NORTH-EAST SALINITY STRATEGY SURFACE WATER SALINITY MONITORING

OVENS CATCHMENTS - 2001

Goulburn - Murray Water

November 2002

GOULBURN-MURRAY WATER
Natural Heritage Trust
NORTH EAST CATCHMENT MANAGEMENT AUTHORITY
SINCLAIR KNIGHT MERZ

Goulburn Murray Water
Natural Resources Tatura

North-East Salinity Strategy Surface Water Salinity Monitoring

Ovens Catchments - 2001

Funded By

North-East CMA
DNRE
Natural Heritage Trust
Goulburn-Murray Water

North-East Salinity Strategy Surface Water Salinity Monitoring

Ovens Catchments - 2001

Final

December 2002

SINCLAIR KNIGHT MERZ

Sinclair Knight Merz Pty Limited
ACN 001 024 095
ABN 37 001 024 095
40 Casey Street
PO Box 260
Tatura VIC
Australia 3616
Telephone: +61 3 5833 5400
Facsimile: +61 3 5833 5444

Contents

Document History and Status

Issue	Rev.	Issued To	Qty	Date	Reviewed	Approved
Draft	0	P Dickinson (G-MW)	1	28/6/02	P D	H Kleindienst
		P Ockenden (NRE)	1	13/9/02	P O	
Final	0	P Dickinson	3 bound	12/12/02	H Kleindienst	H Kleindienst
			1 elec			
		P Ockenden	5 bound			
			1 elec			
		Library - Tatura	1			
		Library - Melb	1			
		File				

Printed: 17 December, 2002
Last Saved: 22 November, 2002
File Name: I:\WTAT\Wt01610\Rep02_01.05\D03dvdne(Final).Doc
Project Manager: Dean Delahunty
Name of Organisation: Goulburn-Murray Water
Name of Project: North-East Salinity Strategy
Surface Water Salinity
Name of Document: Ovens Catchments
Document Version: Final
Project Number: WT01610

1. Introduction

This report provides a review of the surface water salinity data collected at four sites in the Ovens Basin for the 2001 calendar year. A brief analysis of the data is also included.

This report contains :

- An assessment of the usefulness and accuracy of information provided by the monitoring sites, with recommendations where appropriate.
- A schedule of missing data for all sites.
- Basic flow, salinity and salt load statistics for each site.
- Time series graphs for flow and salinity for each site.
- An evaluation of graphs and statistics for possible faulty data.

This brief annual review is essential to ensure the integrity of the monitoring program, and is a precursor to any full analysis of data from these monitoring sites. The collation of additional catchment data such as area, land-use and climate information will assist in the long-term understanding of salinity characteristics in these catchments. It is envisaged that this project will, over this initial stage of salinity strategy implementation, develop and document the information required for assessing the impact of salinity both within the region and in the wider context of the Murray Darling Basin.

2. Catchment Information

The Ovens catchments (shown in Figure 2.1) cover an area of approximately 778,000 ha and are recognised as contributing approximately 14% of the total volume of water to the Murray Darling Basin system (NESWG, 1997). The four continuous flow and salinity monitoring sites that have been reviewed in this report are located in the lower reaches of the Ovens catchments. The purpose of these sites is to record the salinity of these streams over time and to assist in the assessment of dryland salinity impacts. Dryland salinity due to rising water tables in the floodplains is a recognised factor in the decline of water quality in the lower part of catchment, particularly to the foothills regions. There is a large quantity of information available regarding salt discharge sites in the Ovens Basin. An example of this is the Everton Upper area where work is currently being undertaken to remediate a discharge site. The valley where the salt discharge is occurring does not flow as a stream but would naturally drain to the Ovens River during wetter weather. There is potential to collate information to link washoff of salt from these areas, which can be measured by the stream gauge, with particular weather sequences.

Additional information on catchment characteristics will be developed during the initial stages of Salinity Strategy implementation as stream flow and salinity data is gathered. It may then be possible to use the stream flow and salinity data to assess the salinity behaviour of the catchments. The current available information about each of the catchments is summarised below.

2.1 Ovens River (Site 403241)

The Ovens River drains from the northern side of the Great Dividing Range and discharges to the River Murray upstream of Yarrawonga. The Ovens River monitoring site that is being assessed in this report is located at Peechelba. This site is being used by the Murray Darling Basin Commission for spot flow measurements and flood forecasting and would also be an appropriate location to monitor 'End-of-Valley' targets under the Salinity and Drainage Strategy, 2000.

It should be noted that although there is also a flow monitoring site upstream of Peechelba at Wangaratta (Site 403242) the site does not capture any flows from the Fifteen Mile Creek system which flows into the Ovens River downstream of Wangaratta (Refer to Figure 2.1). The Peechelba site was chosen to best represent the salt load reaching the River Murray from the entire Ovens River catchment.

2.2 Three Mile Creek (Site 403249)

The Three Mile Creek drains the area west of the King River and includes the combined flows from the Fifteen Mile and One Mile Creeks. The Creek passes through the city of Wangaratta and discharges to the Ovens River downstream of the town. The upstream catchment terrain is generally flat (Riverine plain) and extensively cleared. There are a number of known salt discharge sites in the upper catchment. Runoff in the lower parts of the catchment includes town stormwater runoff and is also influenced by industrial effluent discharges to the creek.

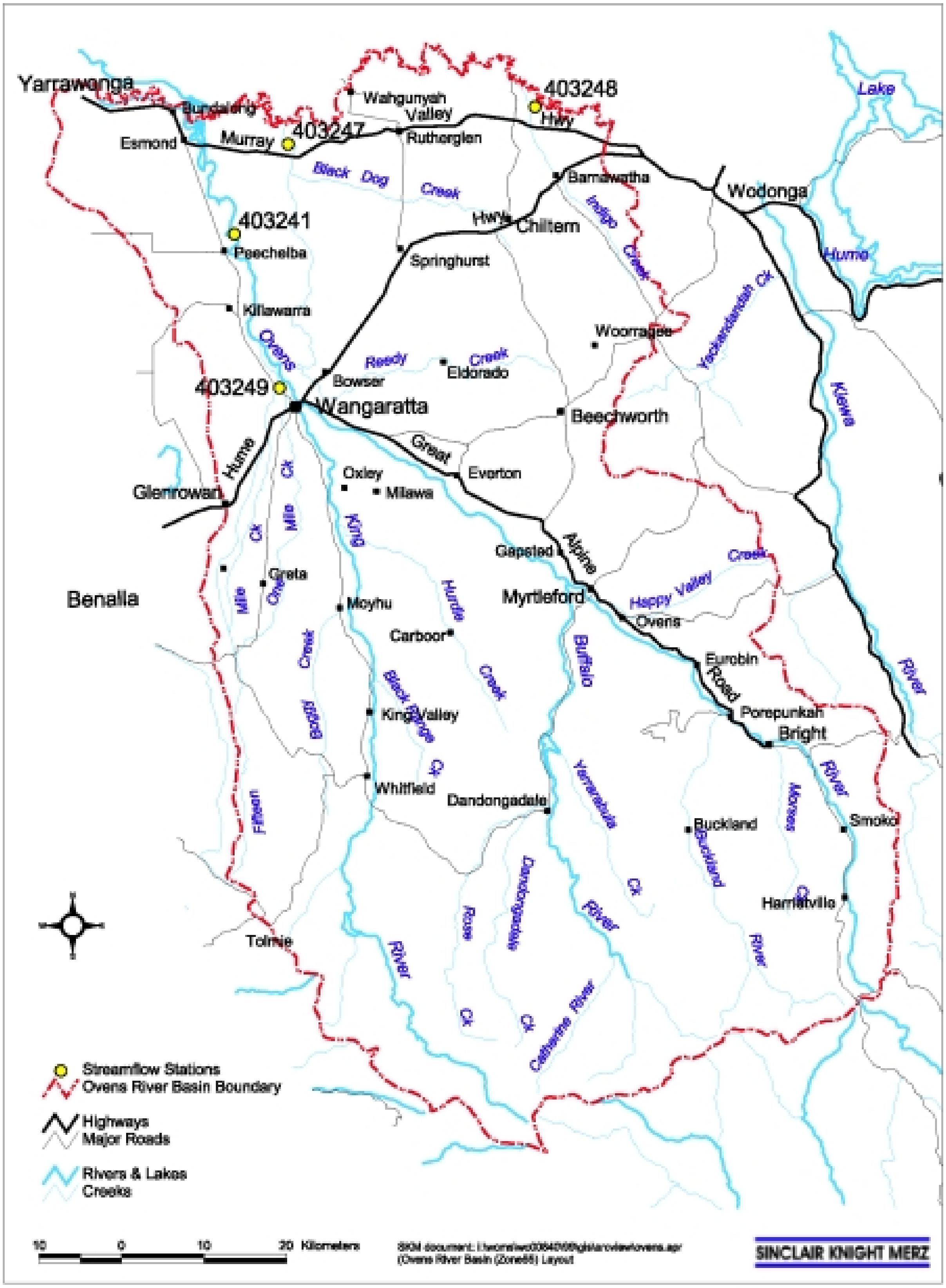
2.3 Black Dog Creek (Site 403247)

Black Dog Creek originates near Chiltern and flows across the Riverine Plains to the River Murray. The catchment is mainly cleared and although there is some steeper terrain in the upper reaches, the significant land management unit is Riverine Plain Upper Terrace. There are a significant number of noted salt discharge sites in the catchment (NESWG, 1997), particularly in the Springhurst Hills area. The catchment includes a large area on the Riverine Plain (in the Reedy Creek area near Wangaratta) where surface water can pond and will not necessarily always discharges to the Black Dog Creek system. This may mean that flow and salinity data exhibit very different characteristics during wetter climatic periods. Further investigation and documentation could allow catchment boundaries for both low flow and flood flows to be more clearly defined.

2.4 Indigo Creek (Site 403248)

The Indigo Creek originates amongst some steep terrain north of Yackandandah and flows across the Riverine Plain Upper Terrace to the River Murray. The catchment is mainly cleared and has been identified as having a significant number of salt discharge sites (NESWG, 1997). The discharge sites are concentrated in the middle reaches of the catchment where there is a transition from the steeper terrain to the Riverine Plains.

■ **Figure 2-1 Locality Plan**



3. Data Assessment

The process used to assess salinity data involves a number of steps. Initially, the data quality is assessed for completeness and accuracy. The assessment and documentation of data collection problems then provides an indication of the degree to which statistics generated from the raw data represent the actual flow and salinity characteristics of the catchments for the year. The data is then infilled before salt loads are produced.

3.1 Data Availability

This report covers four hydrographic monitoring sites for the 2001 calendar year, as listed in Table 3.1 below. The table shows the total extent of data available at the sites. The North-East data collection program began in the latter part of 1998 and all data has been examined for completeness and integrity.

■ **Table 3.1: Data Available**

Station	Number	Parameter	Frequency	Start Date	End Date
Ovens River @ Peechelba	403241	Flow	Continuous	22/9/1998	Ongoing
		Salinity	Continuous	22/9/1998	Ongoing
Black Dog Creek	403247	Flow	Continuous	22/8/1998	Ongoing
		Salinity	Continuous	22/8/1998	Ongoing
Indigo Creek	403248	Flow	Continuous	24/6/1999	Ongoing
		Salinity	Continuous	24/6/1999	Ongoing
Three Mile Creek	403249	Flow	Continuous	2/6/2000	Ongoing
		Salinity	Continuous	2/6/2000	Ongoing

3.2 Data Collation During 2001

The raw data collected during 2001 have been plotted and included in **Appendix A** for reference. Overall the data collected during 2001 was of a good quality with relatively few data gaps.

There were 20 days for which the quality code for flow was higher than 3 (i.e some editing required) and 67 days where the salinity code was greater than 3. Full details of missing data have been included in Appendix B and details of estimated data with an explanation of quality codes is included in Appendix C.

A summary of the significant data collection problems is presented below.

- Equipment malfunction caused salinity data to be lost at two sites for short periods.
- Flow data was extrapolated for three days at the Indigo Creek site due to insufficient gauging (Code 150). Although the flow has been estimated, use of this figure in any detailed studies should be treated with caution. This missing data code is to be expected with new sites as flows beyond the range of the

available rating occur. The accuracy of high flow measurement is expected to improve once additional high flow rating is undertaken by Thiess.
- Some minor editing of the flow and salinity data was undertaken by Thiess.

There are also potential problems indicated by the behaviour of the salinity data at site 403249 (see Figure 6-12). Following the equipment malfunction in June, there is a very distinctive pattern of salinity falling significantly for a period of approximately one week and then returning to previous levels. This type of pattern was not observed during 2000. There does not appear to be a strong correlation with the flow record so further investigation was undertaken.

Discussions with Thiess and Goulburn-Murray Water indicate that the pattern is very distinctive and is only evident during business hours. It was concluded that a trade waste discharge (likely to be an electrolyte that influences the conductivity measurement) is the primary cause of the unexpected salinity increases.

3.3 Proposed Additional Monitoring

One of the recommendations of the North East Salinity Strategy (NESWG, 1997) was that new flow and water quality monitoring sites should be established at a number of nominated locations within the Ovens Basin. The final location nominated for monitoring, which has not yet been established, is the Buffalo River near the Ovens River junction. It was also recommended that water quality monitoring should be re-established on the Ovens River at Wangaratta and Reedy Creek in Wangaratta North. These are yet to be established although flow is currently monitored at these two sites.

Funding is yet to be made available for nutrient monitoring at any of the existing monitoring sites.

4. Flow and Salinity Statistics

4.1 Statistics explained

The statistical analysis is based on available raw data listed in Table 3.1. Flow and salinity statistics for 2001 are presented in Table 4.1 and Table 4.2.

MEAN DAILY - the average value of all measurements on a specified day.

MEDIAN - the value above (or below) which half the data set falls. The median gives an indication of the 'most usual' flow or salinity in the stream.

UPPER QUARTILE - the value below which three quarters of the data set falls, giving an indication of how high the flow and salinity can ordinarily get without being influenced by extreme events.

LOWER QUARTILE - the value below which one quarter of the data set falls, giving an indication of how low the flow and salinity ordinarily falls without being influenced by extreme events.

MAXIMUM - the highest value recorded. It is generally not a good indication of the flow or salinity of the stream because such a high value may be rare. However it is sometimes useful to be aware of extreme values, and the maximum may highlight uncharacteristic behaviour that contributes to high flow and salinity.

MINIMUM - the lowest value recorded. It is generally not a good indication of the flow or salinity of the stream because such a low value may be rare or is zero on one or a number of days.

SALT LOADS – a measure of the total quantity of salt transported by a stream, measured in tonnes. The figures quoted in this report are based on mean daily values, which have been calculated by averaging the instantaneous salt loads throughout the day. The figures quoted (tonnes per month) represent the sum of daily values within a month. The instantaneous salt load is calculated as follows:

Salt Load = Flow (ML/day) x EC (µs/cm) x (0.6/1000)

FLOW WEIGHTED SALINITY (FWS) - a measure of the salinity of water during flow events. This measure is of particular relevance to downstream interests. In many Australian streams the salinity during average to high flow events is much lower than the salinity during low flow periods. The FWS is derived by dividing the total salt load for a study period by the total flow for the same period (which produces a salinity in tonnes/megalitre) then dividing by 0.0006 to express the result in the more familiar EC units.

4.2 Flow Statistics

The key flow statistics as described in the previous section are presented below in Table 4.1. All flows are quoted in ML/day. Time series plots of the raw flow data are included in Appendix A.

- **Table 4.1: Statistical Analysis of Flow (ML/day)**

Station Name	Station Number	Period of Analysis	Mean Daily	Median	Upper Quartile	Lower Quartile	Max	Min
Ovens River @ Peechelba	403241	1/1/2001 – 31/12/2001	2,548	1,074	3,440	546	12,779	214
		22/9/1998 – 31/12/2001	4,305	1,748	5,368	534	95,667	183
Black Dog Creek @ Parris Rd, Brimin	403247	1/1/2001 – 31/12/2001	2	0	0	0	174	0
		22/8/1998 – 31/12/2001	38	0	18	0	1,695	0
Indigo Creek	403248	1/1/2001 – 31/12/2001	8	7	10	4	144	0.3
		24/6/1999 – 31/12/2001	41	11	26	4	2,284	0
Three Mile Creek	403249	1/1/2001 – 31/12/2001	81	34	98	14	905	2.8
		2/6/2000 – 31/12/2001	134	55	156	19	1,456	2.8

4.3 Salinity Statistics

The salinity statistics presented in this report are all quoted in Electrical Conductivity (EC) units of microsiemens per centimetre (µs/cm), standardised to the value at 25^0C. The key salinity statistics are presented in Table 4.2 and time series plots of the raw data are included in Appendix A.

A number of observations can be made from this information:

- Salinity concentrations in 2001 were generally higher compared to previous data, which is to be expected as the climate has been drier. It may be beneficial to review rainfall data in subsequent studies to examine the link between climate and stream salt load.
- The is a distinct salinity pattern observed for each catchment which may influence the statistics;
  - The Ovens River and Three Mile Creek gauges show a distinct low flow period from January to May 2001. The corresponding salinity measurements are high compared to the rest of the record. The second half of the year is opposite with a distinctive higher flows and lower salinities pattern. It may be useful to compare data from an upstream gauge (say Myrtleford) to check whether there may a common process influencing both catchments.
  - The Indigo Creek and Black Dog Creek sites show a less distinct change from the first half of the year to the second half. It would appear that flows are generally lower and that salinity has less variance. Statistics are likely to be more representative for the Indigo Creek Site. There was little flow in Black Dog Creek for the year.
- Salinity statistics for the Three Mile Creek indicate that the salt generation characteristics are different to the other catchments. This is evident from the large difference between mean daily salinity and flow weighted salinity compared to the difference in these statistics at the other sites. The influence of the discharge discussed in Section 3.2 should be quantified after further investigations are undertaken.

■ **Table 4.2: Statistical Analysis of Salinity (µs/cm)**

Station	Number	Period of Analysis	Flow Weighted Salinity	Mean Daily	Upper Quartile	Median	Lower Quartile	Max	Min
Ovens River @ Peechelba	403241	1/1/2001 – 31/12/2001	56	82	110	76	52	154	36
		22/9/1998 – 31/12/2001	53	73	89	67	53	154	36
Black Dog Creek @ Parris Rd, Brimin	403247	1/1/2001 – 31/12/2001	198	248	276	256	232	327	142
		22/8/1998 – 31/12/2001	134	189	224	184	157	327	70
Indigo Creek	403248	1/1/2001 – 31/12/2001	418	493	593	498	388	740	184
		24/6/1999 – 31/12/2001	186	406	515	397	301	740	77
Three Mile Creek	403249	1/1/2001 – 31/12/2001	167	533	833	295	115	2,069	55
		2/6/2000 – 31/12/2001	117	373	437	137	96	2,069	55

4.4 Salt Loads

Salt loads have been calculated as described above in Section 4.1. There were a number of periods for the sites examined where missing flow data needed to be infilled. The infilling techniques are documented in Appendix D. A summary of monthly salt loads is presented below in Table 4.3.

■ **Table 4.3: Monthly Salt Loads, 2001**

Month	**Monitoring Station**											
	Ovens River at Peechelba 403241			**Three Mile Creek 403249**			**Black Dog Creek 403247**			**Indigo Creek 403248**		
	Flow (ML/mth)	Salt Load (t/mth)	FWS (µs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (µs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (µs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (µs/cm)
January	21,055	1,271	101	714	130	303	4	1	253	169	58	576
February	17,067	1,126	110	666	201	503	0	0	0	198	49	417
March	13,709	997	121	332	213	1,069	0	0	0	101	38	630
April	21,251	1,176	92	325	212	1,090	0	0	0	99	37	621
May	12,724	925	121	472	235	832	0	0	0	135	48	593
June	43,945	2,069	78	1,599	233	243	0	0	0	288	76	441
July	42,091	1,774	70	1,239	213	287	0	0	0	253	70	463
August	138,960	4,363	52	4,905	311	106	0	0	0	395	101	426
September	195,129	5,045	43	6,807	383	94	64	9	247	437	95	362
October	262,462	7,563	48	9,175	531	96	657	76	191	683	119	291
November	127,627	3,443	45	2,797	203	121	89	11	211	268	61	379
December	34,150	1,372	67	689	120	290	0	0	0	50	18	582
Total	930,170	31,125	56	29,721	2,987	167	813	97	198	3,076	771	418

4.4.1 Salt Generation Processes

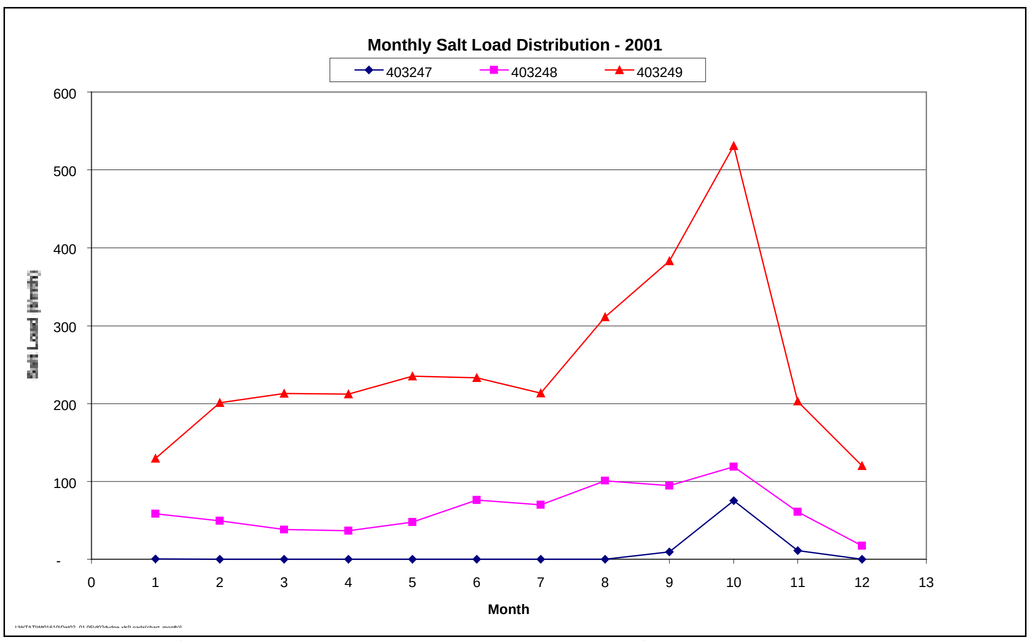
The salt generation processes for each catchment can be examined at a number of different levels using catchment parameters. Some of the catchment information available for the north-east region includes:

- Digital Elevation Model (DEM)
- Land systems
- Landuse
- Salinity discharge sites
- Geology and soil data

In future, these could be used to examine sources of salt loads and potential solutions. Further work is also required to map the low flow and high flow catchment boundaries (ie identify areas where gauged area may differ due to events such as floods) and to better determine the areas contributing to flow. Until this work is done, analysis will be reasonably simple.

The monthly breakdown of salt loads is shown in Figure 4-1. This shows that the higher salt loads are generated during spring when spring rainfall generates higher runoff to streams. The relative rise in salt load is most noticeable in the Three Mile Creek catchment, which indicates that the salt generation processes may be different between catchments. Further investigation may provide a better understanding of the processes that cause these types of observations.

■ Figure 4-1 Monthly Salt Loads



Note: Ovens River follows a similar pattern to 403249 but loads are significantly larger and have not been included in plot.