c/o Coliban Water
Box 2770
Bendigo Mail Centre, VIC 3554
Phone (03) 54 393 157
Fax (03) 54 341 341

NORTH CENTRAL WATERWATCH

Moolort Landcare Group, Waterwatch Report.

Deep Creek, Mullins Bridge

Prepared by Kate Lottkowitz,

North Central Waterwatch Co-ordinator

January 1998.

Background Information

INTRODUCTION

The Waterwatch Program encourages the community to form water monitoring groups to study the condition of local rivers and other waterbodies. People will then be in a position to carry out actions that can maintain or improve the condition of their local streams. The Moolort Landcare Group joined the Waterwatch Program in 1995 and received testing equipment to monitor Joyces Creek, Middle Creek, Tullaroop Creek, Deep Creek, Boundary Gully and the Loddon at Rumbolds Bridge.

Salinity, nutrients and erosion are the main water quality issues in this region.

WHY WE TEST FOR:

Conductivity

Conductivity measures the amount of salinity in a waterbody. Many plant and animal species living in rivers, streams and wetlands can only survive within a certain range of salinity levels, which means that changes to the salinity may cause the loss of some species and replacement by more tolerant ones. This generally means that the water is less able to be used for stock, domestic, industrial or irrigation purposes downstream, see table below.

0	Distilled Water
10	Rainwater
80	Tobacco
80	River Murray at Albury
100-300	Channel water (average)
800	Drinking water and pasture irrigation
800	Onions, white clover
1100	Potatoes, Maize
1250	River Murray at Morgan S.A.
1500	Maximum for irrigation; humans can taste salt

1650	Citrus, legumes, many garden plants
2000	Rice
2500	Maximum level for drinking water; Vines, grass, cabbages
3300	Soybeans, oats
4000	Wheat
5300	Barley
5800	Poultry
7500	Pigs
10,000	Horses, dairy cows, ewes with lambs
16,500	Beef cows
23,000	Adult sheep on dry feed
58,300	Sea water (Pacific Ocean)
555,000	Dead Sea

Electrical conductivity is measured in *micro Siemens per centimetre, (μS/cm)*. To convert EC units to ppm or mg/l, multiply by 0.64.

Turbidity

Turbidity is the cloudiness of the water and is the result of suspended solid material in it. Suspended material decreases the amount of light that can pass through the water and therefore hinders plant growth in water. This will affect the survival of fish and other animals in the water. These suspended solids, especially clay particles, often have nutrients attached to them that will be carried downstream if not used by in-stream plants and algae.

Algal and plankton growth also contribute to turbidity and so factors affecting their growth, such as nutrients entering the stream, will in turn affect the turbidity.

Turbidity often increases sharply after significant rainfall. It is affected by rainfall and water flow since the energy of falling and flowing water increases the sediments dislodged and carried down the river.

Reactive Phosphorus

Phosphorus is a nutrient involved in blue-green algal blooms. High phosphorus concentrations are considered a key factor in supporting algal blooms, along with high temperature, high light and slow flow. It can also cause excessive growth of aquatic weeds and thus the loss of some important species of animals and plants in the water.

Phosphorus occurs naturally at low concentrations in streams and other waterbodies as dissolved phosphates, phosphorus bound to sediments and phosphates occurring in living organisms.

• Reactive phosphorus is a measurement of dissolved forms of phosphorus and indicates the phosphorus that is easily used by algae.

• Total phosphorus includes all forms of phosphorus and comprises the dissolved phosphate in the water and the form that is bound to solid particles in the water.

There is no way to exclude all phosphorus from a river system. Indeed, we do not need to do this. Phosphorus is not a poison and, in a balanced environment, is an important chemical.

Temperature

The distribution and abundance of aquatic plants and animals will be affected by changes in temperature. The amount of oxygen dissolved in the water decreases as the temperature rises and vice versa. It will also affect the rate of photosynthesis in algae and other plants.

Increases in water temperature will cause an increase in the metabolic rate of organisms in the water. Increased metabolism will increase the oxygen demand of fish, aquatic insects and bacteria.

Organisms can tolerate slow changes in temperature, but, thermal stress can occur where the temperature changes by more than ~ 2 ^{0}C in 24 hours. Consequently, a short period of high temperatures each year can make the stream unsuitable for sensitive organisms even though the temperature is tolerable during the rest of the year. This illustrates the important role riparian vegetation plays in stream temperature modification.

pH

pH measures how acidic or alkaline the water is, on a scale from 0 to 14.

* Acidic water 7 – 0 - solution contains more hydrogen (H) ions than hydroxide (OH) ions

* Alkaline water 7 – 14 - solution contains more OH ions than H ions.

Changes in pH outside the normal range of a water body will cause the loss of the more sensitive species of animals and plants living in the water. Extremely high and low pH values will lead to the death of all aquatic life.

One cause of unnatural changes in pH is the exposure of acid sulphate soils to the atmosphere by mining or urban development. High rainfall can wash these into streams, causing rises in pH for short periods. Nutrient pollution can cause pH levels to rise through the excessive growth of algae and other plants. When there is a lot of instream vegetation including algae, pH may rise by more than 2 units in 24 hours, peaking mid afternoon. It is due to the removal of dissolved carbon dioxide from the water by plants photosynthesizing.

Habitat Surveys

The condition of the vegetation in and around a stream provides a good indication of the likely conditions of the aquatic environment. Stream-side vegetation, if it remains intact, makes a good natural buffer against erosion and the transport of sediment and nutrients into streams and wetlands.

Indigenous vegetation will also provide desirable habitat for native birds and animals and whereas, deciduous species drop all their leaves in autumn, local species can provide year-round nutrients as their leaves fall into the waterway.

Macro-invertebrate Surveys

The structure and functioning of biological communities in streams are the true indicators of stream health. Aquatic macro-invertebrates (water bugs) are sensitive to changes in water quantity and quality and certain species will be absent or depleted from streams that are affected by human activities. The type and abundance of organisms found reflects the physical and chemical conditions of the water because different species have their own preferred environmental conditions.

Aquatic macro-invertebrates are common to all healthy streams and are a vital component of aquatic food chains, providing food for fish, birds and mammals and therefore playing an integral role in river ecosystems. They are relatively easy to sample and because they are relatively restricted to their immediate habitat, they can't escape pollution events and thus provide a recent history of stream quality.

Results

Site Descriptions

There are five sites monitored and they are all within the middle Loddon catchment.

Joyces Creek

A medium sized stream rising south of Blampeid and meeting the Loddon River at Cairn Curran Reservoir. The monitoring site is about seven kilometres south of Cairn Curran Reservoir in unrestricted grazing land.

Middle Creek

Middle Creek is a small to medium sized stream in a broad valley flowing through farmland. The monitoring site is within a few kilometres of its junction with Joyces Creek and it then flows into Cairn

Curran Reservoir.

Loddon River at Rumbolds Bridge

This site is about 13 km downstream of Cairn Curran Reservoir and subject to flooding when water is released from the Reservoir in large volumes. One side is fenced from stock and the other allows stock access.

Boundary Gully

Boundary Gully is a narrow, minor tributary of the Loddon that drains local farmland and flows into the Loddon just downstream of Rumbolds Bridge. It has high salinity levels and in periods of high flow would contribute significant salt loads to the Loddon.

Tullaroop Creek, Freds Ford

Tullaroop Creek, at Freds Ford is a small creek, upstream of Tullaroop Reservoir that flows through a steep gorge. The road runs through the gorge thus allowing human access to the creek, but not stock access. Grazing is the main landuse and this occurs at the top of the valley.

Conductivity

Boundary Gully conductivity readings are consistently high. The lowest reading, of 320EC (on 4/8/96) was also the only *rapid flow* event so that the actual amount of salt (or *load*) being transported to the Loddon river might have been the same or greater than in other months. The consistently high salinity readings suggest that the creek is gaining saline seepage from groundwater or drainage from salt affected land. The creek was not flowing in February '96 when the highest reading of 49,200EC was measured, and at that time of year evaporation is likely to be high, thereby concentrating the salt in pools. It would be worth measuring the flow and salinity during the first major rainfall event after the summer to estimate the load being exported.

It is too early to establish any trend in the results as the seasons have varied and other variables including flow, affect the results.

Looking at the table of results from the two Loddon sites and Boundary Gully we cannot demonstrate an effect by Boundary Gully on the Loddon. It might appear that conductivity has increased slightly in July, '95 and in September, '95 however, the difference is not significant and there are insufficient data to make a conclusion. We can only assume that the saline Boundary Gully water flows into the Loddon and adds to the salinity problem downstream.

Referring to the table of site statistics, we could say that the average conductivity at all sites is higher than it should be. According to the State of the Environment Report 1988, middle catchment stream water quality is degraded when conductivity is above 600EC. Out of 181 measurements, 145 were above 600 EC and in general when the reading was lower than this, the flow was fast thus increasing the total load travelling downstream. See Graph showing Deep Creek salinity versus depth.

Salinity management actions

- Establishing deep-rooted perennial vegetation on cleared recharge areas eg. Trees and understorey plants or convert annual introduced pasture to phalaris, lucerne and cocksfoot;

- Revegetating existing saline discharge areas with salt tolerant species

- Rehabilitating a length of streamside each year

- Protecting desirable remnant vegetation; it is easier and less expensive to keep existing vegetation than to replace it.

Turbidity

The turbidity correlated closely with the flow and this was particularly the case with Middle Creek. The higher the flow, the greater the sediment load water can transport and therefore the greater erosion that will occur.

In contrast, at Boundary gully the highest reading in March, '96 of 200 NTU occurred when the creek was not flowing and it was described as a smelly, green and scummy pool! Algae would have contributed more to the turbidity in this case than suspended sediments.

There is also an inverse relationship between salinity and turbidity. So, that when salinity is high, suspended particles will be more likely to drop out of suspension. This may be observed in the graphs of Joyces Creek, Deep Creek and Boundary Gully. In March '96 when both conductivity and turbidity were high at Boundary Gully, the turbidity being caused by algal growth rather than sediments is again supported and the pH of 8.3 could indicate a high rate of photosynthesis.

Erosion management options

- Rabbit Eradication and fencing out riparian strips.

- Rehabilitation of streamsides, (see Riparian Management booklets, attached)

Fold down fencing at Dixons'

Reactive Phosphorus

Reactive phosphorus tended to be highest after significant rain and when flow was fast and turbidity high. This was particularly so on June 7, '95 at all sites monitored and in August, '96. Phosphorus also tended to be high when electrical conductivity was low and this also relates to high flow events. When runoff occurs phosphorus is washed into the waterways bound to silt particles and in animal manure. The Campaspe Nutrient Management Strategy mentions that although electrical conductivity is diluted with higher flows, 'the majority of phosphorus loads are exported in run off after high rainfall events.'

Remedial Actions

- Streamside fencing and rehabilitation, to exclude stock and develop an effective buffer strip.

- More efficient fertiliser use: Apply fertiliser only when plants are able to take it up; Soil test to obtain correct application rates; Limit fertiliser in areas of high water flow during rain; improve water efficiency to prevent over-watering and runoff.

- Attend to leaking septic tanks and have them desludged every 10 years

- On dryland blocks prevent runoff from fertilized paddocks from entering the stream - grow buffer strips along riparian verges and banks.

- On irrigated blocks, ensure minimal surface drainage leaves the farm, particularly during the first two irrigations after fertiliser application.

- Prevent overgrazing so that topsoil is not washed into streams during rain.

Temperature

Temperature was very closely related to the season at all sites.

We could have expected the Loddon site to show a lower average temperature than other sites for a couple of reasons but there was no significant difference. In general a larger volume of water passes Rumbolds Bridge and so would take more energy to reach ambient temperature. Also, being approximately 13 kilometres downstream of Cairn Curran Reservoir summer releases may be considerably cooler than the normal river temperature. The outlet tower in the reservoir allows water from several levels to be released thus reducing this effect. Monitoring the river after a release will indicate whether this is effective or not.

A greater daily variation during hotter months could be expected when overnight lows are ~20 degrees lower than the daily maxima and when creeks are lower and slower. This can be accentuated by a lack of riparian vegetation.

A dry creek bed over summer will also influence the range of aquatic life, both animal and plant.

Actions to keep stream temperatures within an acceptable range

- Retain riparian vegetation which shades the creek and helps prevent stream temperature changing too quickly.

- Prevent warm runoff from urban surfaces such as roads, footpaths and car parks from entering the creek. Stream life can be adversely affected by raising water temperature too suddenly.

pH

The pH has been high on a number of occasions and on October 8,'95 it was high at all sites and especially at Deep Creek (9.8), Joyces Creek(9.2) and Rumbolds Bridge (9.1). These readings were taken in the morning and may have risen further with photosynthetic activity during the day.

pH levels greater than 9 can indicate a stream in degraded condition. It suggests a high rate of photosynthesis, producing a lot of oxygen, which would occur at the onset and during an algal bloom.

Habitat Surveys

	Joyces Ck	Middle Ck	Loddon R	Fred's Ford	Deep Ck
Bank Vegetation	Fair	Poor	Poor – although some regrowth present	Fair – Bottlebrush, Wirilda and age range	Fair
Verge Vegetation	Very Poor - pasture with very few trees	Poor Tree Violet & pasture	Poor	Poor	Poor
In-stream Cover	Fair to Good- water ribbon,reeds, snags, rocks & mud.	Good overrun with phragmites	Fair to Good	Good- elodea, triglochin and phragmites	Excellent

Erosion & Stability	Fair – some undercutting	Fair	Poor	Good	Fair
Pools Riffles & Bends	Good	Very Poor -uniform habitat	Fair	Good	Good
OVERAL L RATING	**FAIR**	**POOR**	**FAIR**	**FAIR**	**FAIR**

40 years ago Joyces Creek had 25 foot deep pools (G. Canfield, pers. comm) and they would have provided important refuges for fish during dry seasons. These have silted up and are no longer found in Joyces Creek. Many other Victorian waterways are in the same situation with obvious implications for fish populations. Clearing of verge and particularly bank vegetation is the first step in allowing silt into waterways. Rivers and creeks without bank vegetation develop wider and shallower cross-sections compared with those with a diverse range and dense cover of riparian vegetation (Raine & Gardiner).

Middle creek was notable because of the abundance of native tree violet (*Hymenanthera sp.*) growing in hedgerows and scattered across the landscape. There were very few large trees and the creek itself was difficult to see amongst the very thick stand of phragmites growing in the streambed. Small birds, waterfowl, and small animals would find suitable habitats here, however, the uniformity of habitat would reduce the overall diversity of animals and this was confirmed by the lack of variety of macroinvertebrates found.

Native tree violet would be a suitable riparian species to include in understorey revegetation and also as a replacement for introduced Boxthorn and Gorse. Dense swards of phragmites (and cumbungi) can indicate a high nutrient load in streams. The data don't necessarily support this though. The highest (poorest) phosphorus readings both occurred during high winter flows, however, levels were on average 'good" to "excellent" (0.015mgP/l or less) for the remainder of the monitoring times. It is possible that nutrients are flowing into the creek with high runoff events and thus not often being recorded. Phragmites is also tolerant of slightly brackish water, up to 16,000 EC, and this may partly explain why it dominates.

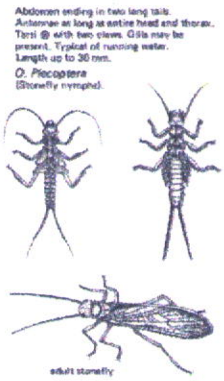
Deep Creek at Mullins Bridge had excellent in-stream cover, however, this was partly due to erosion along the banks eventually causing trees to fall in. Stock access has depleted bank vegetation, caused spot erosion and salinity levels in the stream increase the likelihood of erosion by adversely affecting soil structure.

Fred's Ford on the Tullaroop Creek was given a 'fair' habitat rating overall. The instream cover, riffles, pools and bends and erosion were all rated as 'good' whereas the verge being mainly pasture grasses dominated by phalaris was 'poor' and the bank was only 'fair' in spite of it having a wide range of canopy age including recruitment of native species. The middle storey that is often lacking at other sites included River bottlebrush and Wirilda. In-stream vegetation included elodea, water ribbons (*triglochin)* and phragmites. One side of the creek here is a gorge with boulders and grasses growing between.

- Streamside vegetation performs a number of desirable functions whether it is a "prickly undesirable weed" or an indigenous "desirable species". Plant roots hold the bank together, the vegetation filters nutrients and sediments from runoff; it also shades the creek and provides habitat for native animals including insectivorous birds.

  - Keep this in mind when planning a weed eradication program. Aim for an integrated program including: rabbit control, streamside fencing, weed control and revegetation. Revegetation needs to be carried out concurrently with weed control and bank stabilisation and on a scale that will not destroy the native animal communities living along the creek.

Macro-invertebrate surveys



In December 97 macro-invertebrate surveys were carried out at each site. Sites ranged from "Fair" to "Poor" with least diversity at Middle Creek. Accessibility was difficult here though, and a future survey of this site is recommended when the creek is flowing. Tullaroop Creek at Fred's Ford had greatest diversity but was dominated by macroinvertebrates of medium tolerance. Conspicuous by its absence was the stonefly nymph; the sandy stream bed would have been suitable habitat if water quality was good too. It is possible that turbidity during rainfall events prevents their establishment here.

The Loddon near Rumbolds Bridge had variety but not great numbers of water bugs. It was also dominated by groups of medium tolerance. The large variation in flow, due to releases for downstream water users, would contribute to the "fair" to "poor" rating.

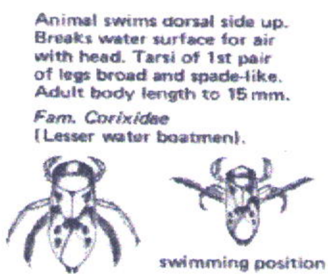
Body laterally compressed.
Length up to about 10 mm.
O. Amphipoda
(Scuds or side swimmers).
Fam. Gammaridae.

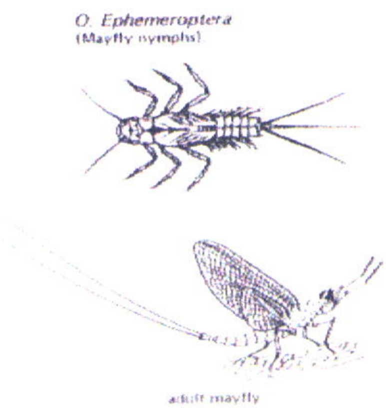
A reasonable diversity of macroinvertebrates were found at Deep Creek but the dominant groups were of medium tolerance and very tolerant. With excellent in-stream habitat a better ranking might have been expected, however, a combination of high salinity, occasionally high nutrient loads and fluctuating turbidity have had an adverse affect on the macroinvertebrate community here. High turbidity levels can have a lasting effect when the fine silt particles settle out like a blanket. They fill crevices and other small spaces and reduce the diversity of habitat for macroinvertebrates, which in turn provides less food for fish, water birds and so on.

SITE	Joyces Ck	Middle Ck	Loddon R	Fred's Ford	Deep Ck, Mullins bridge
Very sensitive Stonefly nymphs					
Sensitive Mayfly nymphs			✓ (3)	✓ (3)	
Caddis-fly larvae		✓(3)	✓	✓	✓
Medium	✓			✓	✓ two types

Dragonfly & damselfly nymphs					
Mites		✓(2)			✓
Yabbies					
Amphipods	✓(1)*	✓✓(1) two types.	✓	✓ (3)	✓
Shrimps			✓	✓ (2)	✓
Water bugs	✓(3) Backswimmers Lesser water boatmen		✓(1) Lesser water boatmen	✓ (1) boatmen ✓ backswimmers	✓(1) boatmen
Diving beetles, waterpennies & other beetles & beetle larvae	✓(2)		✓water tiger & other beetle larvae	✓	✓water tiger
Tolerant Snails & limpets	✓		✓		✓
Bivalves or mussels					
Flatworms					
Leeches					
Very tolerant Chironomids & other midge larvae			✓ (2)	✓	✓ (2) midge larvae ✓chironomids
Worms	✓		✓		
RATING	**FAIR**	**POOR**	**FAIR TO POOR**	**FAIR**	**POOR**

* (1) Most dominant macroinvertebrate group found, (2) Second most dominant, (3)Third most dominant.





Conclusion

The data confirm salinity problems at all sites and in particular at Boundary Gully. Levels of reactive phosphorus and turbidity reach poor and degraded levels sporadically mostly associated with rainfall and high flow events. The poorest site again was Boundary Gully. Middle catchment stream water quality is degraded when conductivity is above 600EC. Out of 181 measurements, 145 were above 600 EC and in general when the reading was lower than this, the flow was fast thus diluting electrical conductivity but increasing the total load travelling downstream.

Natural regeneration at Rumbolds Bridge and Fred's Ford were a good sign and stream health could be further improved by works to reduce salinity and attenuate rainfall events, such as are recommended in the body of this report.

It is too early to establish any trend in the results as the seasonal variation has been great enough to disguise any trends. It would be well worthwhile continuing monitoring for another few years for analysis of trends. The data set is consistent and complete from July 1995 and so trends will be detectable earlier than where this is not the case.

Community based monitoring activities play a valuable role in encouraging better understanding of the relationships between catchment management and stream health.

References

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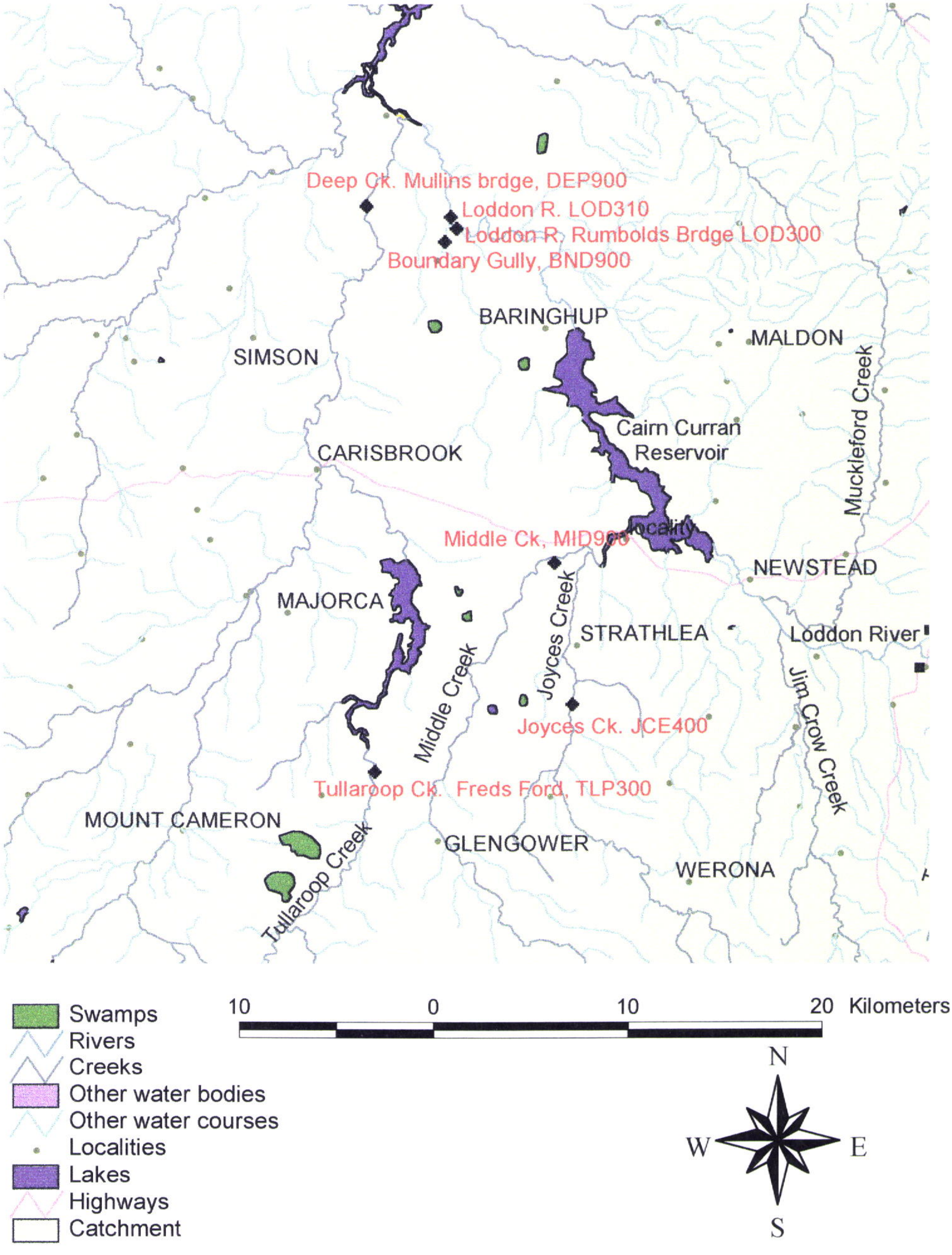
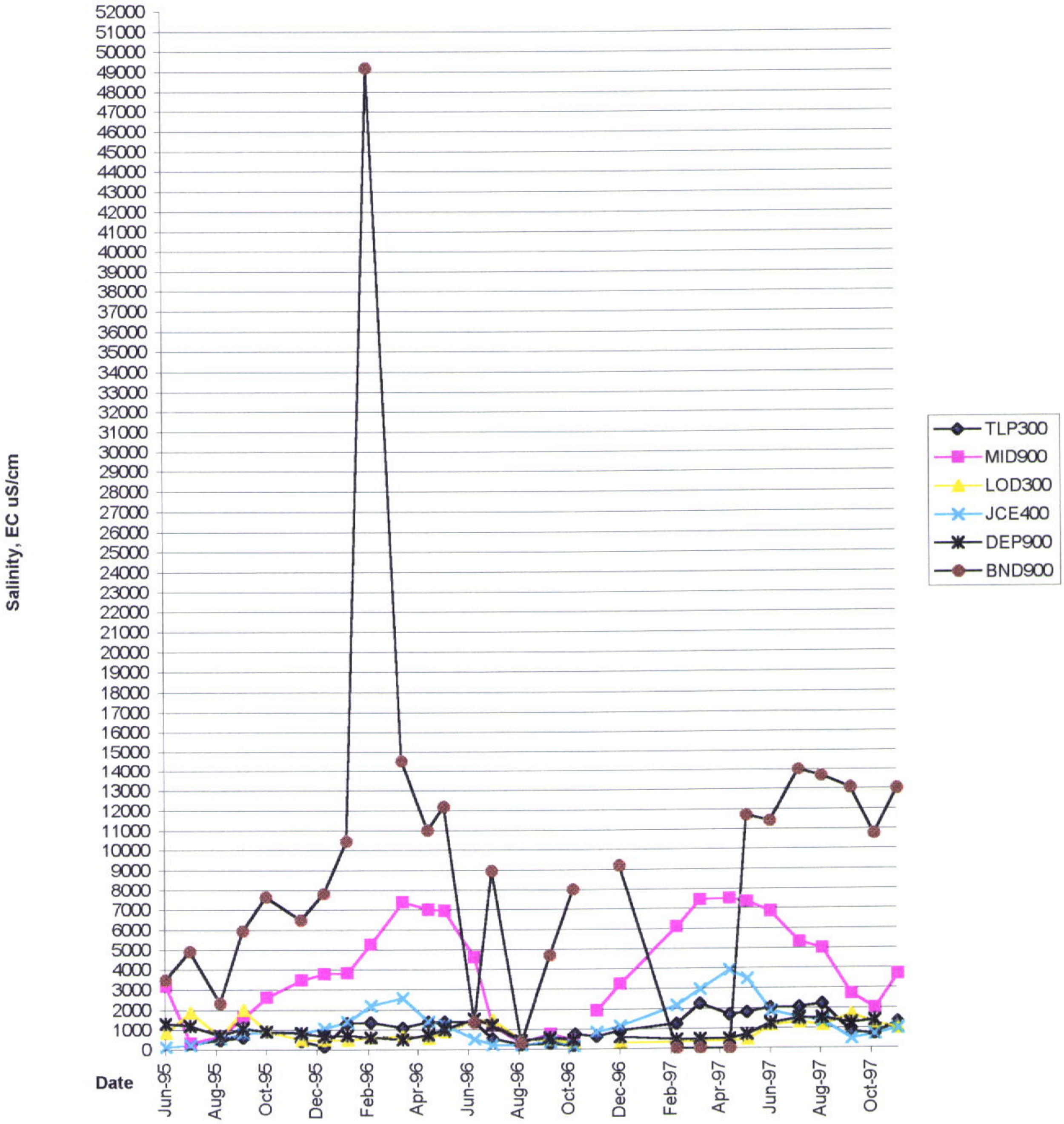
Moolort Landcare Group Waterwatch Sites

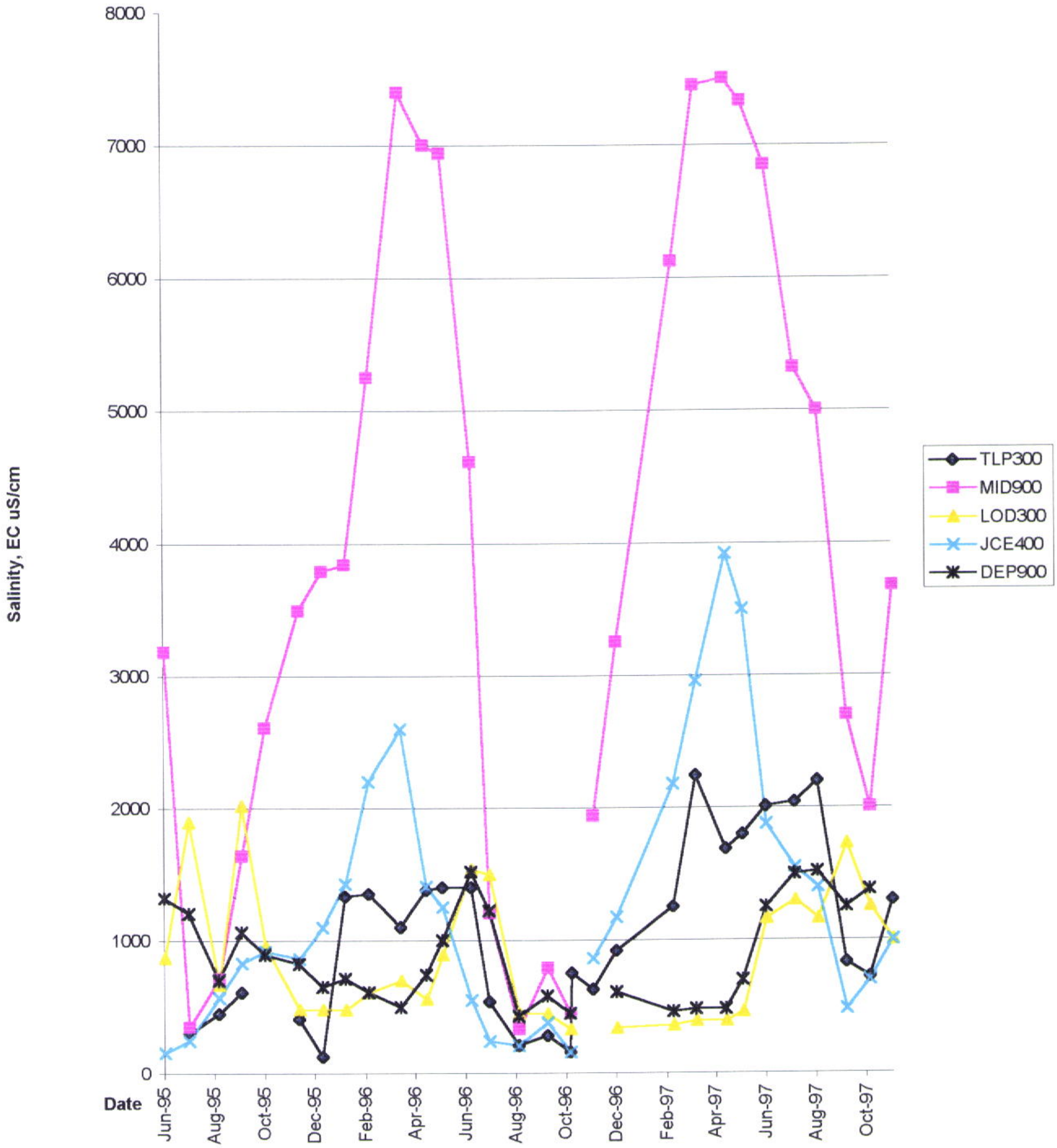


Moolort Salinity



	Jun-95	Aug-95	Nov-95	Jan-96	Mar-96	Jun-96	Aug-96	Oct-96	Nov-96	Mar-97	May-97	Jul-97	Oct-97
TLP300		450	410	1330	1100	1400	210	160	630	2240	1800	2040	720
MID900	3180	710	3490	3840	7400	4610	330	450	1940	7450	7330	5320	2000
LOD300	870	670	480	480	700	1540	450	330		390	460	1300	1250
JCE400	160	570	860	1430	2600	550	210	160	860	2960	3500	1550	700
DEP900	1320	700	820	710	500	1520	430	450		480	700	1500	1380
BND900	3500	2310	6500	10430	14500	1362	320	8000		0	11690	14000	10750

Moolort Salinity Levels, excluding Boundary Gully



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TLP300		450	410	1330	1100	1400	210	160	630	2240	1800	2040	720
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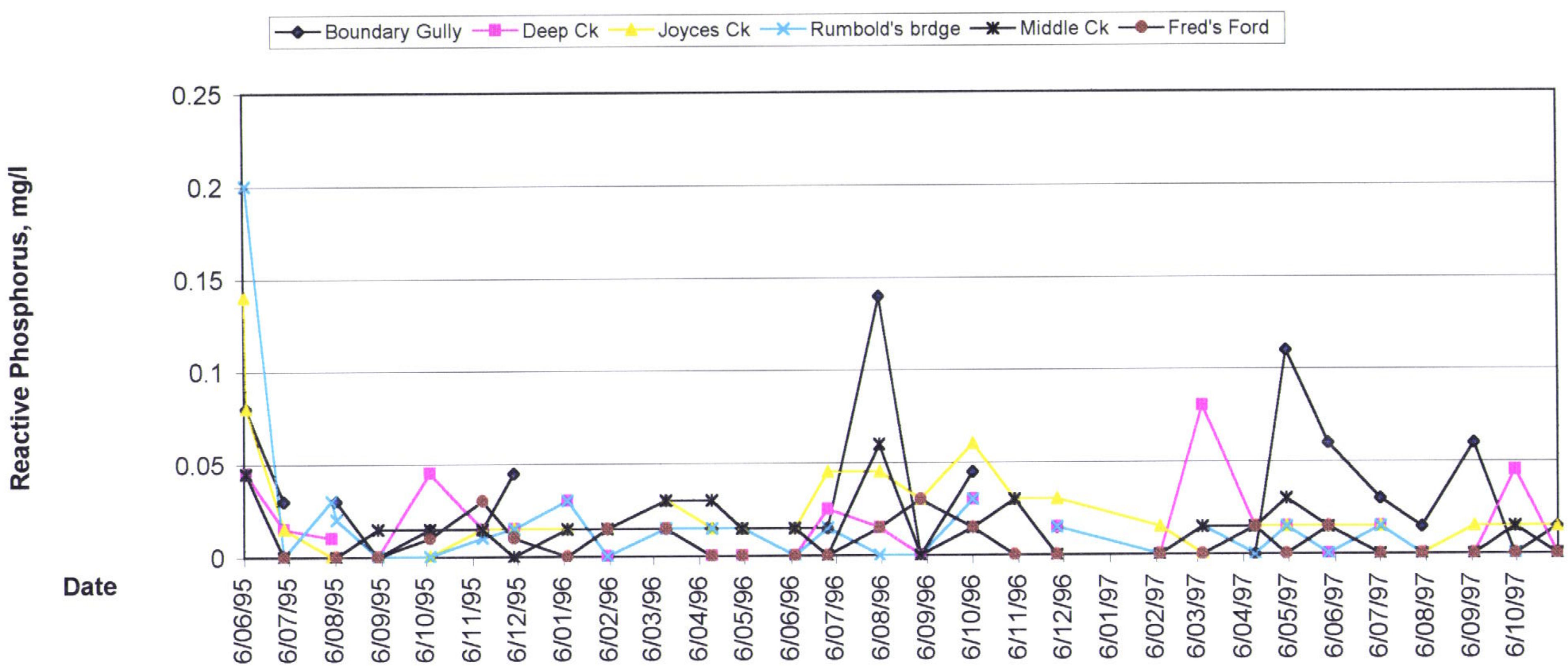
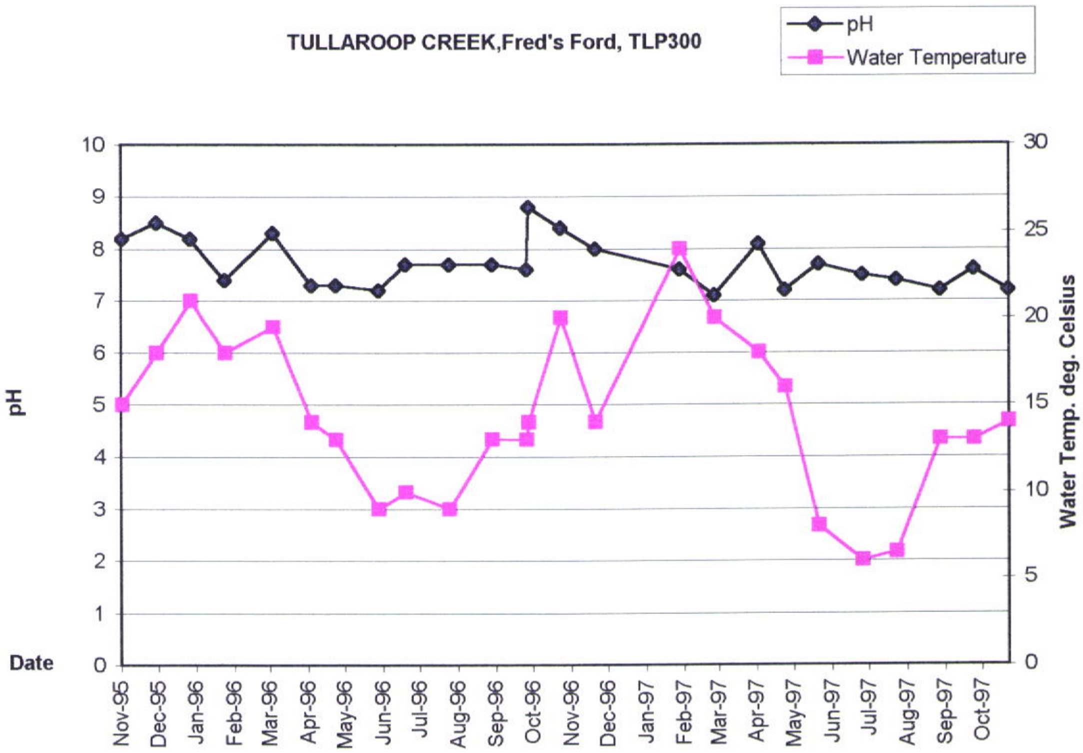
DEP900	1320	700	820	710	500	1520	430	450		480	700	1500	1380

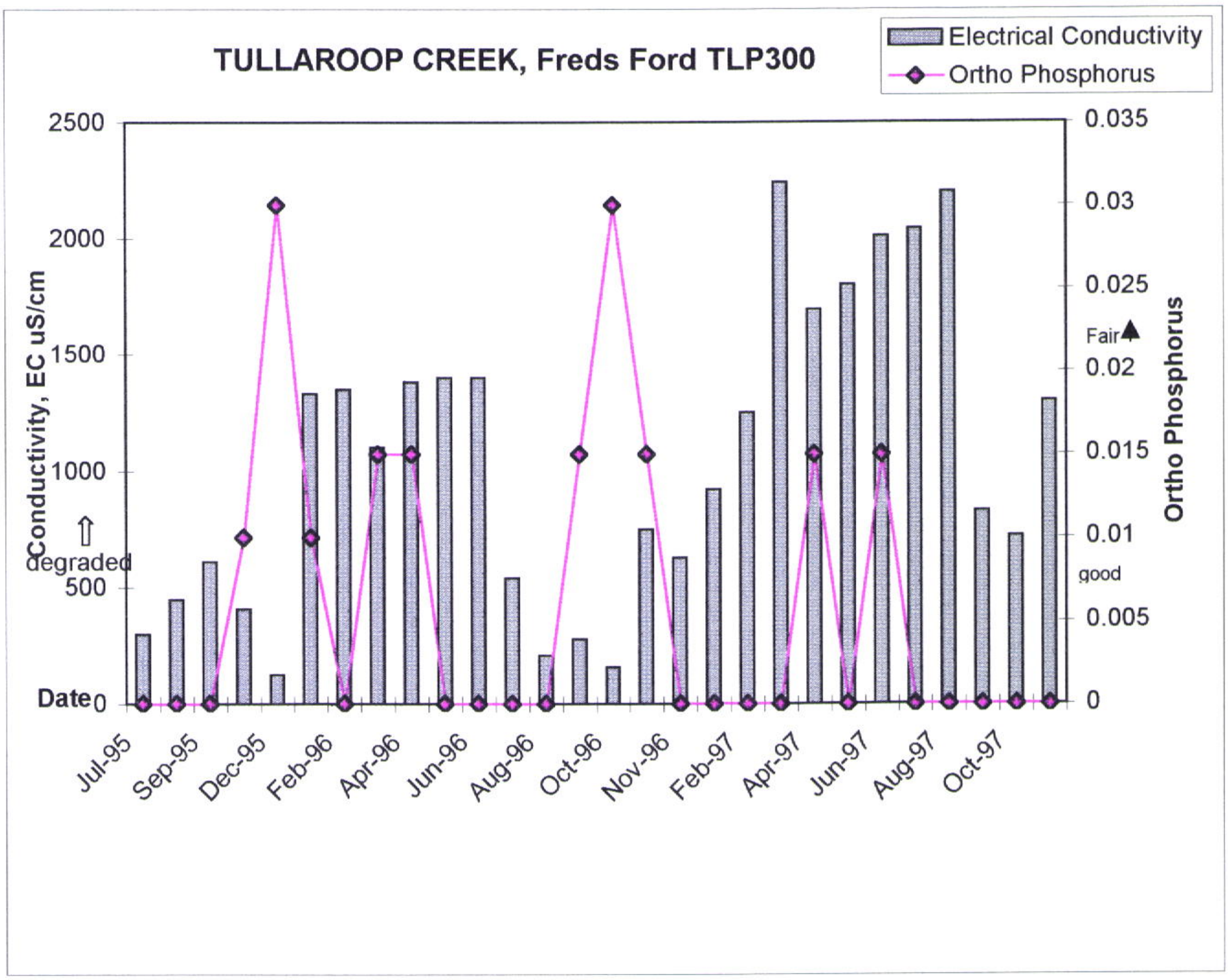
Moolort Reactive Phosphorus

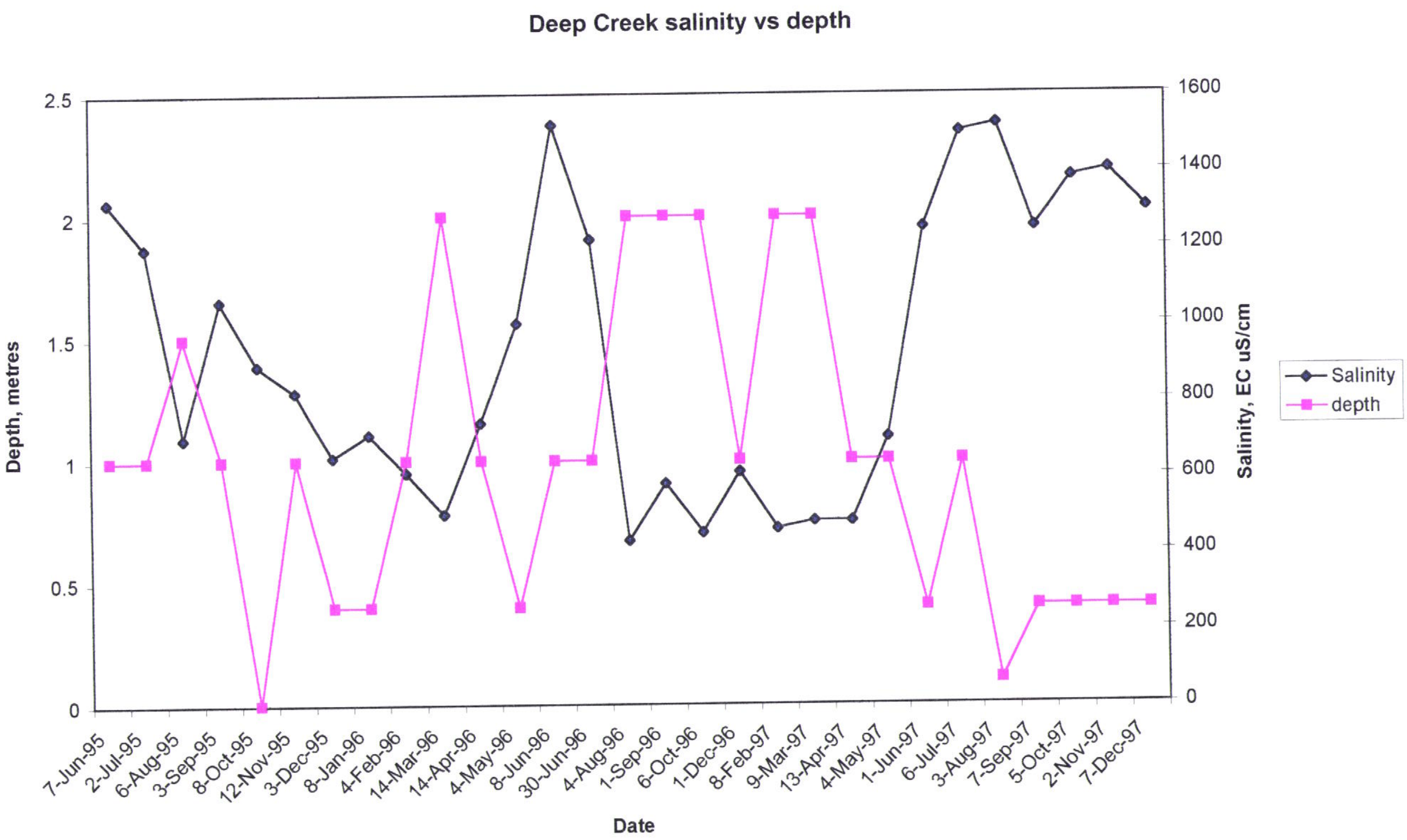


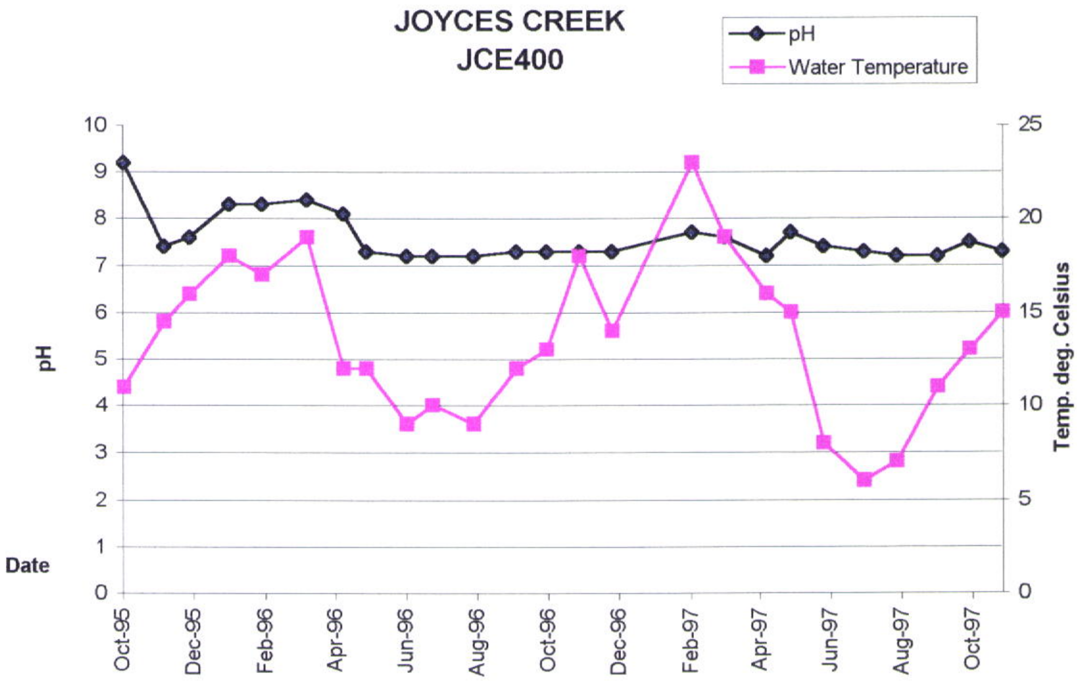
	6-Jun-95	2-Jul-95	3-Aug-95	3-Sep-95	8-Oct-95	3-Dec-95	8-Jan-96	14-Mar-96	14-Apr-96	8-Jun-96	4-Aug-96	1-Sep-96	3-Nov-96	1-Dec-96	9-Mar-97	13-Apr-97	1-Jun-97	6-Jul-97	7-Sep-97	5-Oct-97
Boundary Gully		0.03		0	0.015	0.045		0.015	0.015	0.015	0.14	0		0.015	0	0	0.06	0.03	0.06	0
Deep Ck		0.015	0.01	0	0.045	0.015	0.03	0.015	0	0	0.015	0		0.015	0.08	0.015	0	0.015	0	0.045
Joyces Ck	0.14	0.015	0	0	0	0.015	0.015	0.03	0.015	0.015	0.045	0.03	0.03	0.03	0	0.015	0.015	0.015	0.015	0.015
Rumbold's brdge		0	0.03	0	0	0.015	0.03	0.015	0.015	0	0	0		0.015	0.015	0	0	0.015	0	0
Middle Ck		0		0.015	0.015	0	0.015	0.03	0.03	0.015	0.06	0	0.03	0	0.015	0.015	0.015	0	0	0.015
Fred's Ford		0		0	0.01	0.01	0	0.015	0	0	0.015	0.03	0	0	0	0.015	0.015	0	0	0



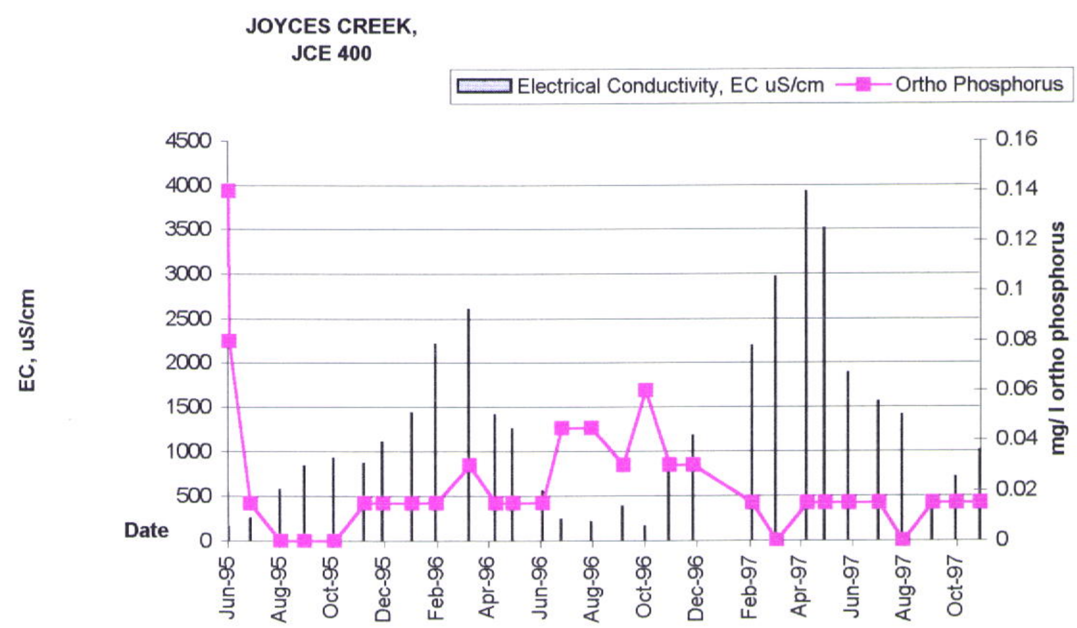
	12-Nov-95	7-Jan-96	14-Mar-96	4-May-96	30-Jun-96	8-Sep-96	8-Oct-96	3-Nov-96	8-Feb-97	13-Apr-97	1-Jun-97	3-Aug-97	5-Oct-97
pH	8.2	8.2	8.3	7.3	7.7	7.7	8.8	8.4	7.6	8.1	7.7	7.4	7.6
Water Temperature	15	21	19.5	13	10	13	14	20	24	18	8	6.5	13



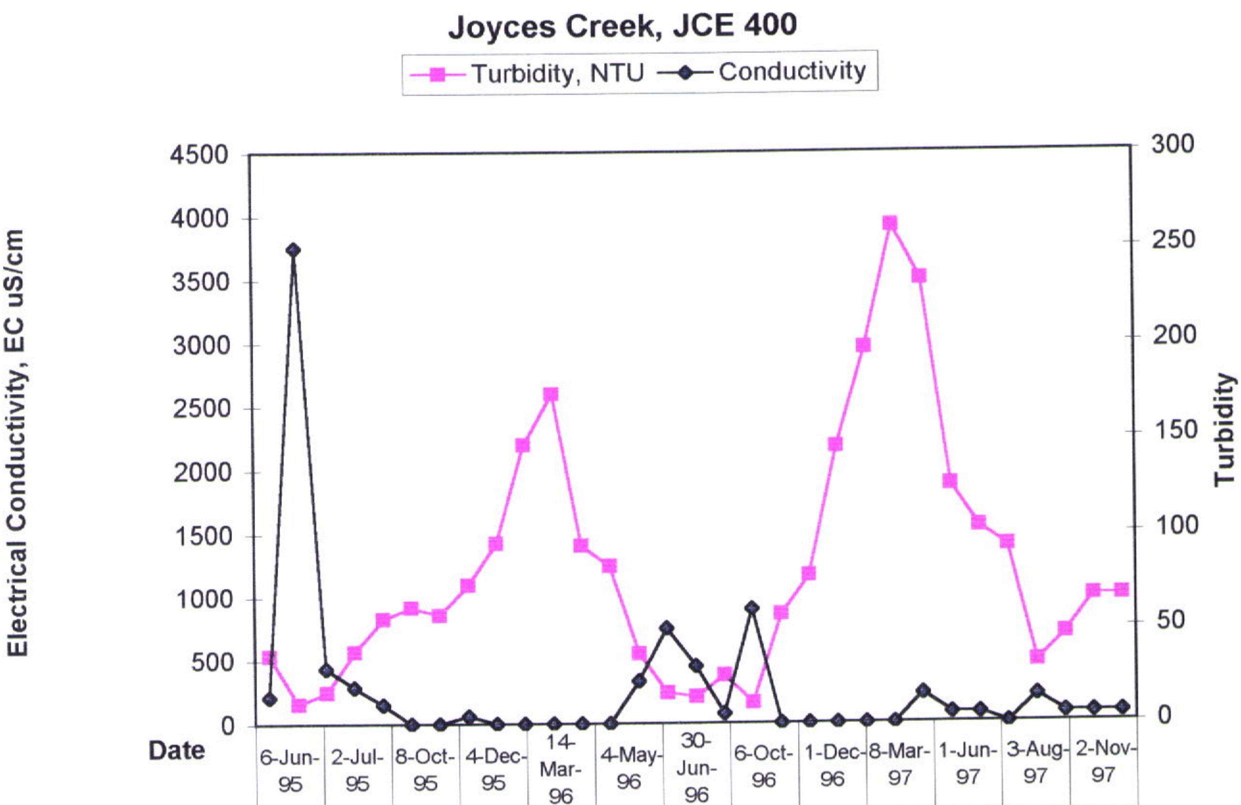

Deep Creek salinity vs depth
Depth, metres
2.5
2
1.5
1
0.5
0
Salinity, EC uS/cm
1600
1400
1200
1000
800
600
400
200
0
Salinity
depth
7-Jun-95
2-Jul-95
6-Aug-95
3-Sep-95
8-Oct-95
12-Nov-95
3-Dec-95
8-Jan-96
4-Feb-96
14-Mar-96
14-Apr-96
4-May-96
8-Jun-96
30-Jun-96
4-Aug-96
1-Sep-96
6-Oct-96
1-Dec-96
8-Feb-97
9-Mar-97
13-Apr-97
4-May-97
1-Jun-97
6-Jul-97
3-Aug-97
7-Sep-97
5-Oct-97
2-Nov-97
7-Dec-97
Date



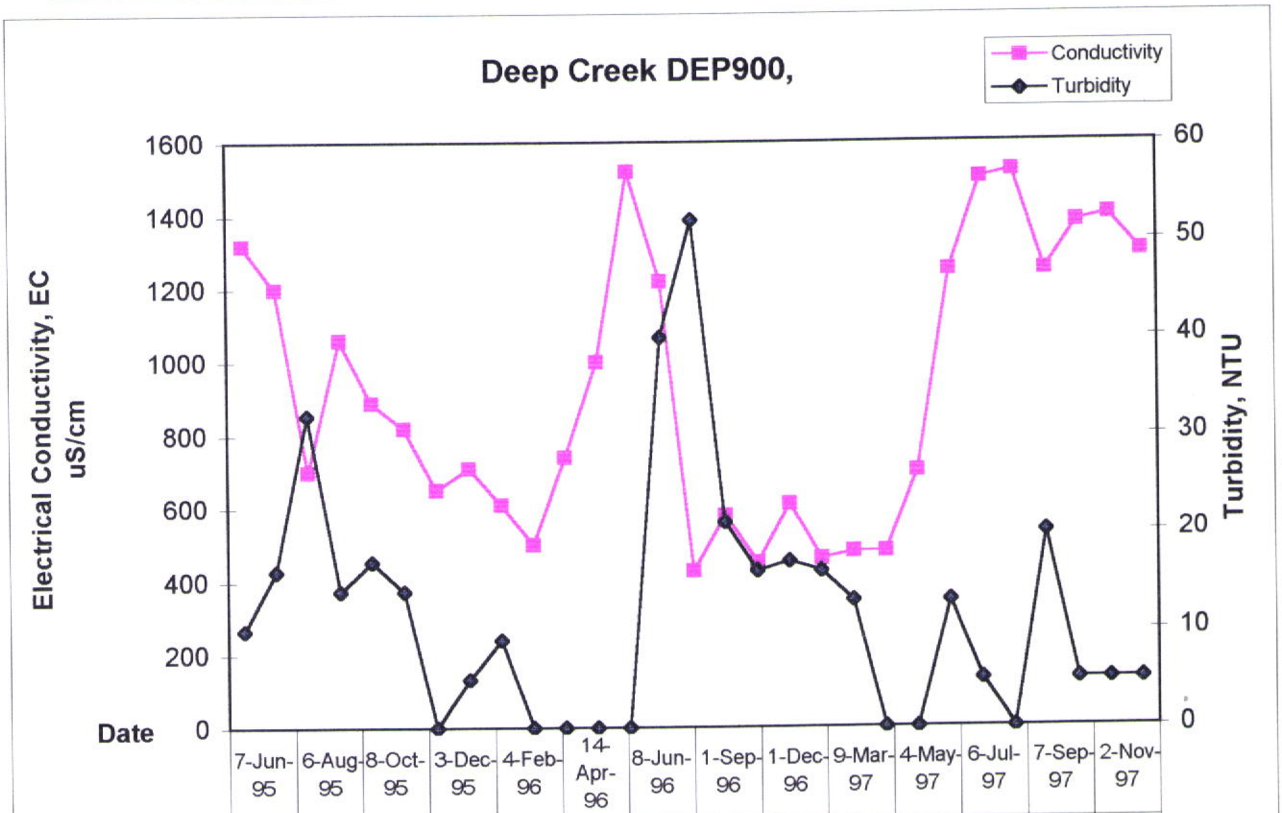
	8-Oct-95	4-Dec-95	4-Feb-96	14-Apr-96	8-Jun-96	4-Aug-96	6-Oct-96	3-Nov-96	8-Feb-97	13-Apr-97	1-Jun-97	3-Aug-97	5-Oct-97
pH	9.2	7.6	8.3	8.1	7.2	7.2	7.3	7.3	7.7	7.2	7.4	7.2	7.5
Water Temperature	11	16	17	12	9	9	13	18	23	16	8	7	13



	6-Jun-95	6-Aug-95	8-Oct-95	7-Jan-96	14-Apr-96	30-Jun-96	10-Sep-96	1-Dec-96	13-Apr-97	6-Jul-97	7-Sep-97
Electrical Conductivity, EC uS/cm	540	570	920	1430	1410	240	380	1170	3920	1550	480
Ortho Phosphorus	0.14	0	0	0.015	0.015	0.045	0.03	0.03	0.015	0.015	0.015

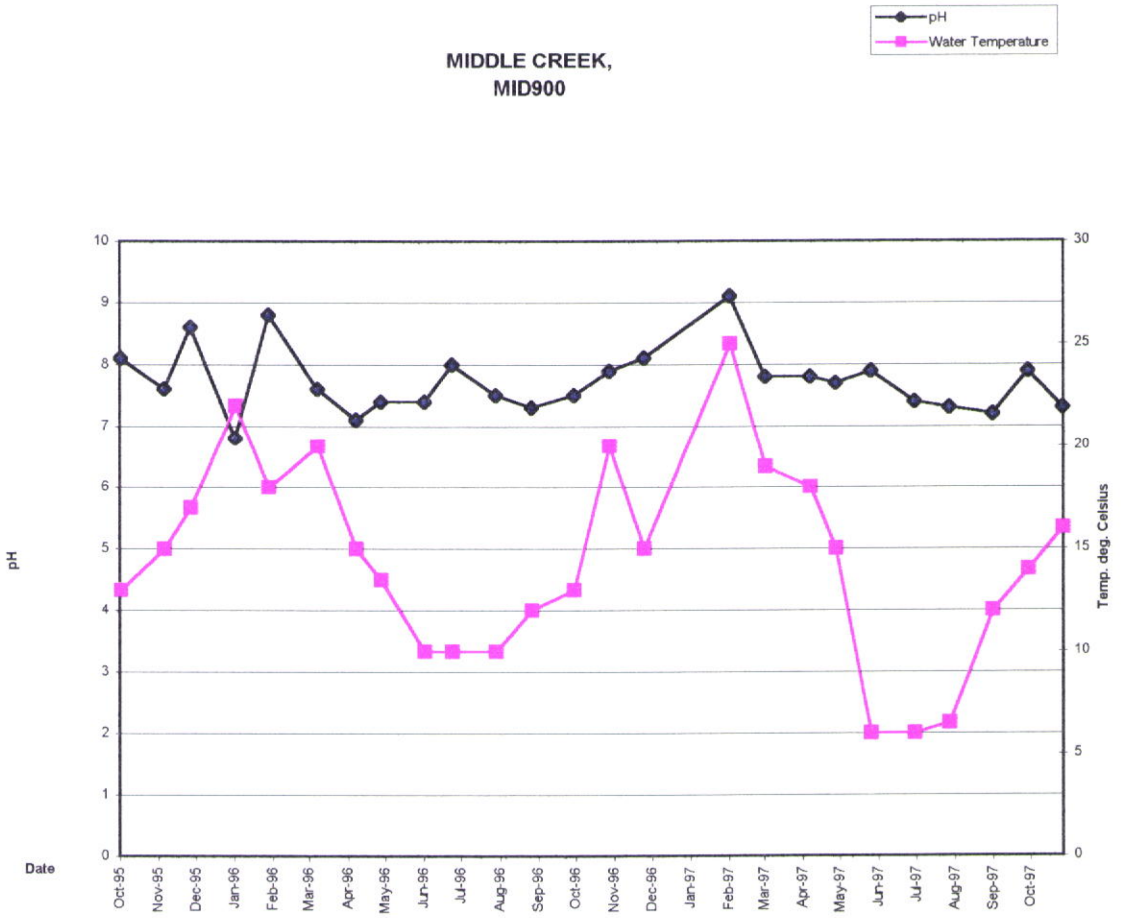


Date	6-Jun-95	2-Jul-95	8-Oct-95	4-Dec-95	14-Mar-96	4-May-96	30-Jun-96	6-Oct-96	1-Dec-96	8-Mar-97	1-Jun-97	3-Aug-97	2-Nov-97
Turbidity, NTU	540	250	920	1100	2600	1250	240	160	1170	2960	1880	1400	1000
Conductivity	14	29	0	4	0	0	50	60	0	0	5	0	5

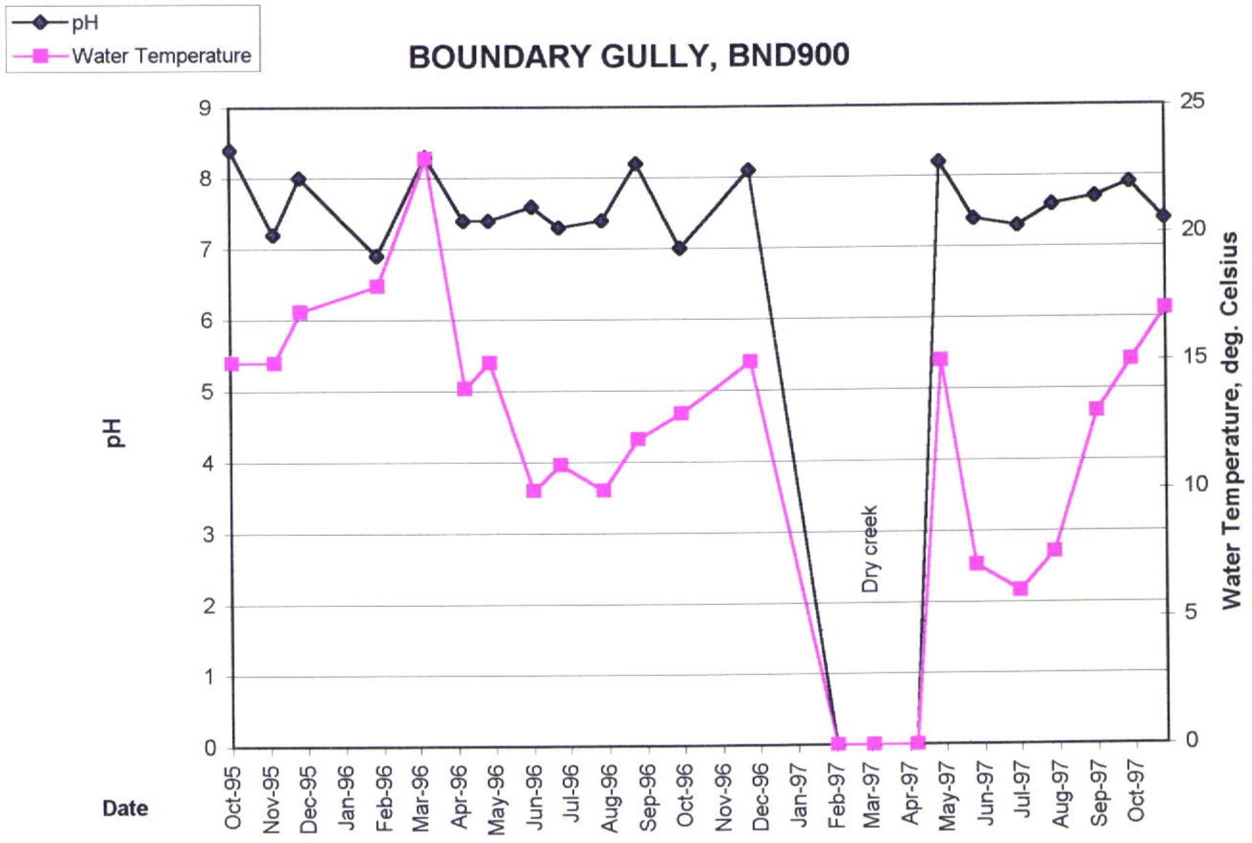


Date	7-Jun-95	6-Aug-95	8-Oct-95	3-Dec-95	4-Feb-96	14-Apr-96	8-Jun-96	1-Sep-96	1-Dec-96	9-Mar-97	4-May-97	6-Jul-97	7-Sep-97	2-Nov-97
Conductivity	1320	700	890	650	610	740	1520	580	610	480	700	1500	1250	1400
Turbidity	10	32	17	0	9	0	0	21	17	13	0	5	20	5

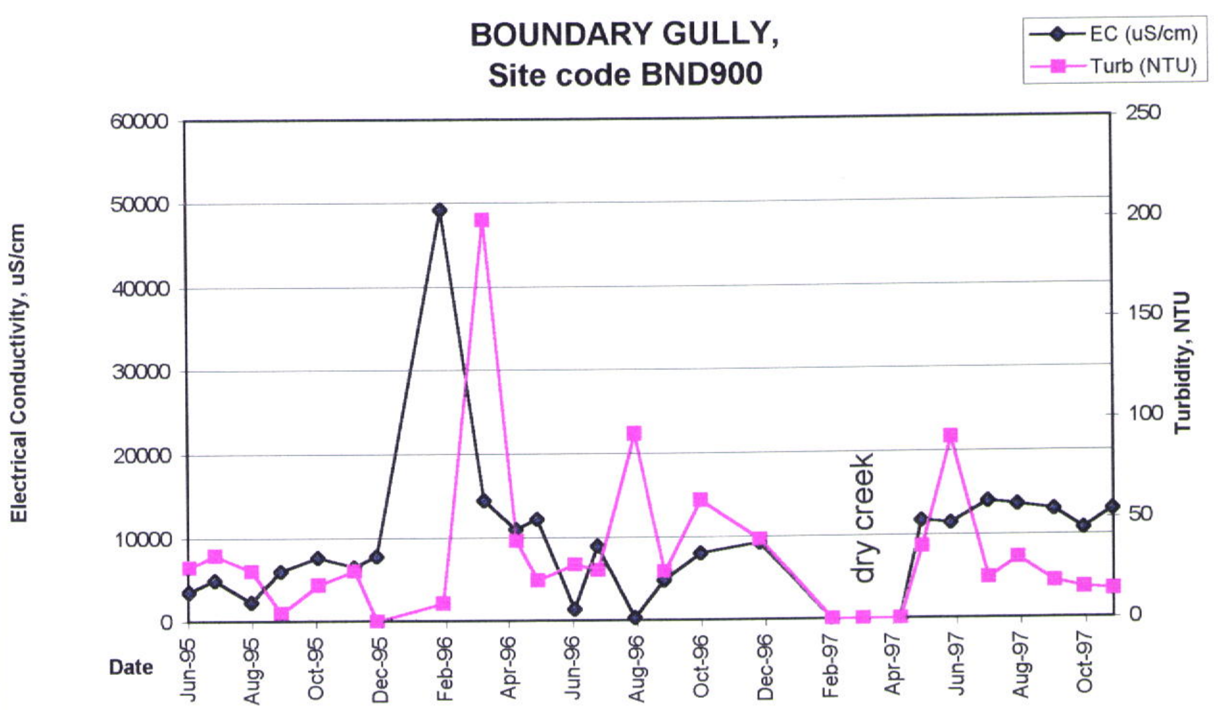
MIDDLE CREEK, MID900



	8-Oct-95	12-Nov-95	3-Dec-95	8-Jan-96	14-Mar-96	14-Apr-96	4-May-96	8-Jun-96	30-Jun-96	4-Aug-96	2-Sep-96	3-Nov-96	1-Dec-96	8-Feb-97	8-Mar-97	13-Apr-97	4-May-97	1-Jun-97	6-Jul-97	7-Sep-97	5-Oct-97	2-Nov-97
pH	8.1	7.6	8.6	6.8	7.6	7.1	7.4	7.4	8	7.5	7.3	7.9	8.1	9.1	7.8	7.8	7.7	7.9	7.4	7.2	7.9	7.3
Water Temperature	13	15	17	22	20	15	13.5	10	10	10	12	20	15	25	19	18	15	6	6	12	14	16



	8-Oct-95	12-Nov-95	4-Feb-96	14-Mar-96	4-May-96	8-Jun-96	4-Aug-96	1-Sep-96	1-Dec-96	8-Feb-97	9-Mar-97	4-May-97	1-Jun-97	3-Aug-97	7-Sep-97	2-Nov-97
pH	8.4	7.2	6.9	8.3	7.4	7.6	7.4	8.2	8.1	0	0	8.2	7.4	7.6	7.7	7.4
Water Temperature	15	15	18	23	15	10	10	12	15	Dry creek		15	7	7.5	13	17



Date (mm/dd/yy)	7-Jun-95	6-Aug-95	8-Oct-95	3-Dec-95	14-Mar-96	4-May-96	30-Jun-96	1-Sep-96	6-Oct-96	8-Feb-97	13-Apr-97	1-Jun-97	3-Aug-97	5-Oct-97
EC (uS/cm)	3500	2310	7630	7790	14500	12200	8940	4690	8000	0	0	11400	13660	10750
Turb (NTU)	27	25	18	0	200	20	25	24	60	0	0	90	30	15

Interpreting all your physico-chemical results

It is important to obtain some baseline data for your catchment and compare any of your results against what has been found in the stream previously. Contact your Waterwatch co-ordinator if you need help locating baseline data.

Listed below is a set of rating guidelines from the 'State of the Environment' Report for a range of parameters. It provides a very broad but useful starting point for determining ratings for water quality. Using this table as a model, for your catchment, try and establish what is considered excellent through to degraded for the parameters you are measuring.

Rating guidelines for some tests

Parameter	Excellent	Good	Fair	Poor	Degraded
Conductivity (µS/cm EC)					
mountain	<30	<90	<150	<225	>225
valley	<80	<240	<400	<600	>600
plain	<100	<250	<500	<750	>750
Turbidity (NTU)					
mountain	<5.0	<7.5	<10.0	<12.5	>12.5
valley	<10.0	<12.5	<15.0	<22.5	> 22.5
plain	< 15.0	<17.5	<20.0	<30.0	>30.0
pH	6.0 -7.0	5.5 - 6 or <8.0	8.0 -8.5	5.0 -5.5 or 8.5 - 9.0	<5.0 or >9.0
Reactive Phosphorus (mg/L)	<0.008	<0.020	<0.040	<0.08	>0.08
Total Phosphorus (mg/L)	<0.010	<0.025	<0.050	<0.10	>0.10
Nitrates (mg/L)	<0.05	<0.1	<0.2	<0.4	>0.4
Total Nitrogen (mg/L)	< 0.2	0.2 - 0.35	0.35 - 0.50	0.50 - 1.00	>1.0
E. coli (o/m per 100 mL)	0 -50	51 - 200	201 -600	601 - 2000	>2000

Key:	< 'less than'	> 'more than'

(Source: State of the Environment Report - Victoria's Inland Waters)

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
Boundary G	7-Jun-95		0.4	3500	fast	0.08		52	12	27	1.5
BND900	2-Jul-95		0.4	4900	slow	0.03		0		33	1.5
BND900	6-Aug-95	9	0.4	2310	slow	0.03		2	8.5	25	0.5
BND900	3-Sep-95	12	0.4	5940	slow	0		0	6	4	0.5
BND900	8-Oct-95	12	0.1	7630	v.slow	0.015	8.4		15	18	
BND900	12-Nov-95	19	0.1	6500	slow	0.015	7.2	8	15	25	
BND900	3-Dec-95	16	0.1	7790	slow	0.045	8		17	5	1
BND900	8-Jan-96	20.5	0.1	10430	slow	0.11	8.6		20	10	1
BND900	4-Feb-96	18	0.4	49200	0	0	6.9		18	9	
BND900	14-Mar-96	22	0.4	14500	0	0.015	8.3		23	200	
BND900	14-Apr-96	17	0.4	11000	slow	0.015	7.4	15	14	40	1
BND900	4-May-96	21	0.4	12200	slow	0.015	7.4		15	20	1
BND900	8-Jun-96	11	0.4	1362	slow	0.015	7.6		10	28	1.5
BND900	30-Jun-96	11	0.4	8940	fast	0.015	7.3	2	11	25	1
BND900	4-Aug-96	10	1	320	rapid	0.14	7.4	2	10	93	2
BND900	1-Sep-96		0.4	4690	slow	0	8.2	11	12	24	2
BND900	6-Oct-96	16	1	8000	slow	0.045	7		13	60	1.5
BND900	1-Dec-96		0.4	9180		0.015	8.1	0	15	40	1
BND900	8-Feb-97		0		0						
BND900	9-Mar-97				0						
BND900	13-Apr-97				0						
BND900	4-May-97		0.4	11690		0.11	8.2	15	15	36	1
BND900	1-Jun-97	10	0.4	11400	0	0.06	7.4	0	7	90	1
BND900	6-Jul-97	8	0.4	14000		0.03	7.3	0	6	20	1
BND900	3-Aug-97		0.4	13660		0.015	7.6	0	7.5	30	1
BND900	7-Sep-97	12	0.4	13050	0	0.06	7.7	8	13	18	1
BND900	5-Oct-97	19	0.4	10750		0	7.9		15	15	1
BND900	2-Nov-97	17	0.4	13000		0.015	7.4	0	17	14	1
BND900	7-Dec-97	24	0.4	19400	0	0.03	6.6	0	22	40	1

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
Deep Ck	7-Jun-95		1	1320		0.045		52	17.5	10	
DEP900	2-Jul-95		1	1200		0.015				16	5
DEP900	6-Aug-95	9	1.5	700		0.01		1	8	32	3.4
DEP900	3-Sep-95	12	1	1060		0			6	14	8
DEP900	8-Oct-95			890		0.045	9.8		15	17	
DEP900	12-Nov-95	19	1	820		0.015	8.1		16	14	4
DEP900	3-Dec-95		0.4	650		0.015	7.5		17	0	3.5
DEP900	8-Jan-96	20	0.4	710		0.03	7.8	35	20	5	2.5
DEP900	4-Feb-96	19	1	610		0	7.6		18	9	
DEP900	14-Mar-96	22	2	500		0.015	6.9		21	0	
DEP900	14-Apr-96	16	1	740		0	7.3	15	14	0	5.5
DEP900	4-May-96	21	0.4	1000		0	8.3		15	0	5.5
DEP900	8-Jun-96	11	1	1520		0	7.4	25	9.5	0	6
DEP900	30-Jun-96	11	1	1220		0.025	7.2	2	11	40	7
DEP900	4-Aug-96	10	2	430		0.015	7.3	2	11	52	30
DEP900	1-Sep-96		2	580		0	8.6	44	12	21	11
DEP900	6-Oct-96	16	2	450		0.03	7.2		13	16	15
DEP900	1-Dec-96		1	610		0.015	7.2	0	15	17	10
DEP900	8-Feb-97		2	460		0	8.5		25	16	15
DEP900	9-Mar-97		2	480		0.08	7.4	0	20	13	15
DEP900	13-Apr-97		1	480		0.015	7.2		14	0	9
DEP900	4-May-97		1	700		0.015	8	15	15	0	
DEP900	1-Jun-97	9	0.4	1250		0	7.5	0	6	13	8
DEP900	6-Jul-97	9	1	1500		0.015	7.3	0	8	5	4
DEP900	3-Aug-97		0.1	1520		0	7.3	0	7	0	2
DEP900	7-Sep-97	12	0.4	1250		0	7.4	8	13	20	3
DEP900	5-Oct-97	19	0.4	1380		0.045	7.4		15	5	3
DEP900	2-Nov-97	17	0.4	1400		0	7	0	16.5	5	3
DEP900	7-Dec-97		0.4	1300		0	7.2	0	23	5	8

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
Joyces Ck	6-Jun-95	14	2	540		0.14		31	15.5	14	6
JCE400	7-Jun-95		2	160		0.08			14.5	250	
JCE400	2-Jul-95		1	250		0.015		1	6	29	6
JCE400	6-Aug-95		0.5	570		0		15	8	19	0.5
JCE400	3-Sep-95	12	0.3	830		0			8.5	10	2.5
JCE400	8-Oct-95	12	0.4	920	0.05	0	9.2	2	11	0	2
JCE400	12-Nov-95	19	0.2	860		0.015	7.4	10	14.5	0	2
JCE400	4-Dec-95	14.5		1100		0.015	7.6	7	16	4	1.5
JCE400	7-Jan-96	22	0.1	1430		0.015	8.3	32	18	0	2.5
JCE400	4-Feb-96	16	1	2200		0.015	8.3		17	0	
JCE400	14-Mar-96	21	0.4	2600	0	0.03	8.4		19	0	
JCE400	14-Apr-96	14	0.4	1410		0.015	8.1	12	12	0	2.5
JCE400	4-May-96	20	0.1	1250		0.015	7.3		12	0	3
JCE400	8-Jun-96	9	1	550		0.015	7.2	47	9	22	5.5
JCE400	30-Jun-96	11	2	240		0.045	7.2	4	10	50	7
JCE400	4-Aug-96	8	1	210		0.045	7.2	2	9	30	9
JCE400	10-Sep-96	14	0.4	380		0.03	7.3	3	12	5	4.5
JCE400	6-Oct-96	14	1	160		0.06	7.3	6	13	60	10
JCE400	3-Nov-96		0.4	860		0.03	7.3		18	0	5
JCE400	1-Dec-96		0.4	1170		0.03	7.3	0	14	0	5
JCE400	8-Feb-97		0.4	2180	0	0.015	7.7	2	23	0	2.5
JCE400	8-Mar-97		1	2960	0	0	7.6		19	0	2.5
JCE400	13-Apr-97		0.4	3920		0.015	7.2	0	16	0	2.5
JCE400	4-May-97		0.4	3500	0	0.015	7.7	26	15	15	2.5
JCE400	1-Jun-97	11	1	1880		0.015	7.4		8	5	5
JCE400	6-Jul-97	5	1	1550		0.015	7.3	0	6	5	5
JCE400	3-Aug-97		1	1400		0	7.2	0	7	0	5
JCE400	7-Sep-97	12	1	480		0.015	7.2	7	11	14	6
JCE400	5-Oct-97	18	0.4	700		0.015	7.5	0	13	5	5
JCE400	2-Nov-97	17	1	1000		0.015	7.3	1	15	5	6
JCE400	2-Dec-97	25	1	1000	0	0.015	7.5	0	24	5	4.5

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
Rumbolds B	7-Jun-95		1	930	fast	0.14		52	11.8	250	
LOD300	2-Jul-95		1	1900	fast	0				55	6
LOD300	3-Aug-95	9		670	fast	0.03			9	15	6
LOD300	6-Aug-95		2	710	fast	0.02		1	9	14	10
LOD300	3-Sep-95	12	1	2020	slow				6	8	6
LOD300	8-Oct-95			960		0	9.1		15	0	
LOD300	12-Nov-95	19	1	480	fast	0.01	8.2	8	16	21	4
LOD300	3-Dec-95	16	1	480	fast	0.015	8.4		15	14	4
LOD300	8-Jan-96	21	1	480	fast	0.03	8.1	35	21	10	6
LOD300	4-Feb-96	18	2	610	fast	0	7.4		18	14	6
LOD300	14-Mar-96	22	2	700	rapid	0.015	7.4		21	0	6
LOD300	14-Apr-96	17	2	560	fast	0.015	6.6	15	18	0	6
LOD300	4-May-96	20	1	890	fast	0.015	7.4		15	0	6
LOD300	8-Jun-96	11	1	1540	medm.	0	7.5	25	10	0	6
LOD300	30-Jun-96	11	1	1500	fast	0.015	7.7	2	11	16	6.5
LOD300	4-Aug-96	10	2	450	rapid	0	7.1	2	12	23	40
LOD300	1-Sep-96		1	450	fast	0	8	11	12	20	9
LOD300	6-Oct-96	16	2	330	fast	0.03	6.7		12	25	30
LOD300	1-Dec-96		1	340	fast	0.015	7.8	0	15	16	6
LOD300	8-Feb-97		2	360	fast	0	8.2	3	24	10	7
LOD300	9-Mar-97		2	390	fast	0.015	7.8	0	18	10	12
LOD300	13-Apr-97		2	390	fast	0	7.4	0	14	0	12
LOD300	4-May-97		2	460	fast	0.015	7.5	15	15	0	12
LOD300	1-Jun-97	10	0.4	1160	slow	0	8.5	0	6	12	5
LOD300	6-Jul-97	8	1	1300	slow	0.015	7.3	0	8	5	4
LOD300	3-Aug-97		0.4	1160	slow	0	7.7	0	7	0	4
LOD300	7-Sep-97	13	1	1730	slow	0	7.6	7	12	14	4
LOD300	5-Oct-97	19	1	1250	slow	0	8.2	0	15	5	4
LOD300	2-Nov-97	17	1	1000	slow	0	6.7	0	16.5	5	4
LOD300	7-Dec-97	24	1	800	fast	0	7.1	0	23	5	8
LOD310	7-Jun-95		1	930		0.14		52	11.8	250	
LOD310	2-Jul-95		1	2000		0				28	10
LOD310	3-Aug-95	9	2	670		0.03			9	15	6
LOD310	3-Sep-95	12	1	2060		0			6.5	10	8

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
Middle Ck	7-Jun-95	14	2	3180	fast	0.045		125	16.5	88	8
MID900	2-Jul-95	9	1	350	medm.	0				14	6
MID900	6-Aug-95	9	1	710	fast	0		6	9	43	3
MID900	3-Sep-95	12	1	1640	slow	0.015			10	8	3.5
MID900	8-Oct-95	12	1	2610	slow	0.015	8.1	1	13	10	6
MID900	12-Nov-95	20	0.4	3490	slow	0.015	7.6	18	15	0	4
MID900	3-Dec-95	16	0.4	3790	0		8.6		17	0	3
MID900	8-Jan-96	25	0.4	3840	slow	0.015	6.8	34	22	15	2.5
MID900	4-Feb-96	18	0.4	5250	slow	0.015	8.8		18	16	2
MID900	14-Mar-96	22	0.4	7400	slow	0.03	7.6		20	0	2.5
MID900	14-Apr-96	16	0.4	7000	slow	0.03	7.1	9	15	0	4
MID900	4-May-96	22	0.4	6940	slow	0.015	7.4		13.5	0	3
MID900	8-Jun-96	12	1	4610	slow	0.015	7.4	45	10	0	3
MID900	30-Jun-96		2	1200	fast	0	8	2	10	32	10
MID900	4-Aug-96		2	330	fast	0.06	7.5	2	10	50	12
MID900	2-Sep-96	10	1	790	fast	0	7.3	52	12	27	8
MID900	6-Oct-96	16	1	450	fast	0.015	7.5	6	13	25	4
MID900	3-Nov-96		0.4	1940	slow	0.03	7.9	3	20	5	3
MID900	1-Dec-96		0.4	3250	slow	0	8.1	2	15	0	2
MID900	8-Feb-97		0.4	6120	slow	0	9.1	1	25	0	2.5
MID900	8-Mar-97		0.4	7450	slow	0.015	7.8	0	19	0	2.5
MID900	13-Apr-97		0.4	7500	slow	0.015	7.8	0	18	0	2.5
MID900	4-May-97		4	7330	slow	0.03	7.7	23	15	0	2.5
MID900	1-Jun-97	10	0.4	6850	slow	0.015	7.9	0	6	5	5
MID900	6-Jul-97	10	0.4	5320	slow	0	7.4	0	6	5	2
MID900	3-Aug-97		0.4	5000	slow	0	7.3		6.5	0	2
MID900	7-Sep-97	12	1	2700	slow	0	7.2	8	12	5	5
MID900	5-Oct-97	19	0.4	2000	slow	0.015	7.9		14	5	6
MID900	2-Nov-97	18	0.4	3670	slow	0	7.3	0	16	5	5
MID900	7-Dec-97	22	0.4	3380	slow	0.015	7.7	0	20	5	3.5

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
	2-Jul-95		1	300	fast	0		6		22	3.5
TLP300	6-Aug-95	9	2	450	fast	0			8	19	2
TLP300	3-Sep-95	12	1	610		0			11	10	2
TLP300	12-Nov-95	19	1	410	medm.	0.01	8.2	10	15	8	2
TLP300	10-Dec-95	16	1	125	slow	0.092	8.5	1	18	0	2
TLP300	7-Jan-96	23	1	1330	slow	0.01	8.2	4	21	0	2
TLP300	4-Feb-96	18	1	1350	fast	0	7.4		18	0	
TLP300	14-Mar-96	22	0.4	1100	slow	0.015	8.3		19.5	0	
TLP300	14-Apr-96	1	0.4	1380	slow	0.015	7.3		14	0	
TLP300	4-May-96	20	0.4	1400	slow	0	7.3		13	0	2.5
TLP300	8-Jun-96	9	1	1400	slow	0	7.2	40	9	0	5.5
TLP300	30-Jun-96	11	1	540	medm.	0	7.7	3	10	33	6
TLP300	4-Aug-96	9	2	210	rapid	0	7.7	2	9	40	20
TLP300	8-Sep-96			280	fast	0.015	7.7		13	17	5.5
TLP300	6-Oct-96	15	2	160	fast	0.03	7.6	6	13	20	20
TLP300	8-Oct-96	12		750		0.015	8.8	5	14	0	2
TLP300	3-Nov-96		1	630		0	8.4		20	0	5
TLP300	1-Dec-96		0.4	920		0	8	2	14	0	3
TLP300	8-Feb-97		1	1250		0	7.6		24	0	5
TLP300	8-Mar-97		1	2240		0	7.1		20	0	5
TLP300	13-Apr-97		1	1690		0.015	8.1	0	18	0	5
TLP300	4-May-97		1	1800		0	7.2	24	16	0	5
TLP300	1-Jun-97	10	1	2010		0.015	7.7	0	8	5	5
TLP300	6-Jul-97	9	1	2040		0	7.5	0	6	5	4
TLP300	3-Aug-97		1	2200		0	7.4		6.5	0	4
TLP300	7-Sep-97	12	1	830		0	7.2	8	13	40	4
TLP300	5-Oct-97	19	1	720		0	7.6	0	13	5	4
TLP300	2-Nov-97			1300		0	7.2		14	5	
TLP300	7-Dec-97	21	1	1180		0	7.8	0	19	5	4

Site code	Date	AirT, C	Depth, M	EC-uS/cm	Flow	Ophos-mg/l	pH	Rain, mm	Temp, deg C	Turb (NTU)	Width (M)
LOD300	7-Jun-95		1	930		0.14		52	11.8	250	
BND900	7-Jun-95		0.4	3500		0.08		52	12	27	1.5
LOD310	7-Jun-95		1	930		0.14		52	11.8	250	
LOD300	2-Jul-95		1	1900		0				55	6
BND900	2-Jul-95		0.4	4900		0.03		0		33	1.5
LOD310	2-Jul-95		1	2000		0				28	10
LOD300	6-Aug-95		2	710		0.02			9	14	10
BND900	6-Aug-95	9	0.4	2310		0.03		2	8.5	25	0.5
LOD310	3-Aug-95	9	2	670		0.03			9	15	6
LOD300	3-Sep-95	12	1	2020					6	8	6
BND900	3-Sep-95	12	0.05	7630		0.015	8.4		15	18	
LOD310	3-Sep-95	12	1	2060		0			6.5	10	8