Concentrations

Figures 12 and 13 show the dissolved oxygen concentrations at sites monitored during this study. The SEPP objective for dissolved oxygen of 80 % saturation (EPA, 1995) was met at most sites. The only exceptions were within Macclesfield Creek (MAC15) and Wandin Yallock Creek (WAY03 and WAY02), in which, oxygen concentrations fell to a low of 40 % saturation on several occasions. Both Macclesfield and Wandin Yallock Creek stopped flowing during this study and it was at these times that oxygen concentrations declined. During periods in which streamflow existed in these creeks, oxygen concentrations were close to the SEPP objective.

Figure 10: Biochemical oxygen demand in the Woori Yallock catchment (Cockatoo Creek and tributaries)*

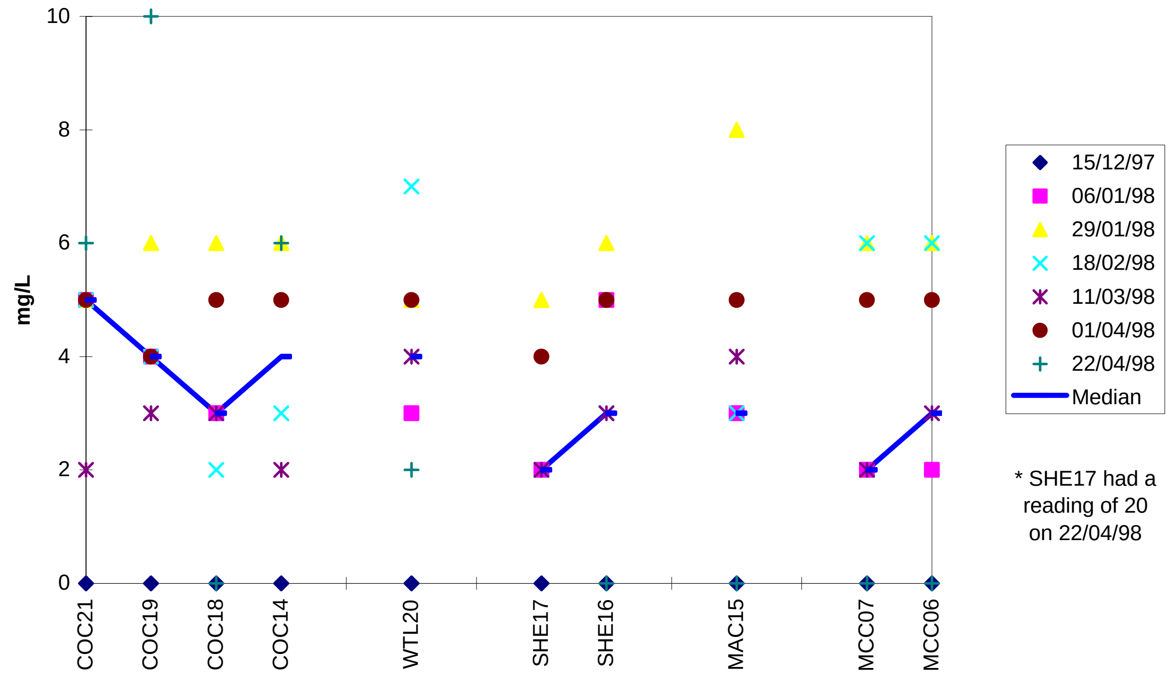


Figure 11: Biochemical oxygen demand in the Woori Yallock catchment (Woori Yallock Creek and other tributaries)*

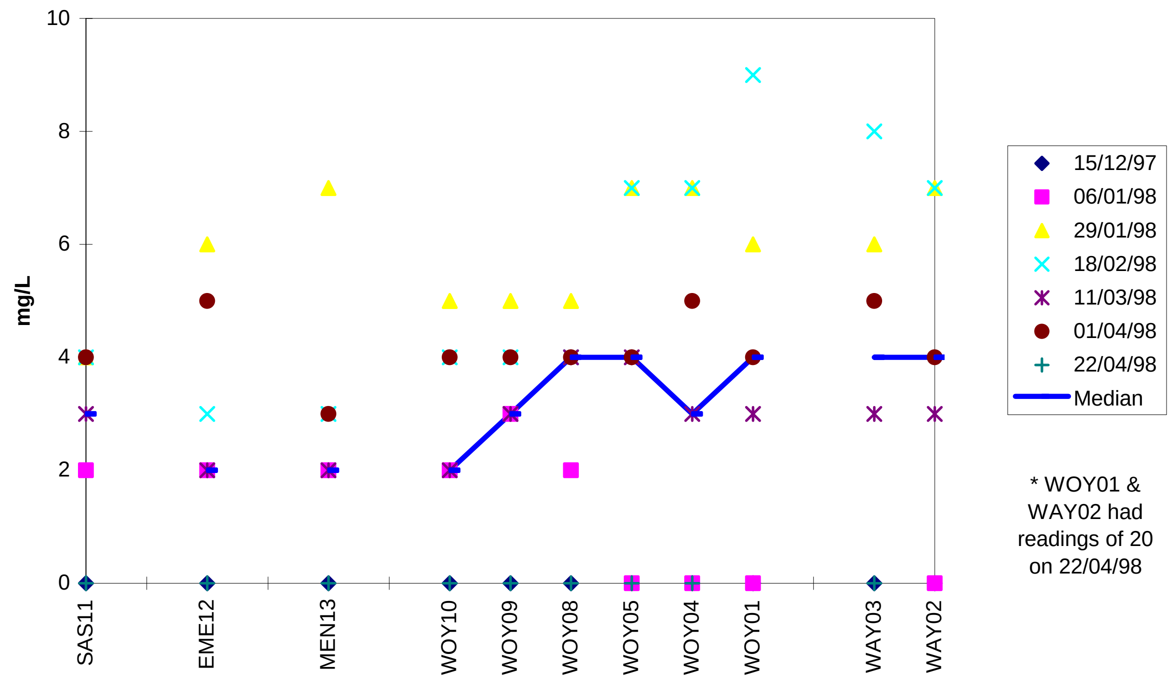


Figure 12: Dissolved oxygen concentrations in the Woori Yallock catchment (Cockatoo Creek and tributaries)

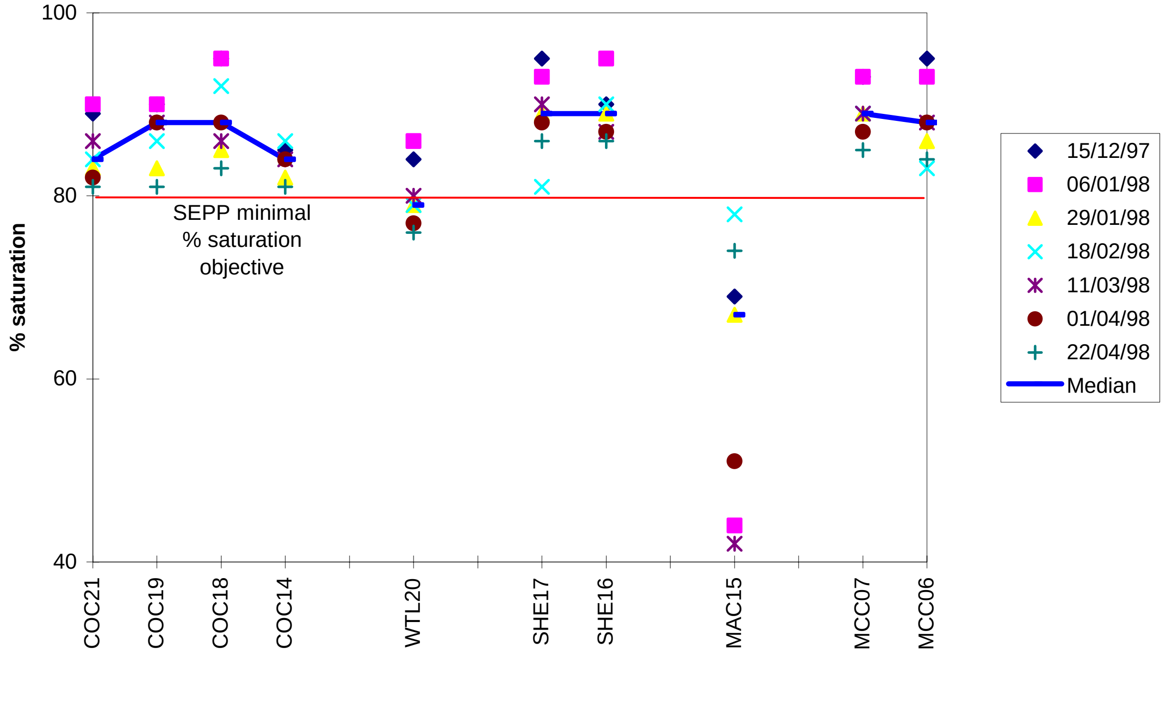
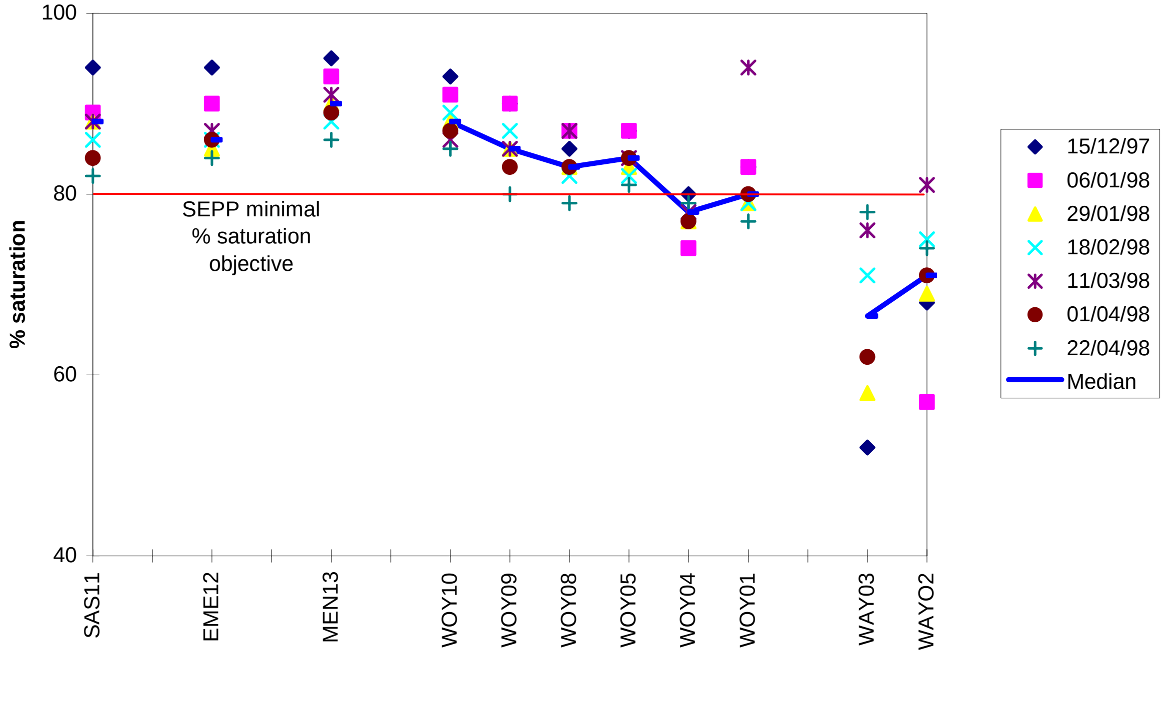


Figure 13: Dissolved oxygen concentrations in the Woori Yallock catchment (Woori Yallock Creek and other tributaries)



Fish and invertebrates are expected to become stressed when oxygen concentrations are below 80% saturation (ANZECC, 1992; Koehn & O'Connor, 1990). The low flow events that occurred during 1997-98 have been associated with drought conditions, consequently, Macclesfield and Wandin Yallock Creeks may meet the SEPP objective when more usual annual base flows occur.

The median dissolved oxygen concentration were highest in the headwaters of the catchment and diminished slightly in the lowlands areas, which is common for river systems. In headwater streams, riffles and runs contribute to water turbulence, elevating dissolved oxygen concentrations. At lowland sites, there is less water turbulence because the proportion of riffles and runs to pools is considerably lower than upland streams, therefore, dissolved oxygen concentrations are somewhat lower at these sites.

3.7 Suspended Solids

Figures 14 and 15 show the suspended solids at sites monitored during this study. Most of all sites had suspended solid concentrations that were below the SEPP annual 50th percentile objective (EPA, 1995).

Wattle Creek (WTL20) was the only site that had a median that exceeded both the SEPP annual 50th and 90th percentile. In Wattle Creek (WTL20), suspended solid concentrations exceeded the SEPP annual 90th percentile on 4 of the 7 sampling occasions. There was only one occasion that the concentration at this site was below the SEPP annual 50th percentile. It is suspected that seepage from a faulty septic system may have been the cause of the elevated suspended solid readings. Cockatoo Creek (COC19 and COC14) exceeded the SEPP 90 percentile on 15 December 1997, as did Wandin Yallock Creek (WAY02) on 22 April 1998.

The suspended solid reading of 208 mg/L in Wandin Yallock Creek on 22 April 1998 was approximately 10 times higher than any other value recorded at this site. It is suspected that the turbidity at this site would be similarly elevated, but it was not. Therefore, it is assumed that the suspended solid value has been incorrectly reported (possibly should have been reported as 20.8).

StreamWatch suspended solid data collected from the Woori Yallock catchment is presented in Table 3. With the exception of sites on Cockatoo Creek (COC19 and COC18), Menzies Creek (MEN13) and Woori Yallock Creek (WOY10), the 75 percentile suspended solid concentrations in the Woori Yallock catchment have been below the 40 mg/L SEPP annual 90th percentile objective (EPA, 1995). All of the above mentioned sites have historically received effluent water from sewerage plants. Improved sewage disposal as proposed by the Emerald-Cockatoo Wastewater Strategy (Yarra Valley Water, 1995) should resulting in an overall lowering of suspended solid concentrations at these sites.

Figure 14: Suspended solids in the Woori Yallock catchment (Cockatoo Creek and tributaries)

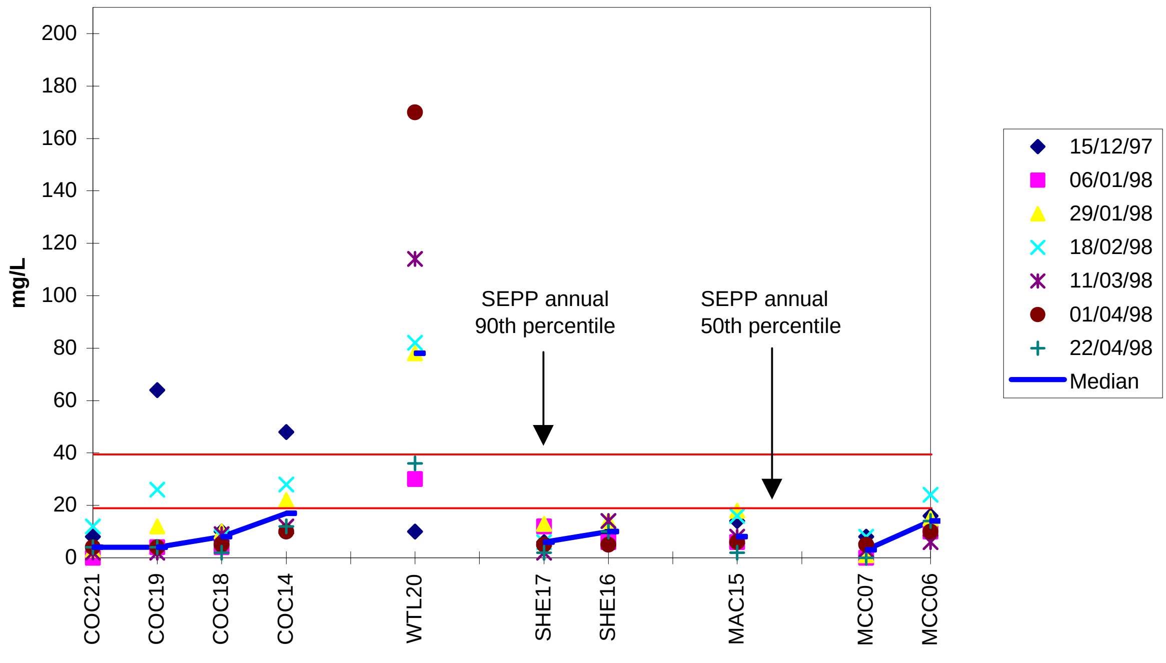


Figure 15: Suspended solids in the Woori Yallock catchment (Woori Yallock Creek and other tributaries)

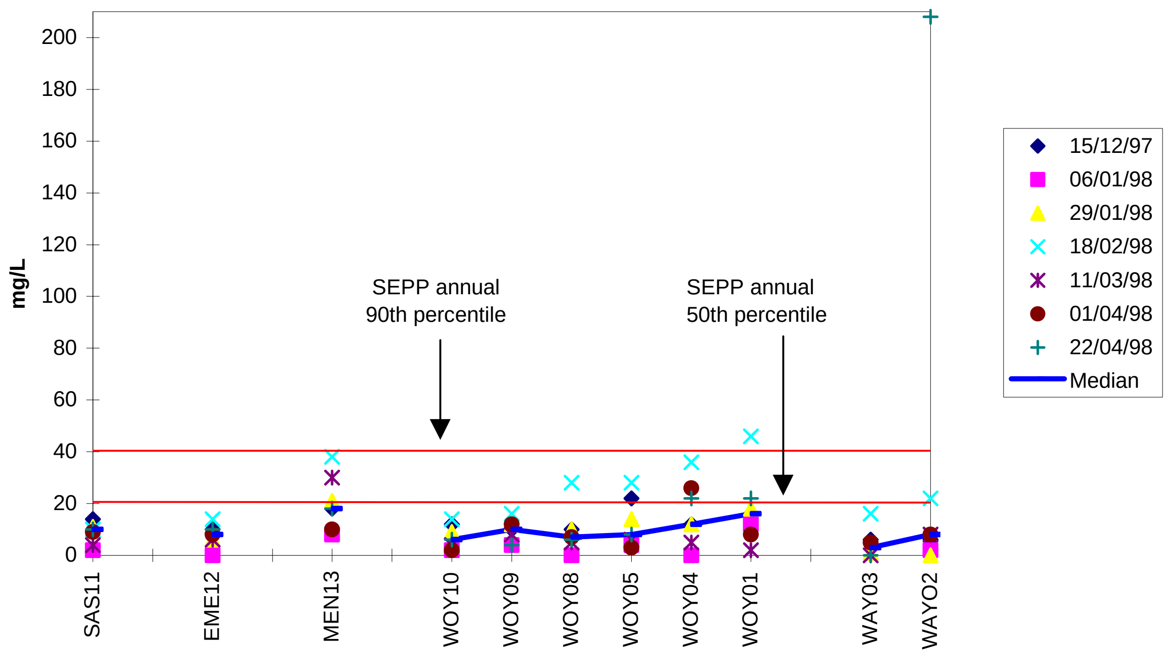


Table 3. Suspended solid concentrations (mg/L) at StreamWatch sites in the Woori Yallock catchment.

StreamWatch Site	Study Site	Period of record	No.	Min	Max	Mean	Percentile				
							10	25	50	75	90
UY32	COC19	04/03/92-10/01/94	90	4	420	53	10	24	36	60	110
UY12	COC18	22/01/92-10/01/94	97	5	490	81	13	32	68	98	137
UY52	WTL20	01/04/92-10/01/94	81	5	170	23	8	12	16	24	34
UY20	SAS11	22/01/92-11/10/93	81	2	926	44	15	20	27	38	65
UY39	EME12	04/01/93-10/01/94	51	4	81	21	7	10	14	26	42
UY18	MEN13	22/01/92-10/01/94	96	4	186	37	17	22	30	40	77
UY19	WOY10	22/01/92-10/01/94	95	3	340	33	14	18	22	37	79
UY11	WOY08	22/01/92-10/01/94	98	7	278	49	11	19	40	60	88
UY10	WOY05	22/01/92-10/01/94	95	7	121	31	11	18	25	38	101
UY09#	WOY04	22/01/92-29/05/97	148	2	90	25	9	16	21	30	40
UY04	WAY02	22/01/92-10/01/94	98	2	274	33	5	8	14	33	84

data between 1992 and 1997.

3.8 Turbidity

Figures 16 and 17 show turbidity readings for each of the study sites. The majority of sites had turbidity readings that exceeded the SEPP annual 50th percentile (15 NTU) and about half of the sites exceeded the SEPP annual 90th percentile (30 NTU) on at least one occasion. The highest turbidity in this study (83 NTU), was recorded in Cockatoo Creek (COC14) on 15 December 1997. On 3 other occasions, the turbidity at this site exceeded 30 NTU. Macclesfield Creek consistently recorded turbidities of about 30 NTUand is suspected to have been the source of elevated turbidities in Cockatoo Creek (COC14). Turbidities in Wattle Creek were consistently above the SEPP annual 50th percentile and often above the SEPP annual 90th percentile.

Maximum turbidities recorded for the Woori Yallock and Wandin Yallock Creeks were recorded on 18 February 1998. Heavy rain in the Woori Yallock catchment several days earlier, is expected to be responsible for these elevated turbidities.

Headwater sites, Cockatoo Creek (COC21), Shepherd Creek (SHE17), McCrae (MCC07), and Sassafras Creek (SAS11) had relatively consistent turbidities readings with less than a 10 NTU difference between all sampling events. The McCrae Creek headwater site (MCC07) was the least variable of all sites. Low turbidities recorded in headwater sites reflect the advantage of retaining forested riparian strips for binding soil and reducing sediment inflow. Man made disturbances caused by clearing of native vegetation would contribute to increased turbidities noted at sites downstream of headwater sites (COC14, SHE16, MCC06 and WAY02).

The median turbidity was more variable in the tributaries of Woori Yallock Creek than within the creek itself. Within Woori Yallock Creek, the median turbidity was noted to increase at downstream sites but was close to the SEPP annual 50th percentile objective (EPA, 1995).

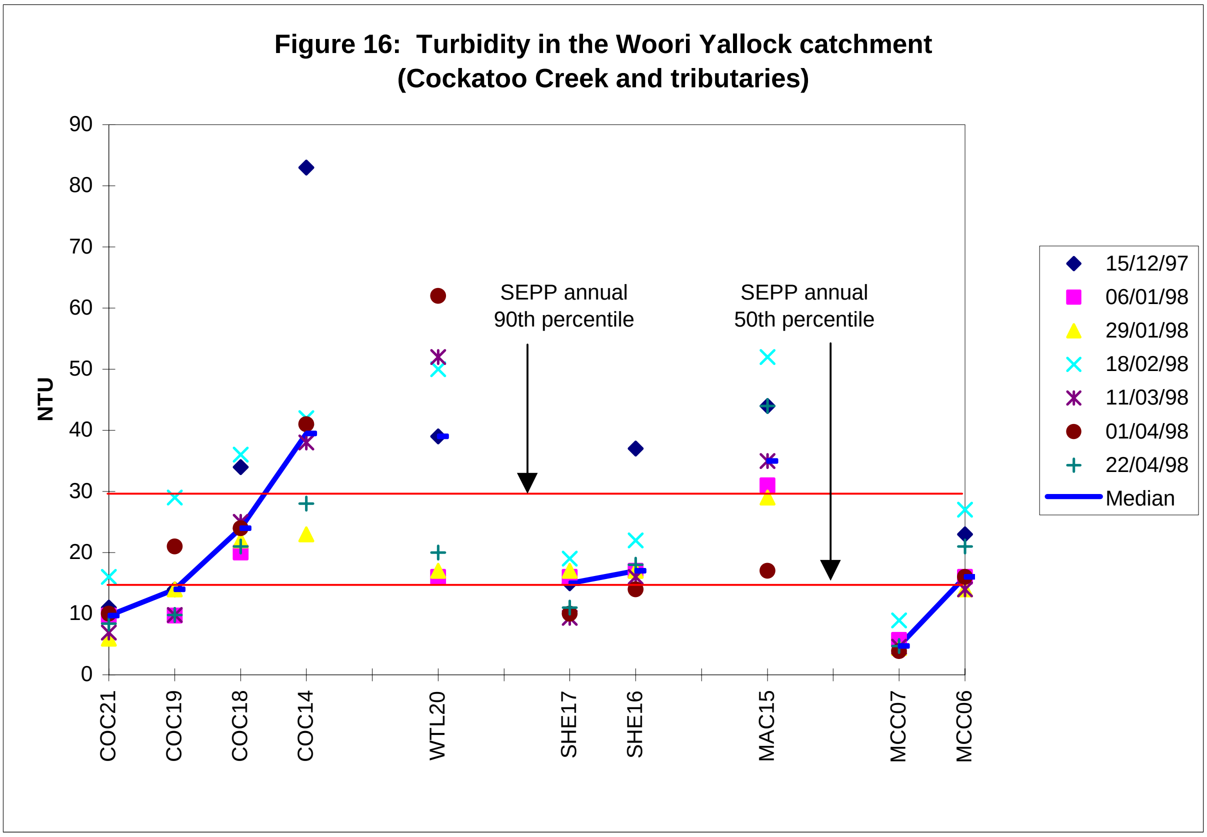


Figure 16: Turbidity in the Woori Yallock catchment
(Cockatoo Creek and tributaries)
NTU
0
10
20
30
40
50
60
70
80
90
SEPP annual
90th percentile
SEPP annual
50th percentile
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

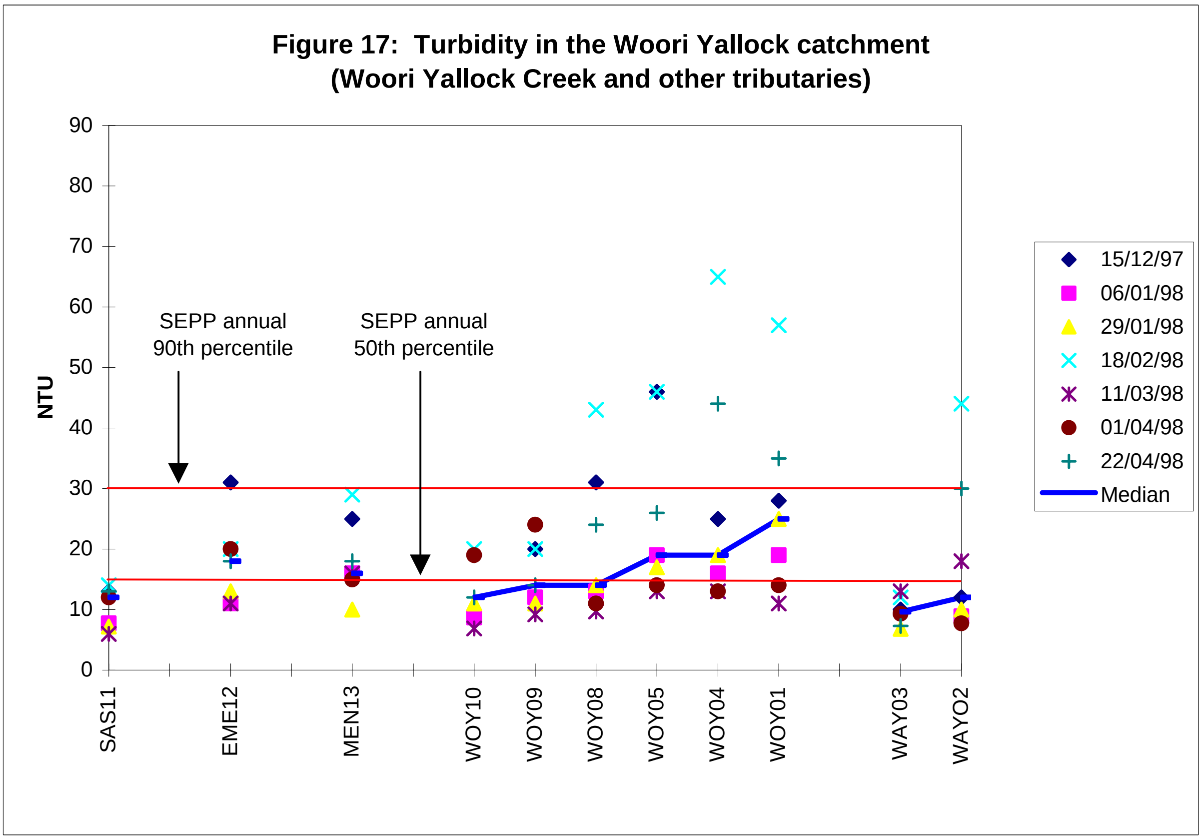


Figure 17: Turbidity in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)
NTU
0
10
20
30
40
50
60
70
80
90
SEPP annual
90th percentile
SEPP annual
50th percentile
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

4.0 NUTRIENTS

4.1 Phosphorus

Figures 18 and 19 show the total phosphorus (TP) concentrations for sites monitored during this study. The total phosphorus SEPP objective for the Woori Yallock catchment is 0.05 mg/L (EPA, 1995). In some creeks, levels of TP were up to 6 times the SEPP objective. At most sites, the highest TP concentrations were recorded on 15 December 1997, however, at Wattle Creek (WTL20), readings of 0.65 mg/L and 0.43 mg/L occurred on 18 February and 11 March 1998. Median concentrations throughout the Woori Yallock catchment were between 0.08-0.18 mg/L, or about 2 to 4 times the SEPP objective.

The amount of phosphorus that is readily available for uptake by aquatic biota is a measure of the ratio of orthophosphate in the TP concentration. Figures 20 and 21 show that the average orthophosphate and average TP levels are similar at each site in the Woori Yallock catchment. This suggests that orthophosphate is a principal component of the TP levels. The most likely source of the high phosphorus levels is from the input of raw sewage, possibly from faulty septics and poor wastewater treatment (Yarra Valley Water, 1995).

Table 4 is a summary of StreamWatch TP data collected in the Woori Yallock catchment between 1992 and 1994 (data for StreamWatch Site UY09 is between 1992 and 1997). Most sites had a mean TP concentration that exceeds the SEPP objective.

Table 4. TP (mg/L) at StreamWatch sites in the Woori Yallock catchment.

StreamWatch Site	Study Site	Period of record	No.	Min	Max	Mean	Percentile				
							10	25	50	75	90
UY32	COC19	04/03/92-10/01/94	92	0.010	0.57	0.09	0.01	0.030	0.056	0.110	0.16
UY12	COC18	22/01/92-10/01/94	99	0.010	1.10	0.11	0.03	0.052	0.087	0.120	0.16
UY52	WTL20	01/04/92-10/01/94	83	0.740	13.00	8.75	7.10	8.000	9.000	9.700	10.00
UY20	SAS11	22/01/92-11/10/93	84	0.010	1.10	0.10	0.02	0.050	0.07	0.010	0.14
UY39	EME12	04/01/93-10/01/94	50	0.005	0.18	0.05	0.01	0.028	0.045	0.069	0.09
UY18	MEN13	22/01/92-10/01/94	99	0.010	0.74	0.07	0.01	0.026	0.048	0.074	0.14
UY19	WOY10	22/01/92-10/01/94	98	0.009	0.80	0.07	0.01	0.026	0.050	0.080	0.15
UY11	WOY08	22/01/92-10/01/94	99	0.007	0.44	0.08	0.01	0.038	0.061	0.099	0.14
UY10	WOY05	22/01/92-10/01/94	96	0.006	0.29	0.05	0.01	0.027	0.048	0.069	0.10
UY09#	WOY04	22/01/92-29/05/97	147	0.010	0.39	0.06	0.02	0.032	0.048	0.067	0.10
UY04	WAY02	22/01/92-10/01/94	99	0.040	3.00	0.19	0.07	0.100	0.140	0.180	0.27

data between 1992 and 1997.

Table 5 shows the ratio between the median orthophosphate and TP values for selected StreamWatch sites. Generally, only 10% of all values recorded during this time period were below the SEPP objective. These data show that exceptionally high values have been recorded in Wattle Creek (WTL20); most likely from sewage discharged from upstream.

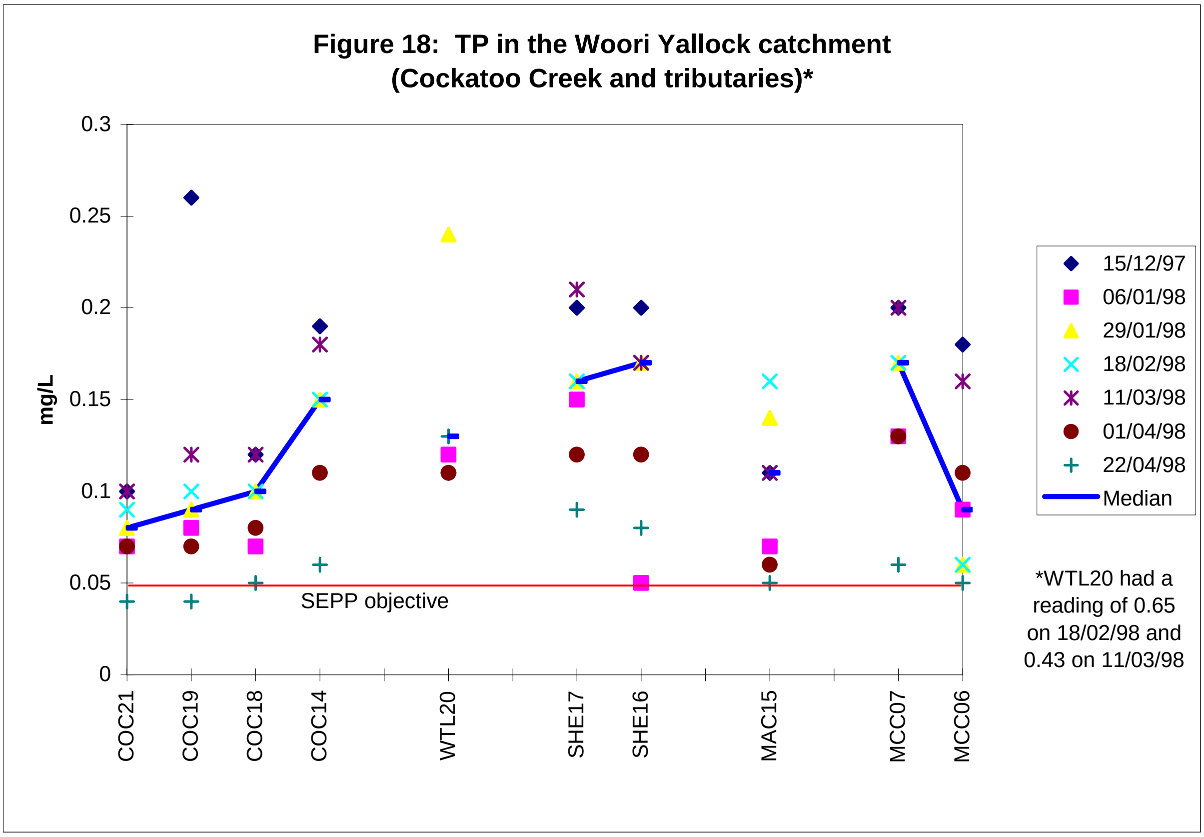


Figure 18: TP in the Woori Yallock catchment
(Cockatoo Creek and tributaries)*
mg/L
0.3
0.25
0.2
0.15
0.1
0.05
0
SEPP objective
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median
*WTL20 had a reading of 0.65 on 18/02/98 and 0.43 on 11/03/98

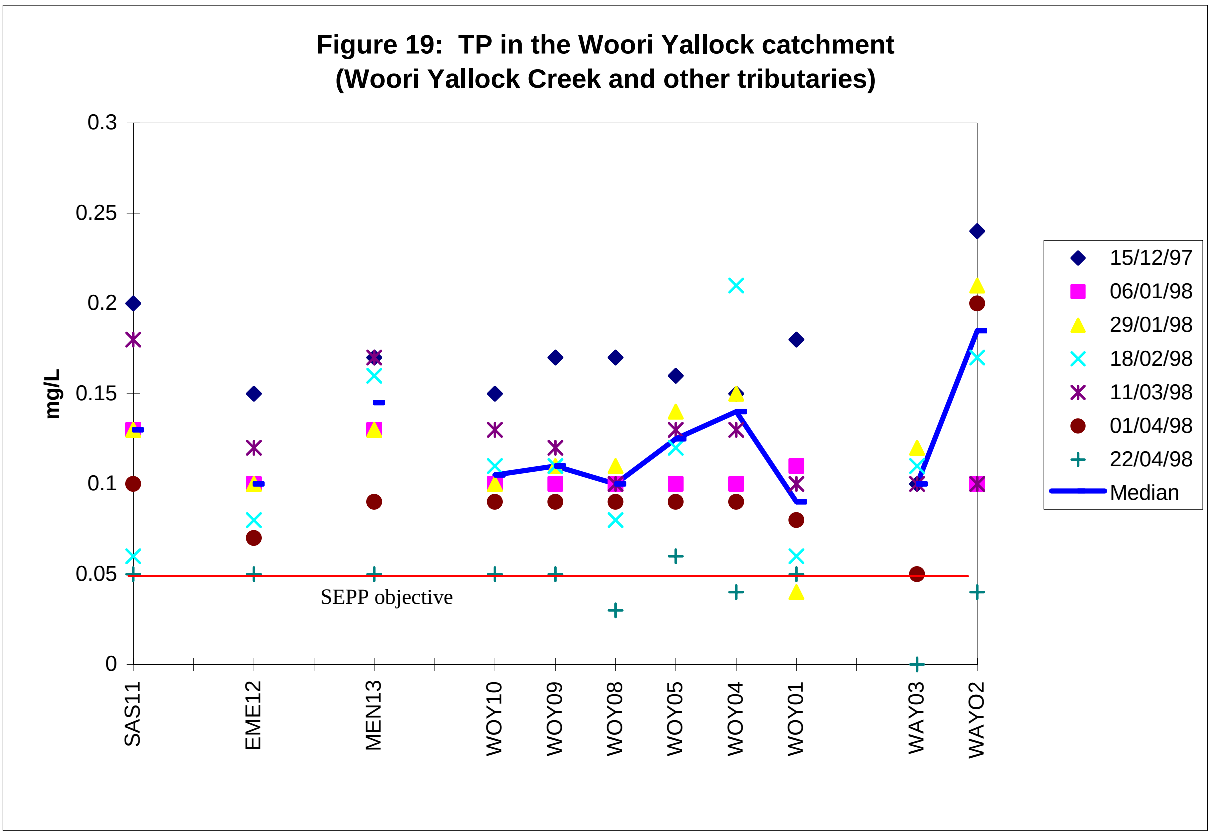


Figure 19: TP in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)
mg/L
0.3
0.25
0.2
0.15
0.1
0.05
0
SEPP objective
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median

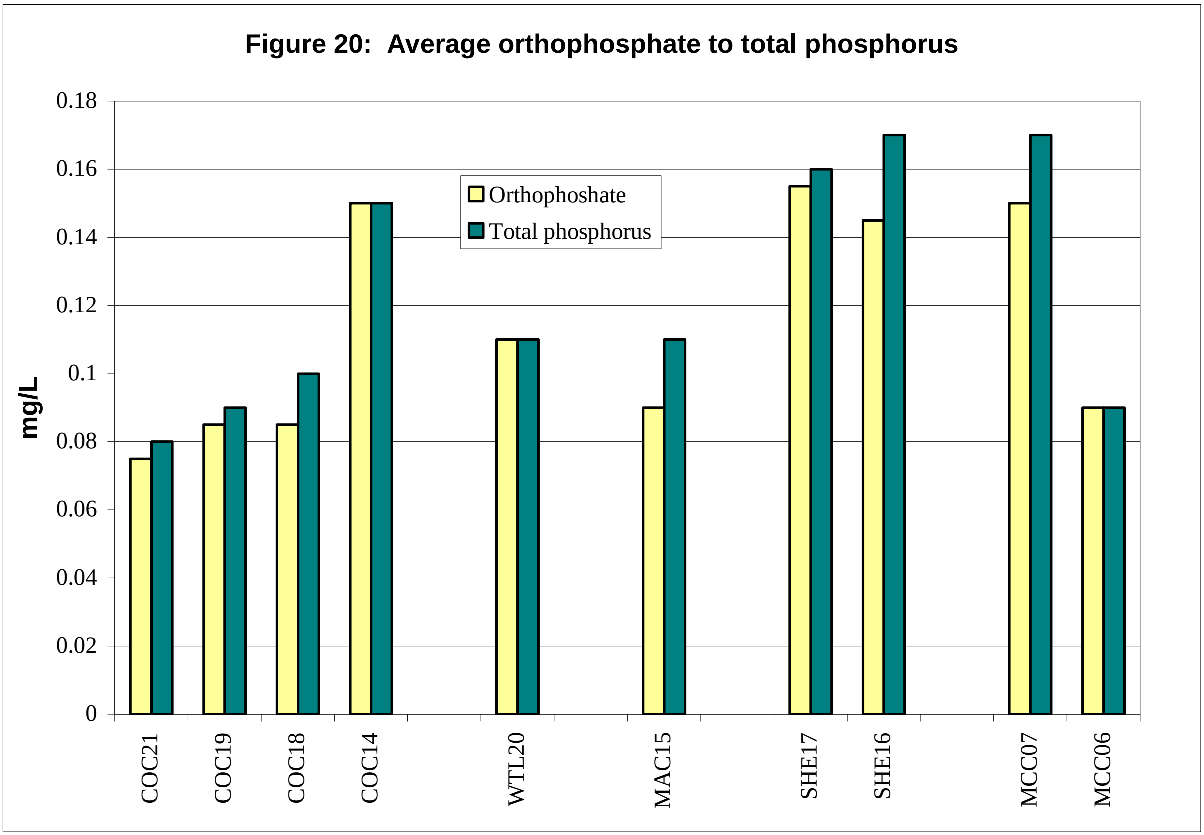


Figure 20: Average orthophosphate to total phosphorus
mg/L
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Orthophoshate
Total phosphorus
COC21
COC19
COC18
COC14
WTL20
MAC15
SHE17
SHE16
MCC07
MCC06

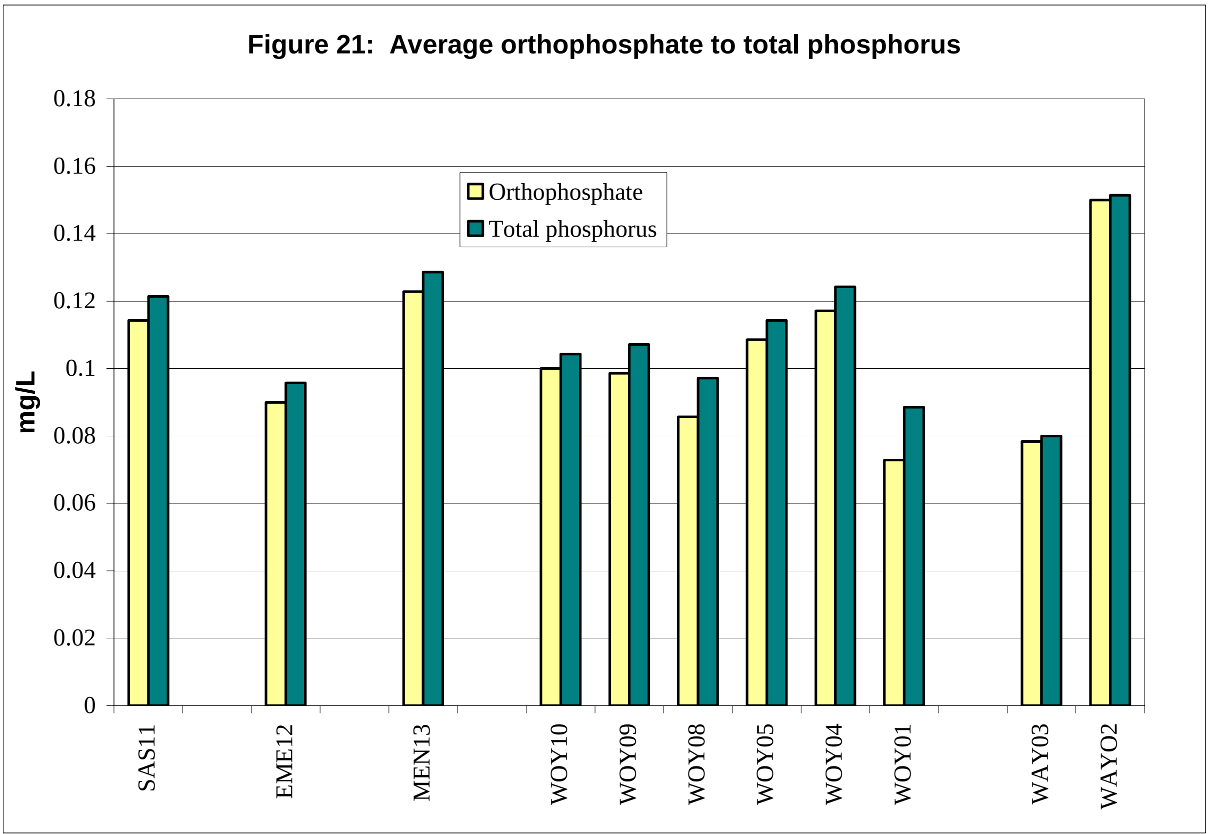


Figure 21: Average orthophosphate to total phosphorus
mg/L
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Orthophosphate
Total phosphorus
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2

Table 5. Ratio of median orthophosphate and TP at StreamWatch sites in the Woori Yallock catchment (1992-1994).

Survey Site	StreamWatch Site	Orthophosphate	Total Phosphorus	Ratio
COC19	**UY32**	0.005	0.056	0.09
COC14	**UY12**	0.012	0.087	0.14
WTL20	**UY52**	7.800	9.000	0.87
SAS11	**UY20**	0.025	0.070	0.36
EME12	**UY39**	0.008	0.045	0.18
MEN13	**UY13**	0.007	0.048	0.15
WOY10	**UY19**	0.007	0.050	0.14
WOY08	**UY11**	0.008	0.061	0.13
WOY05	**UY10**	0.005	0.048	0.10
WOY04	**UY09#**	0.005	0.048	0.10
WAY02	**UY04**	0.060	0.140	0.43

data between 1992 and 1997.

4.2 Nitrogen

Figures 22 and 23 show the total Kjeldahl nitrogen (TKN) concentrations in the Woori Yallock catchment at sites monitored during this study. TKN is a measure of the organic component of nitrogen and is an indicator of organic enrichment and the general health of a waterbody (Cottingham *et al.*,1995). At most sites, TKN were below the Total Nitrogen (TN) SEPP objective of 0.6 mg/L (EPA, 1995), but occasionally this level was exceeded. Median values show that Wattle Creek (WTL20) and Macclesfield Creeks had the highest TKN concentrations. At the headwater sites (COC21, SHE17, MCC07, SAS11 and EME12) median values were about 0.3 mg/L and progressively increased to a median of 0.7 mg/L in the lowest Woori Yallock Creek site (WOY01). This suggests that TKN loads from tributaries are cumulative within Woori Yallock Creek.

Figures 24 and 25 show the median nitrogen concentrations in the Woori Yallock catchment. Nitrate and Nitrate (NOx) measures the major form of nitrogen which is biologically available to algae and can be used to determine potential aquatic and algal growth (Cottingham *et al.*,1995). A substantial component of the median nitrogen concentrations was derived from NOx, particularly at sites on Sassafras Creek (SAS11), Emerald Creek (EME12) and Menzies Creek (MEN13).

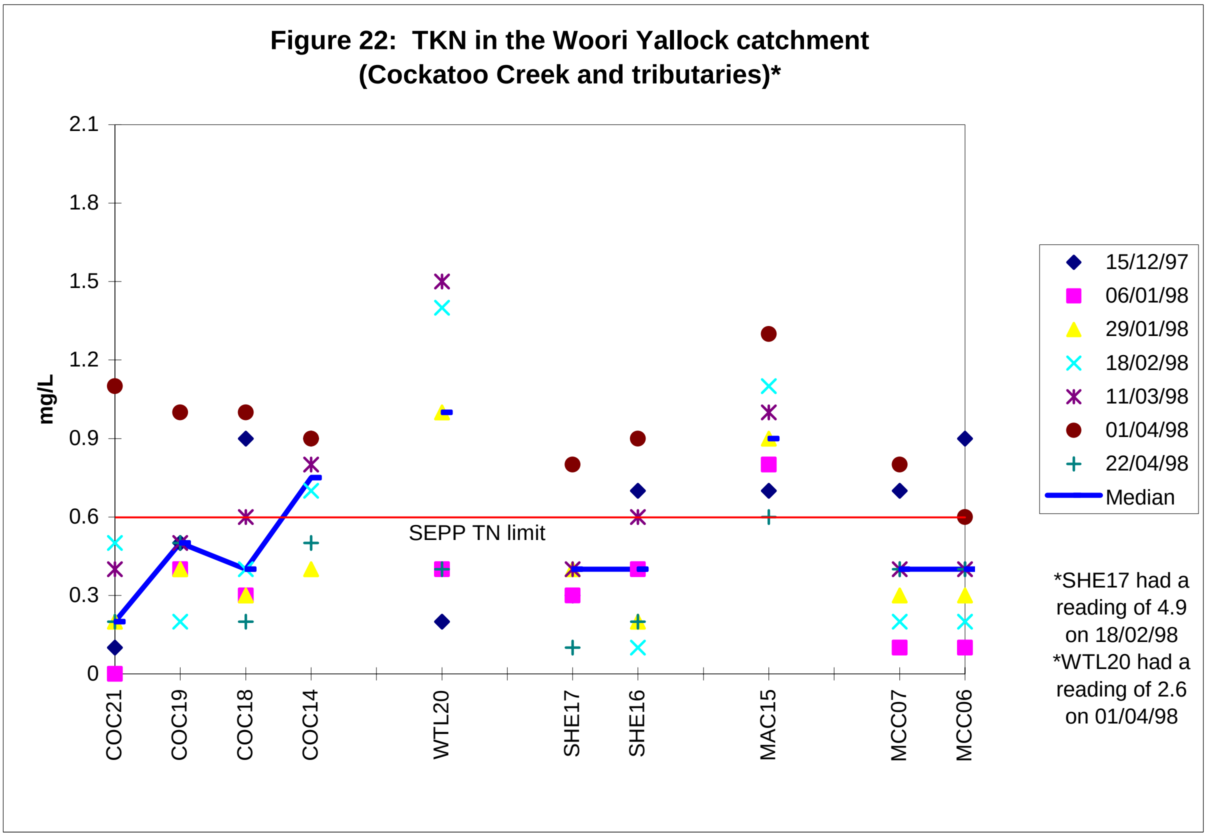


Figure 22: TKN in the Woori Yallock catchment
(Cockatoo Creek and tributaries)*
mg/L
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
SEPP TN limit
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median
*SHE17 had a reading of 4.9 on 18/02/98
*WTL20 had a reading of 2.6 on 01/04/98

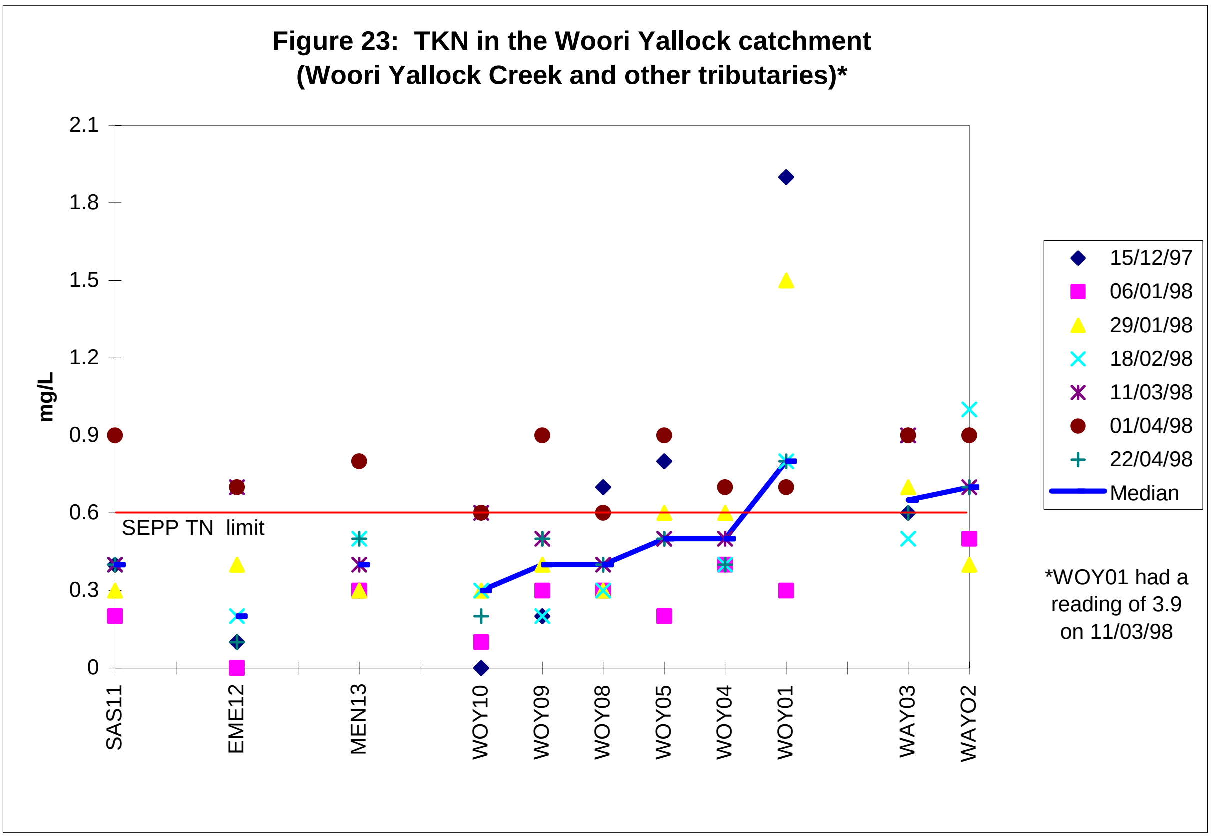


Figure 23: TKN in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)*
mg/L
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
SEPP TN limit
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03
WAYO2
15/12/97
06/01/98
29/01/98
18/02/98
11/03/98
01/04/98
22/04/98
Median
*WOY01 had a reading of 3.9 on 11/03/98

Figure 24: Median nitrogen concentrations in the Woori Yallock catchment (Cockatoo Creek and tributaries)

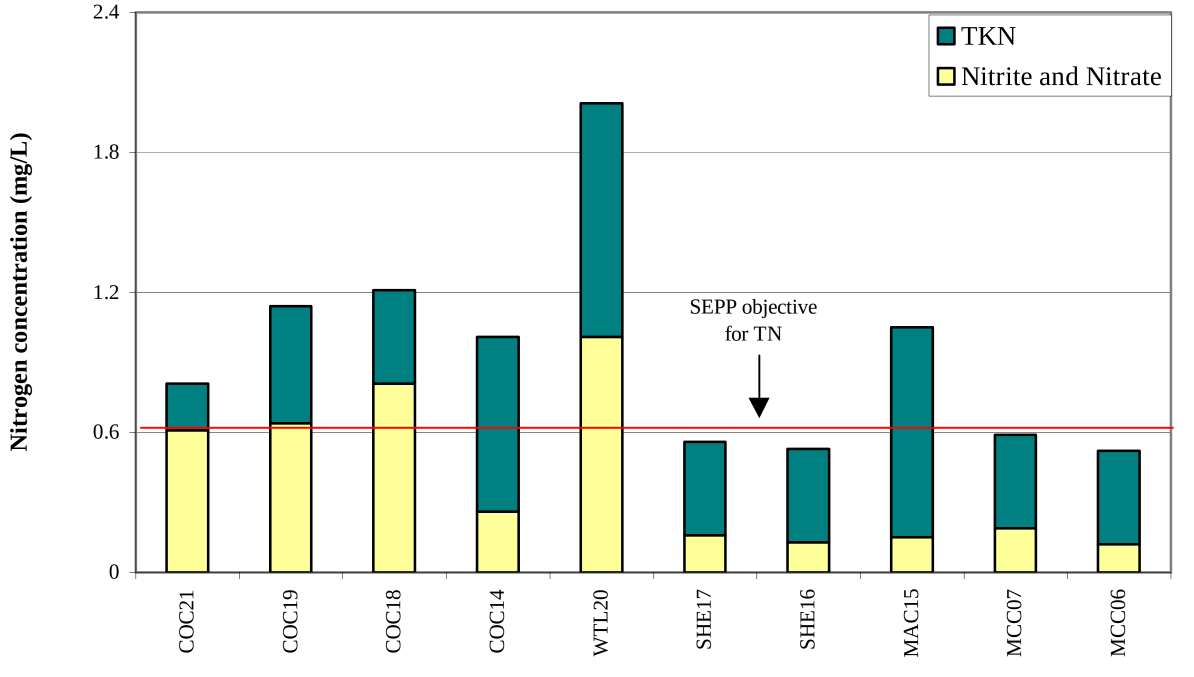


Figure 25: Median nitrogen concentrations in the Woori Yallock catchment (Woori Yallock Creek and other tributaries)

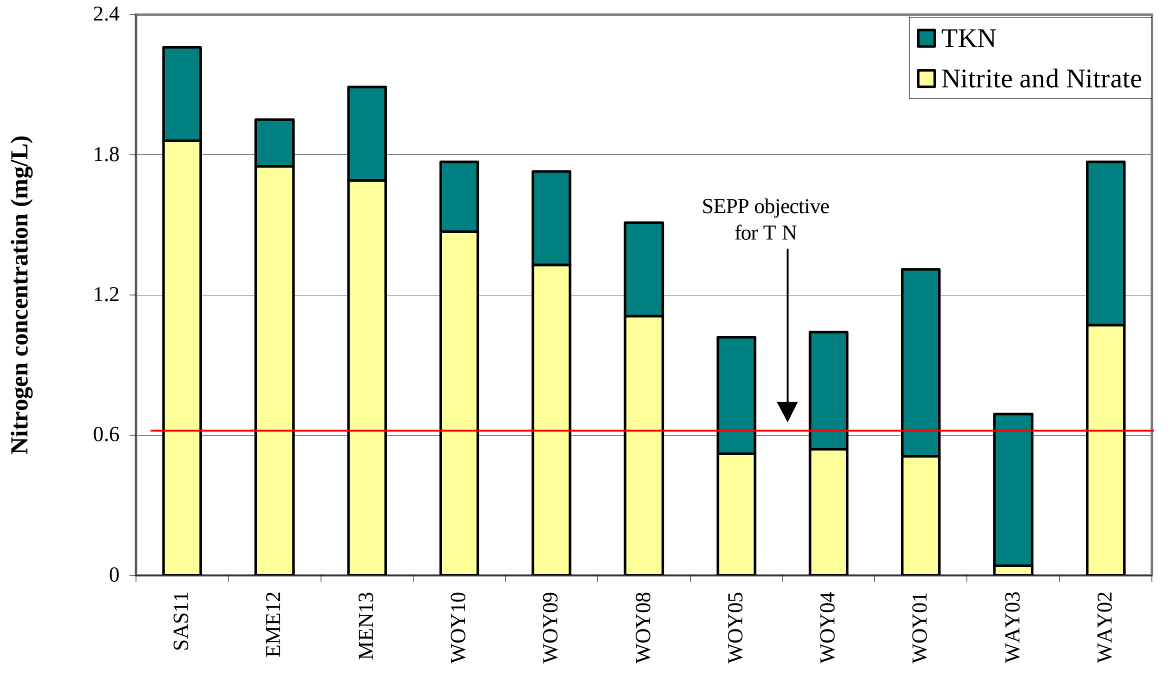


Table 6 is a summary of StreamWatch TKN data collected in the Woori Yallock catchment between 1992 and 1994 (data for StreamWatch Site UY09 is between 1992 and 1997). At most sites, 75% of results were below the total nitrogen SEPP objective. TKN in Wattle Creek (WTL20) during this study were considerably lower than Streamwatch data. This is most likely due to improved wastewater treatment of effluent discharges.

Table 6. TKN (mg/L)at StreamWatch sites in the Woori Yallock catchment.

Streamwatch Site	Study Site	Period of record	No.	Min	Max	Mean	Percentile				
							10	25	50	75	90
UY32	COC19	04/03/92-10/01/94	92	0.001	1.80	0.430	0.10	0.22	0.37	0.52	0.69
UY12	COC18	22/01/92-10/01/94	99	0.001	2.80	0.530	0.20	0.31	0.45	0.65	1.00
UY52	WTL20	01/04/92-10/01/94	83	4.600	48.00	12.900	5.80	7.00	10.00	17.00	22.00
UY20	SAS11	22/01/92-11/10/93	84	0.002	6.90	0.590	0.15	0.30	0.41	0.60	0.75
UY39	EME12	04/01/93-10/01/94	50	0.001	0.78	0.274	0.03	0.18	0.27	0.35	0.42
UY18	MEN13	22/01/92-10/01/94	99	0.001	2.10	0.449	0.20	0.27	0.4	0.55	0.70
UY19	WOY10	22/01/92-10/01/94	98	0.001	2.90	0.400	0.10	0.23	0.34	0.05	0.07
UY11	WOY08	22/01/92-10/01/94	99	0.001	4.30	0.516	0.20	0.28	0.43	0.60	0.82
UY10	WOY05	22/01/92-10/01/94	96	0.002	1.77	0.437	0.15	0.30	0.39	0.57	0.86
UY09#	WOY04	22/01/92-29/05/97	153	0.003	2.40	0.470	0.19	0.28	0.40	0.55	0.75
UY04	WAY02	22/01/92-10/01/94	99	0.003	2.00	0.680	0.28	0.40	0.60	0.80	1.20

data between 1992 and 1997.

Ammonia

Elevated levels of ammonia can be acutely toxic to organisms, particularly fish (Pettigrove and Coleman, 1998). A conservative ammonium guideline level of 0.7 mg/L used for Jumping and Anderson Creeks (Pettigrove and Coleman, 1998) has been adopted for the Woori Yallock catchment. Ammonia only exceeded the detection limit of 0.01 mg/L in Cockatoo, Wattle, Shepherd and Macclesfield Creeks. Concentrations of less than 0.1 mg/L were recorded at these sites. The only sample to exceed 0.7 mg/L was 3.72 mg/L in Cockatoo Creek (COC21) on 29 January 1998.

TP and TN concentrations of 0.08 and 0.90 mg/L respectively, are recommended for the Yarra River over the next 10 years in the Yarra River EPA, 1995). The Schedule will be reviewed in an attempt to meet the 10 year objective by reducing effluent discharges to waterways. It has been proposed that wastewater within the catchment be transferred via a pressure main between Cockatoo and Belgrave (Yarra Valley Water, 1995).

4.3 *E.coli*

E.coli are a measure of faecal pollution from warm blooded animals. The SEPP objective for *E.coli* are specified as the geometric means of at least 5 samples across 6 weeks with less than 200 organisms/100 mL (EPA, 1995). The geometric mean of *E.coli* in the Woori Yallock catchment are presented in Figures 26 and 27. These means are based upon 7 samples taken over a 17 week period. Although the sampling does not comply with the conditions specified in the SEPP, comparison with the objective has been made to show the suitability of the waterways for secondary and passive forms of recreational contact.

The *E.coli* levels exceeded the SEPP objective in most creeks of the Woori Yallock catchment. Geometric means were highest in Menzies Creek (MEN13) and Wandin Yallock Creek (WAY03). Geometric means at most sites within Cockatoo and Woori Yallock Creeks were close to the SEPP objective.

Table 6 is a summary of StreamWatch *E.coli* data collected in the Woori Yallock catchment between 1992 and 1994 (data for StreamWatch Site UY09 is between 1992 and 1997). Most sites indicate very high values occurred in the past. The current study shows some evidence of improvement and could be indicative of improved waterway management in the catchment. Future transfer of wastewater from the Cockatoo-Emerald area, as proposed in the Emerald-Cockatoo Wastewater Strategy (Yarra Valley Water, 1995), should result in further reductions in *E.coli* levels within the creeks of the Woori Yallock catchment.

Table 7. *E.coli* (mg/L)at StreamWatch sites in the Woori Yallock catchment.

StreamWatch Site	Study Site	Period of record	No.	Min	Max	Mean	Percentile				
							10	25	50	75	90
UY32	COC19	04/03/92-10/01/94	92	2	13000	1054	50	130	250	550	1700
UY12	COC18	22/01/92-10/01/94	99	2	18100	932	60	102	200	570	1800
UY52	WTL20	01/04/92-10/01/94	83	2	470000	6654	16	35	110	200	500
UY20	SAS11	22/01/92-11/10/93	83	25	80000	1853	160	270	500	820	1700
UY39	EME12	04/01/93-10/01/94	51	20	3800	437	40	96	232	330	1140
UY18	MEN13	22/01/92-10/01/94	98	35	6600	748	86	160	340	800	2500
UY19	WOY10	22/01/92-10/01/94	97	30	10700	804	82	150	310	500	1500
UY11	WOY08	22/01/92-10/01/94	98	2	8300	392	25	42	110	280	800
UY10	WOY05	22/01/92-10/01/94	96	2	4200	369	40	80	130	350	1030
UY09#	WOY04	22/01/92-29/05/97	155	10	6000	382	58	82	140	270	690
UY04	WAY02	22/01/92-10/01/94	99	35	440000	1642	100	140	350	1400	4300

data between 1992 and 1997.

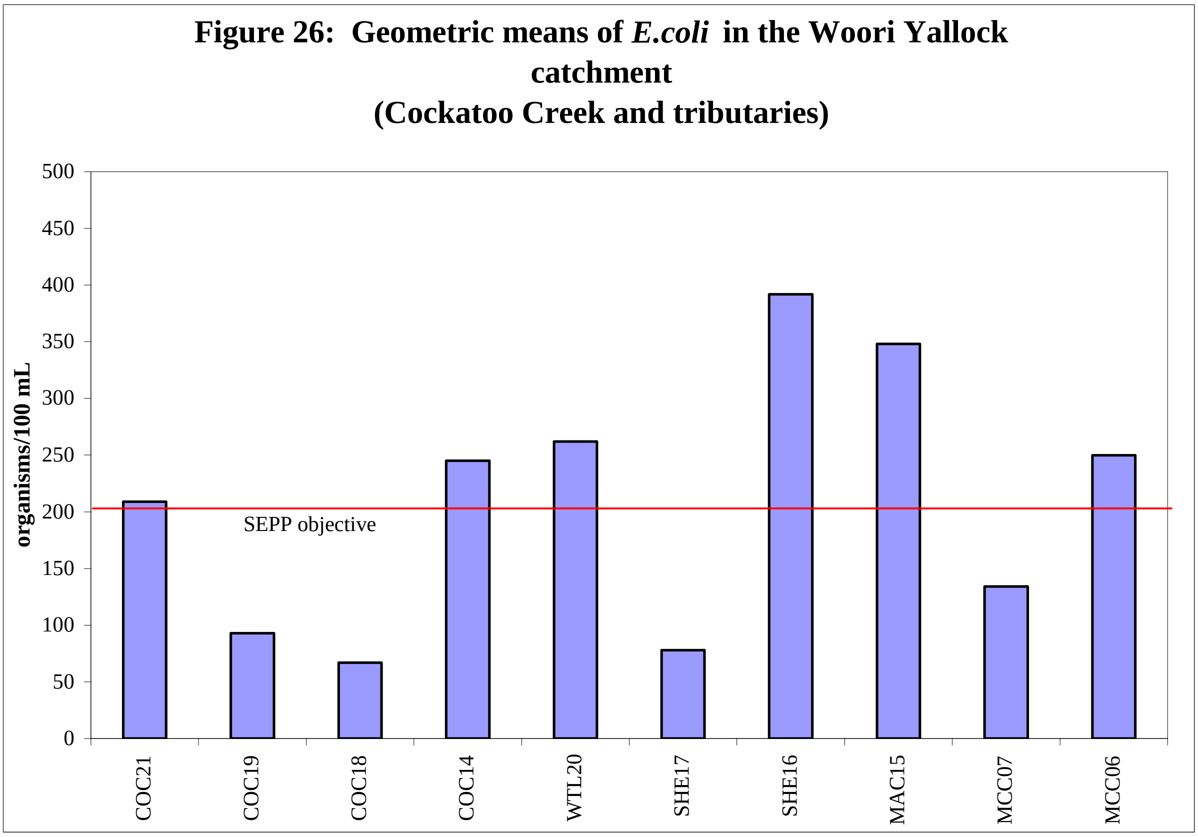


Figure 26: Geometric means of *E.coli* in the Woori Yallock catchment
(Cockatoo Creek and tributaries)
organisms/100 mL
500
450
400
350
300
250
200
150
100
50
0
SEPP objective
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06

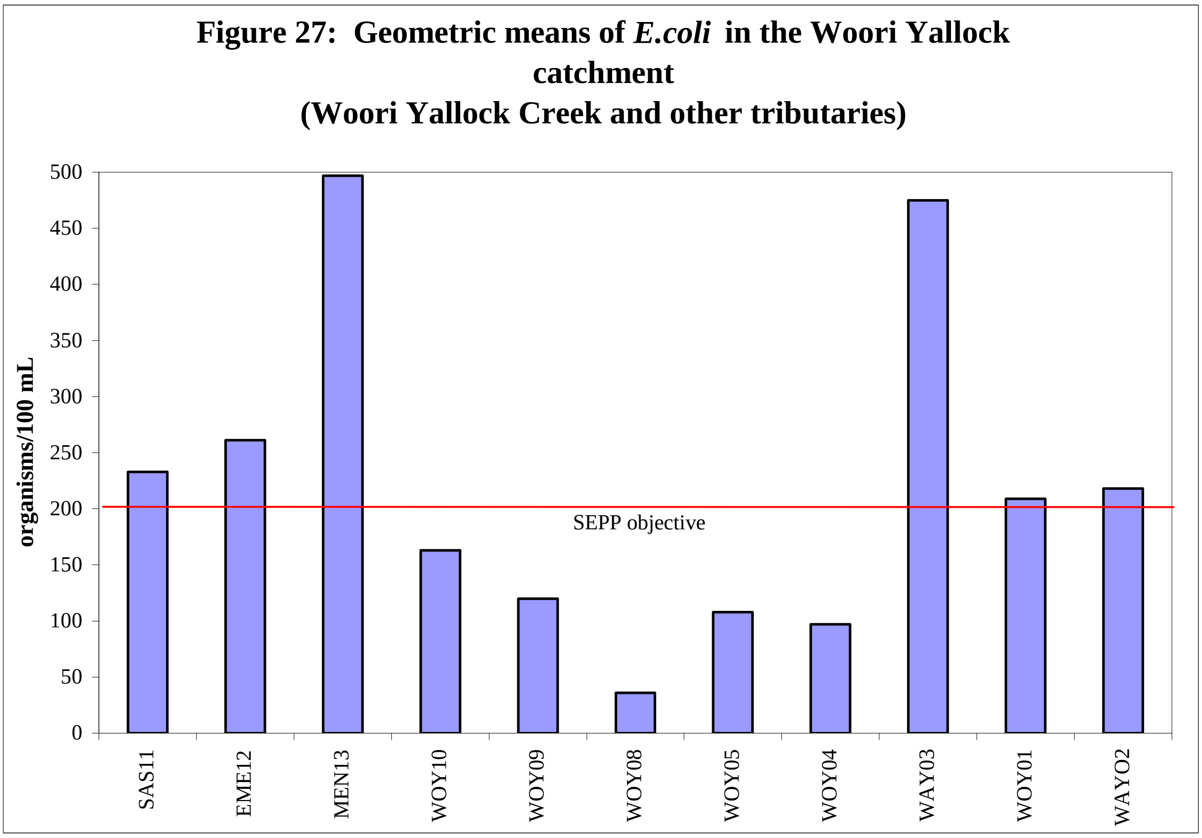


Figure 27: Geometric means of *E.coli* in the Woori Yallock catchment
(Woori Yallock Creek and other tributaries)
organisms/100 mL
500
450
400
350
300
250
200
150
100
50
0
SEPP objective
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WAY03
WOY01
WAYO2

5.0 TOXICANTS IN SEDIMENTS

5.1 Metals

5.1.1 Cadmium and mercury

The concentrations of cadmium and mercury in sediments collected from all sites within the Woori Yallock catchment were below the detection limits of 2 mg/L and 0.2 mg/L respectively.

5.1.2 Arsenic

Figure 28 shows the arsenic concentrations in fine sediments from the Woori Yallock catchment. Levels at both Wattle Creek (WTL20) and McCrae Creek (MCC07) were the only sites that exceeded the Ontario Lowest Effect Level (LEL) of 6 mg/kg (Ontario Ministry of Environment (OME), 1995). Levels at these sites, however, did not exceed the Interim Sediment Quality Guideline (ISQG) value of 20 mg/L, so arsenic concentrations in the Woori Yallock catchment sediments are considered low risk to ecological health (ANZECC, 1997).

5.1.3 Chromium

Figure 29 shows the chromium concentrations in fine sediments from the Woori Yallock catchment. Eight sites exceeded the Ontario LEL of 31 mg/kg (OME), 1995). Wandin Yallock Creek (WAY02) had the highest concentration (94 mg/kg). This concentration also exceeded the ISQG value of 80 mg/kg which indicates a moderate risk to ecosystem health (ANZECC, 1997).

5.1.4 Copper

Figure 30 shows the copper concentrations in fine sediments from the Woori Yallock catchment. With the exception of Wandin Yallock Creek (WAY02), no sites exceeded the Ontario LEL. The copper concentration at this site was well below the ISQG value of 65 mg/kg, therefore, it is assumed that these sediments represent a low risk to ecological health (ANZECC, 1997).

5.1.5 Nickel

Figure 31 shows the nickel concentrations in fine sediments from the Woori Yallock catchment. Cockatoo Creek (COC21 and COC19) and Wandin Yallock Creek (WAY03) are the only sites that exceed the ISQG low risk to ecological health threshold of 21 mg/kg, but were below the ISQG high risk threshold of 52 mg/kg. As the toxicity of nickel is influenced by water hardness and salinity; the lower ISQG screening value provides a conservative predictor of the threshold for ecosystems effects (ANZECC, 1997). Wandin Yallock Creek (WAY03) was the only site that exceeded the Ontario LEL.

Figure 28: Arsenic concentrations in fine sediments in the Woori Yallock catchment*

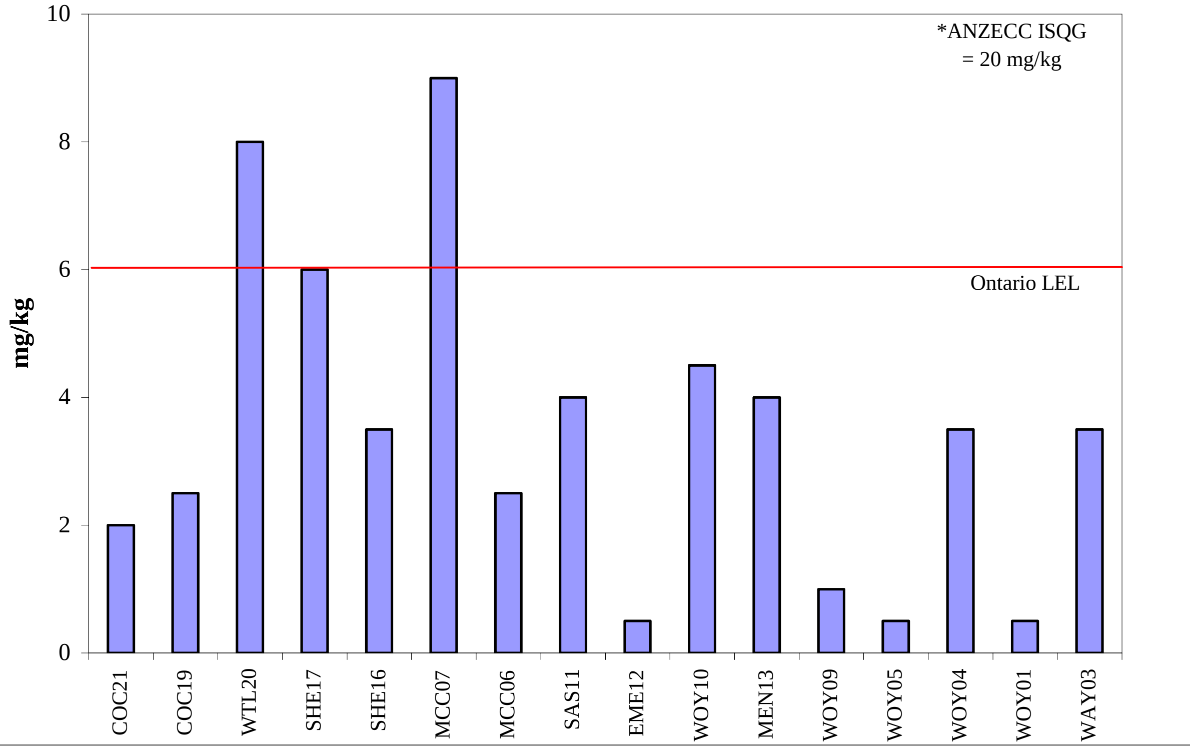


Figure 29: Chromium concentrations in fine sediments in the Woori Yallock catchment

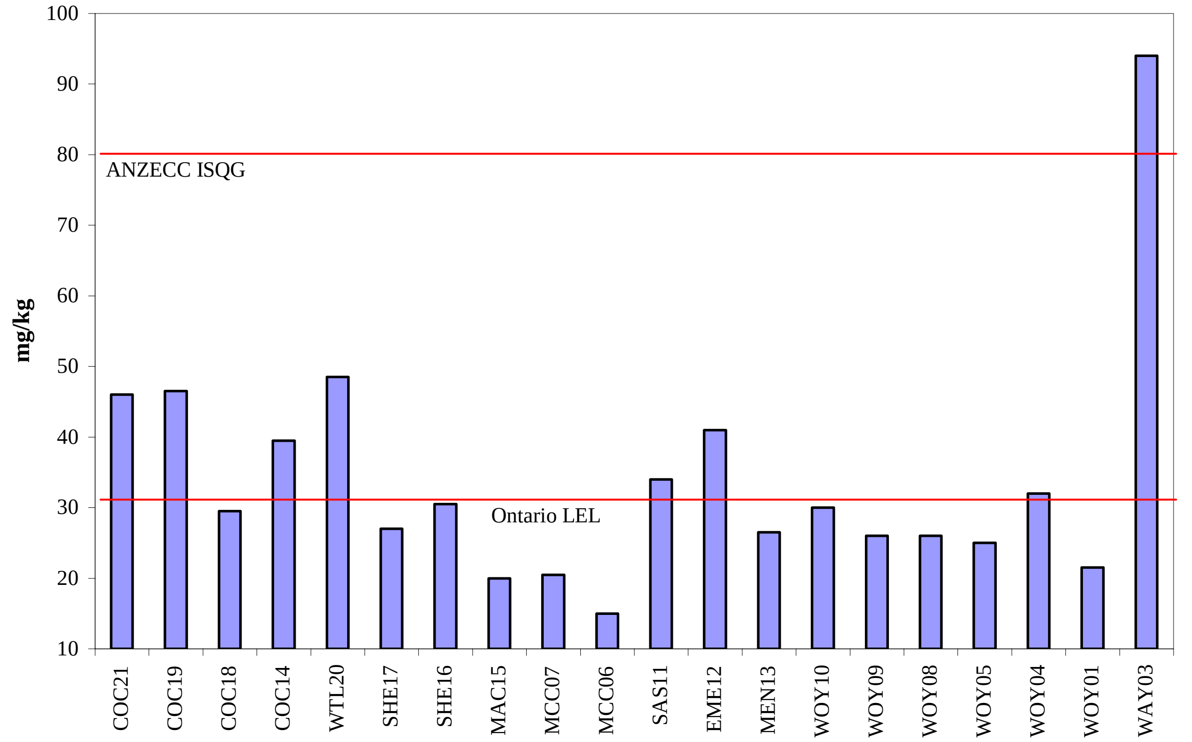


Figure 30: Copper concentrations in fine sediments in the Woori Yallock catchment*

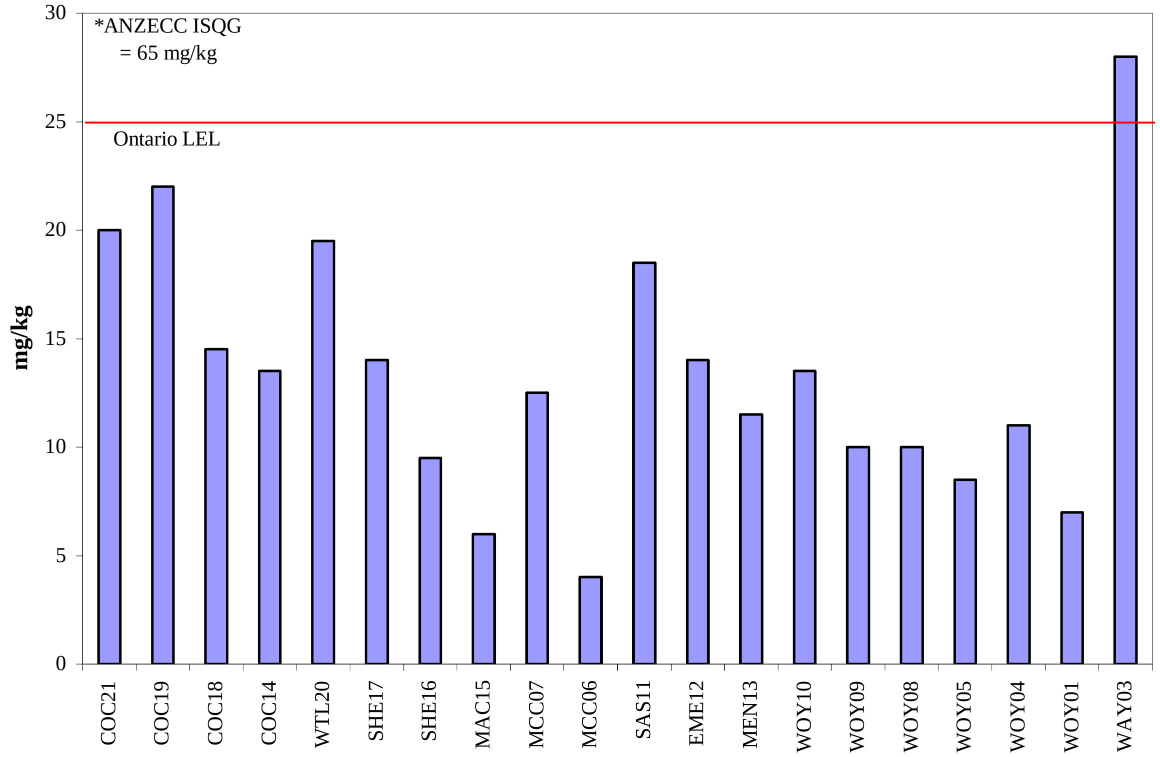
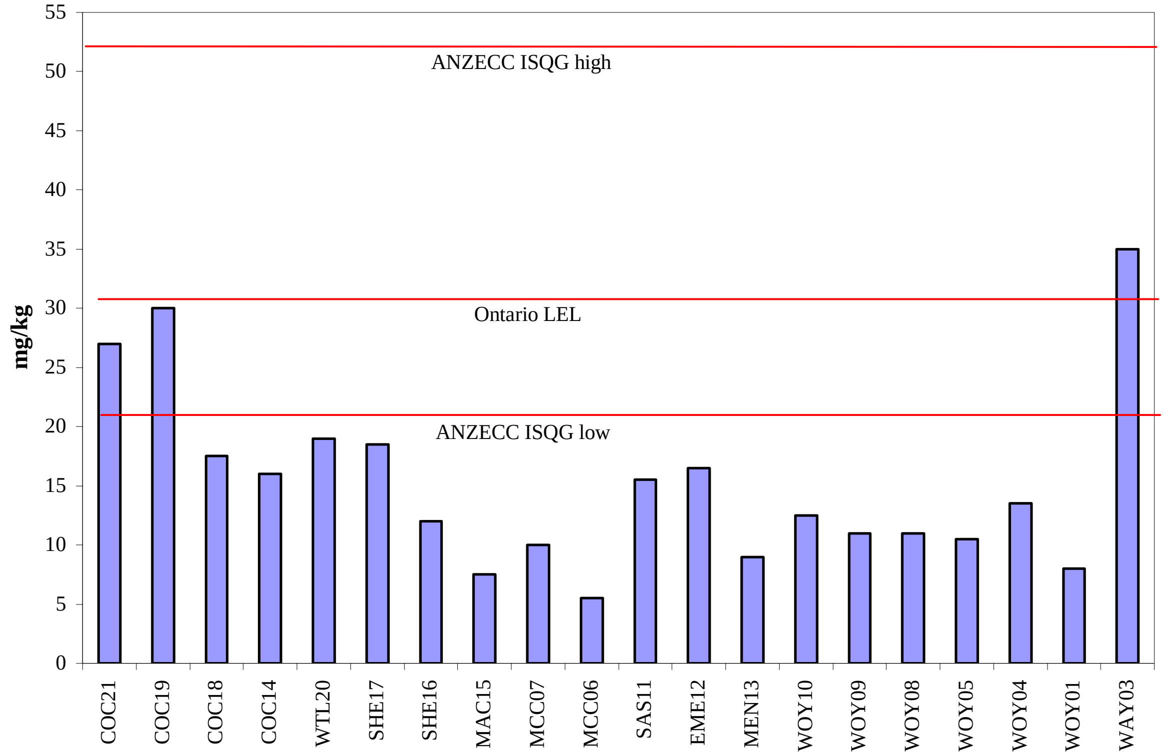


Figure 31: Nickel concentrations in fine sediments in the Woori Yallock catchment



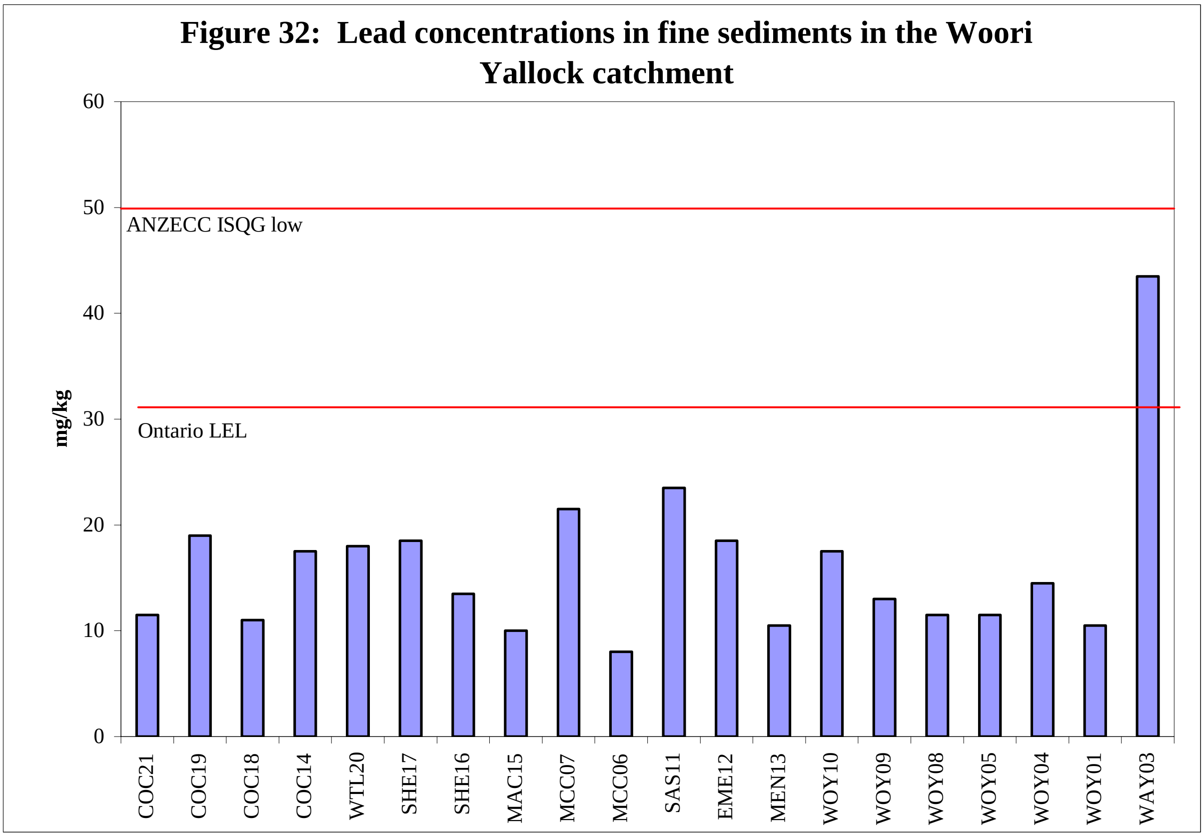


Figure 32: Lead concentrations in fine sediments in the Woori Yallock catchment
mg/kg
0
10
20
30
40
50
60
ANZECC ISQG low
Ontario LEL
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03

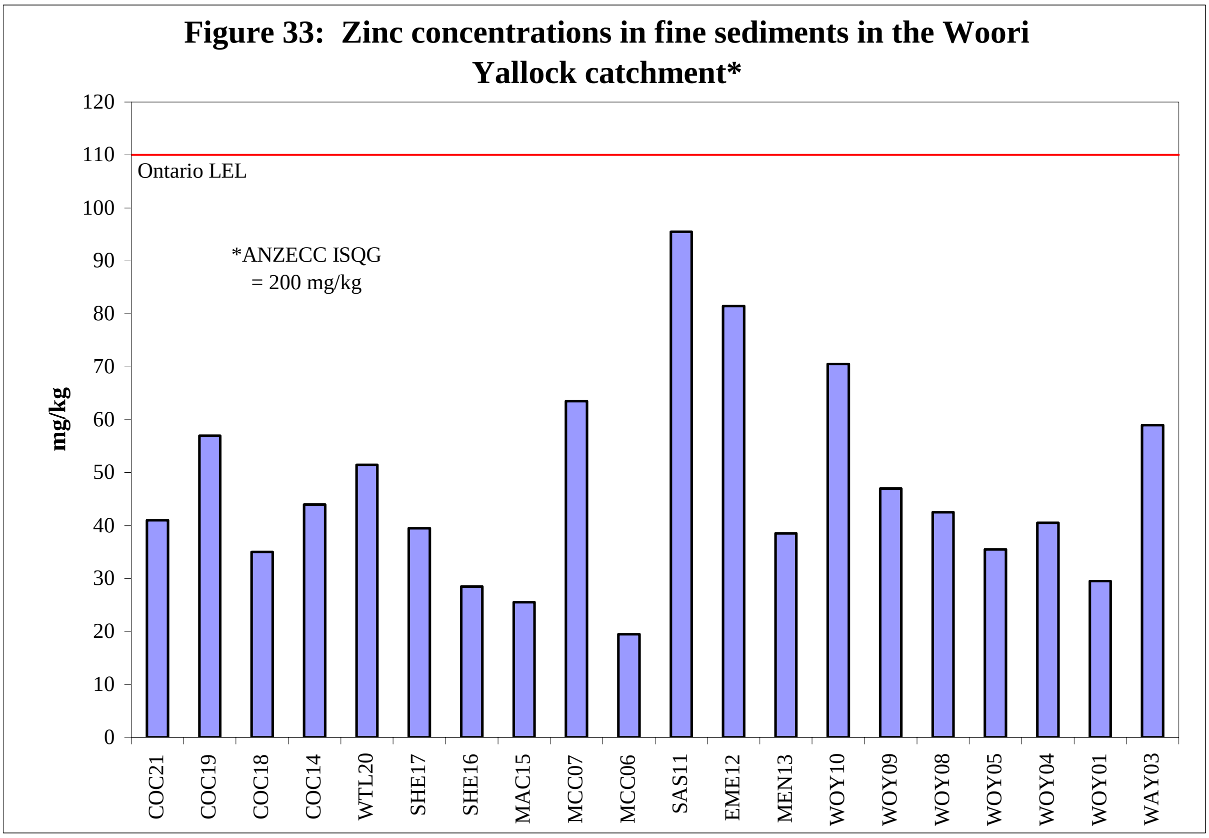


Figure 33: Zinc concentrations in fine sediments in the Woori Yallock catchment*
mg/kg
0
10
20
30
40
50
60
70
80
90
100
110
120
Ontario LEL
*ANZECC ISQG
= 200 mg/kg
COC21
COC19
COC18
COC14
WTL20
SHE17
SHE16
MAC15
MCC07
MCC06
SAS11
EME12
MEN13
WOY10
WOY09
WOY08
WOY05
WOY04
WOY01
WAY03

5.1.6 Lead

Figure 32 shows the lead concentrations in fine sediments from the Woori Yallock catchment. Wandin Yallock Creek (WAY02) was the only site that exceeded the Ontario LEL of 31 mg/kg, but was below the ISQG low risk to ecological health value of 50 mg/kg (ANZECC, 1997).

5.1.7 Zinc

Figure 33 shows the zinc concentrations in fine sediments from the Woori Yallock catchment. No sites exceeded the Ontario LEL of 110 mg/kg (OME, 1995) and all were considerably lower than the ISQG low risk to ecological health threshold of 200 mg/kg (ANZECC, 1997).

5.2 Pesticides

Pesticides in sediment samples were examined from 9 sites in the Woori Yallock catchment. Only 2 sites, Cockatoo Creek (COC18) and Emerald Creek (EME12) had detectable dieldrin levels, with concentrations of 0.012 mg/L and 0.007 mg/L respectively. These levels of dieldrin were above the ISQG low risk to ecological health value of 0.02 mg/kg but less than the ISQG high risk to ecological health value of 8.0 mg/kg (ANZECC, 1997).

A DDT concentration of 0.02 mg/L was detected in Emerald Creek (EME12), 0.01 mg/L in Shepherd Creek (SHE16), 0.01 mg/L in Sassafras Creek (SAS11) and 0.02 mg/L in Wandin Yallock Creek (WAY02). All of these levels are less than the ISQG low risk to ecological health value of 1.6 mg/kg (ANZECC, 1997).

6.0 CONCLUSION

Based on water quality data collected during this study, the creeks of the Woori Yallock catchment are in fairly good condition. Water quality parameters at most sites are within limits that can support and maintain a healthy diversity of aquatic life.

The headwater site of McCrae Creek (MCC06), which has a forested catchment, had the best water quality. Woori Yallock Creek has good water quality throughout its length. Cockatoo, Sassafras, Emerald, Menzies and Shepherd Creeks all have fairly good water quality. Water quality is only fair in Macclesfield and Wandin Yallock Creeks and poor in Wattle Creek.

The exposure of soil in the market garden areas (particularly in the upper reaches of McCrae and Shepherd Creeks) is expected to degrade water quality. Heavy rainfall will erode the exposed soils and lead to the deposition of sediment into nearby waterways. The use of pesticides in these areas should be monitored to determine effects upon stream biota following storm events.

Water quality in lowland areas of the Woori Yallock catchment is mostly influenced by clearing of riparian strips, agricultural practices and wastewater disposal. Replanting of riparian zones with native vegetation is one practice that could be adopted to improve the water quality of surface inflows. This practice would also assist in the stabilising of streambanks. Cattle access directly to creeks should be restricted in farmland areas, as this will contribute to poor water quality.

The implementation of the Emerald-Cockatoo Wastewater Strategy will reduce poor quality effluent discharges to waterways in the Cockatoo area and will provide a significant improvement to the water quality of many of the creeks of the Woori Yallock catchment.

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