Appendices

Appendix A The Mount Lyell Remediation, Research and Demonstration Program Projects

The Program manager was Warren Jones of the Tasmanian Department of Environment and Land Management (DELM), with the Program Implementation Committee comprising Warren Jones, Stewart Needham of the Office of the Supervising Scientist (***oss***) and Arthur Johnston of the Environmental Research Institute of the Supervising Scientist (***eriss***), branches of the Federal Environment Department. The Program was overseen by an eight member Steering Committee which included representatives of DELM, ***oss***, Copper Mines of Tasmania and the Hydro-Electric Commission of Tasmania.

A third body, the Consultative Committee, was established as a means of communicating the progress and outcomes of the projects to the relevant government and community organisations.

Environmental quality objectives

The long-term environmental quality objectives need to be defined to give the Program a clear focus, although it must be emphasised that the present Program cannot and will not achieve these objectives.

The following long-term environmental quality objectives have been compiled after discussion with the community.

Mount Lyell lease site

Subject to the requirements of ongoing and possible future mining operations on the Mount Lyell lease site, the rehabilitation of historic waste rock dumps and other historic environmental damage such that:

- emissions of acid drainage from the areas are reduced to the point that they do not compromise the environmental quality objectives for the Queen and King Rivers, and Macquarie Harbour;
- the land is stabilised to minimise erosion and effects on water quality;
- the 'lunar landscape' is maintained, particularly the field of view coming into Queenstown; and
- exotic species infestation is minimised; and culturally significant artefacts are maintained.

The Queen and King Rivers

The remediation of water quality, sediments and the banks of the Queen and King Rivers where necessary such that:

- the rivers can support a healthy, although not pristine, aquatic ecosystem;
- erosion and transport of sediments and tailings which are deposited on the banks and beds of the rivers, or the leaching of metals from these, do not pose an ongoing threat to the environmental quality objectives for Macquarie Harbour;
- restoration of the visual appearance of the rivers and banks to meet community requirements;
- navigability of the lower King River is improved;
- problems caused by a higher water table in the lower reaches of the King River are reduced;

- undamaged areas are maintained as undamaged; and
- existing heritage values are maintained.

Macquarie Harbour

The remediation of the water quality, sediments, the tailings delta and foreshore in Macquarie Harbour where necessary such that:

- the harbour will support a healthy, although not pristine, aquatic ecosystem;
- water quality throughout the harbour will be suitable for fish farming;
- fish and other aquatic life harvested from the Harbour will be suitable for consumption;
- the harbour sediments and tailings delta will not pose an ongoing threat to the water quality;
- the foreshore in the vicinity of Strahan should be safe and clean;
- dust from the delta will not pose a health risk;
- visual impact of the delta and the wharf area at Strahan will be reduced; and
- environmental quality in that part of the harbour which is in the World Heritage Area moves towards being in keeping with this designation.

Project number	Project title	Project description	Project leaders	Consultants
1	Characterisation of sources of acid drainage from the Mount Lyell lease site and surrounds	Overview document detailing the current knowledge on the quantity and quality of effluent water from the lease site	Dr Chris McQuade (***oss***) John Johnston (DELM)	Dr Chris McQuade (***oss***) John Johnston (DELM) Shelley Innes (DELM)
2	Options to reduce acid drainage from the Mount Lyell lease site and surrounds	The identification of potential short and long-term options for managing effluent water from the lease site and recommendations for construction and operation of demonstration/evaluation trials	John Johnston (DELM) Dr Chris McQuade (***oss***)	John Miedecke and Partners Pty Ltd incorporating Environmental Geochemistry International and the Australian Nuclear Science and Technology Association
2b	Estimation of water quality over time at several locations in the King River	Using the RIVCHEM model rank options for site remediation against their impacts on the water quality at several locations within the King River	Dr Chris McQuade (***oss***) John Johnston (DELM)	Environmental Geochemistry International
3	Construction and evaluation of remediation options	This project involves constructing and evaluating some or all of the remediation options for the lease site as identified in project 2	John Johnston (DELM) Dr Chris McQuade (***oss***)	John Miedecke and Partners Pty Ltd
4	Tailings and fluvial processes in the Queen and King Rivers	Assess the dynamics of tailings movement within the Queen and King Rivers	Helen Locher (DELM) Dr Lois Koehnken (DELM)	Helen Locher (DELM)
5	Tailings chemistry in the Queen and King Rivers and the delta	Quantify the varying types of tailings deposits distributed along the river banks and in the delta and the effects of different physio-chemical environments to which each are exposed. The potential for the tailings to be an on-going source of metals will be determined	Dr Lois Koehnken (DELM) Dr Patrick McBride (***oss***)	Earth Systems Pty Lty incorporating Monash University Earth Science Department
6	Remediation of tailings deposits	Identify a range of options for alleviating environmental impacts arising from tailings deposits in the King Rivers and Macquarie Harbour, listing environmental, aesthetic, economic and social attributes both positive and negative for each. A small scale program of trials will be set in train as the final stage of the project.	Peter Waggitt (***oss***)	Hydro-Electric Commission in association with Coffey Partners International Pty Ltd
7	Stream monitoring	Undertake biological and water quality surveys of the fresh waters affected by the Mount Lyell operations and design a long-term monitoring program which will enable trends and patterns in biota and water quality to be assessed in relation to remediation activities and other environmental conditions.	Dr Chris Humphrey (***eriss***)	Freshwater Systems Pty Ltd

Project number	Project title	Project description	Project leaders	Consultants
9A	Toxicity testing	Estimate the levels and forms of copper which can be tolerated in Macquarie Harbour waters without causing detriment to fish and other aquatic life	Dr Patrick McBride (***oss***)	CSIRO Institute of Natural Resources and Environment
9B	Toxicity testing	Estimate the levels and forms of copper which can be tolerated by farmed fish in Macquarie Harbour	Dr Simon Stanley (DPIF)	DPIF
10	Strahan wharf rehabilitation	Rehabilitating the Macquarie Harbour foreshore between Strahan and the mouth of the King River from the environmental impacts of infrastructure or practises related to mining at Mount Lyell	Stewart Needham (***oss***) John Johnston (DELM)	Community and government sponsored groups
11	Implications on Macquarie Harbour from likely remediation measures	Determine the likely implications for the Harbour of the remediation measures which could be taken on the lease site, the rivers and the delta, and the time frame during which predicted changes will occur	Dr Lois Koehnken (DELM)	Dr Lois Koehnken (DELM)
12	Macquarie Harbour sediments	Quantify the release of metals from the sediments and the conditions that release will occur	Dr Lois Koehnken (DELM) Dr Patrick (***oss***)	CSIRO Division of Coal and Energy Technology, Centre for Advanced Analytical Chemistry
13A	Biological survey of Macquarie Harbour	Design a biological monitoring program to assess the recovery of Macquarie Harbour; and determining the concentrations and significance of trace metals in edible or potentially edible invertebrates or fish tissues	Dr Patrick McBride (***oss***)	Water Ecoscience
13B	Monitoring biological indicators	Assess the recovery of Macquarie Harbour	Dr Patrick McBride (***oss***)	Nick O'Conner, Water Ecoscience
14	Hydraulic and chemical modelling of Macquarie Harbour	Develop a Hydraulic and chemical modelling to quantify the impacts of the Mt Lyell operation on the Harbour and to provide input to the management of the Harbour	Dr Lois Koehnken (DELM) Dr David Klessa (***eriss***)	Computational Fluid Dynamics Pty Ltd

oss Office of the Supervising Scientist (Federal)

eriss Environmental Research Institute of the Supervising Scientist (Federal)

DELM Department of Environment and Land Management (Tasmanian)

DPIF Department of Primary Industries and Fisheries (Tasmanian)

Appendix B Monitoring stations and parameters in the Queen–King River catchment area

Haulage Creek

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment area (km^2)	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Haulage Creek above Conveyor Tunnel and below West and North Lyell Tunnels														
HEC	670	-42:04:03.7	145:34:10.0	381650.000	5341700.000			100	1	Flow	L/s	Continuous	14/05/93 @ 12:15:00	28/03/95 @ 14:00:00
CMT	HCWL	-42:04:03.7	145:34:10.0	381650.000	5341700.000					pH	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCWL									TSS, Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D)	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCWL									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCWL									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current
Haulage Creek above Conveyor, North and West Tunnels														
HEC	669	42:04:03.9	145:34:18.7	381850.000	5341700.003	Weir above north and west tunnels		100	1	Flow	L/s	Continuous	14/05/93 @ 09:00:00	Current
MLMRCL	5	42:04:03.9	145:34:18.7	381850.000	5341700.003					Flow	L/s	Continuous	1/05/93	1/10/94
	5									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	5									pH		Periodic	1/12/79	1/12/94
	5									Temperature	^oC	Periodic	1/12/79	1/12/94
CMT	HCCT	42:04:03.9	145:34:18.7	381850.000	5341700.003					pH		Periodic	26/04/95 @ 00:00:00	Current
	HCCT									TSS, Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D)	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCCT									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCCT									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Haulage Creek at Tailings Discharge														
HEC	680	-42:03:54.9	145:33:33.3	380800.000	5341960.001	Ultrasonic flow meter in culvert juxtaposed to old tailings outlet pipe		100	1	Flow	L/s	Continuous	23/08/93 @ 14:45:00	28/03/95 @ 15:45:00
MLMRCL	9a	-42:03:54.9	145:33:33.3	380800.000	5341960.001					Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	9a									pH		Periodic	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	9a									Temperature	^oC	Periodic	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
DELM	9a	-42:03:54.9	145:33:33.3	380800.000	5341960.001					Cu, Fe, Mn, Al (D)	mg/L	Daily	17/12/94	26/01/95
	9a									Cu, Fe, Mn, Al (D)	mg/L	Periodic	27/01/95 @ 00:00:00	10/04/95 @ 08:00:00
	9a									Flow	L/s	Daily	17/12/94	26/01/95
	9a									Flow	L/s	Periodic	27/01/95 @ 00:00:00	10/04/95 @ 08:00:00
West Lyell Tunnel														
MLMRCL	6			381700.000	5341780.000					Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/07/93	1/12/94
	6									pH		Monthly	1/07/93	1/12/94
	6									Temperature	^oC	Monthly	1/07/93	1/12/94
HEC	10670			381700.000	5341780.000	Flow meter at tunnel mouth				Flow	L/s	Continuous	Apr 95	Current
North Lyell Tunnel														
MLMRCL	7			381680.000	5341780.000	Recorded runoff from Crown Lyell diversion (since July 1991) and northern end of West Lyell open-cut				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/07/93	1/12/94
	7									pH		Monthly	1/07/93	1/12/94
	7									Temperature	^oC	Monthly	1/07/93	1/12/94
HEC	670			3816800.000	5341780.000	Flow meter at tunnel mouth				flow L/sec		Continuous	Apr 95	Current

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Conveyor Tunnel														
MLMRCL	8a			381250.000	5341960.000	Mine water from Level 17 pump station in Prince Lyell mine. Includes catchment from the majority of the West Lyell open-cut				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	8a									pH			1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
										Temperature	^oC		1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
HEC	11670			381400.000	5341960.000	Flow meter at tunnel mouth				Flow	L/s	Continuous	Apr 95	Current
CMT	CTW									Flow, pH, TSS, Fe, Mn, Zn, Cu, Pb, Al (T&D), SO_4, F (D)		Daily	Apr 95	Nov 95
Pure Tailings before Discharge														
MLMRCL	10	-42:03:54.9	145:33:33.3	380800.000	5341960.001	Sampled from discharge pipe at Haulage Creek				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	10									pH		Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	10									Temperature	^oC	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Haulage Creek at Slag Dump														
MLMRCL	12a			380850.000	5341210.000	Adjacent shed in lay down area				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	12a									pH		Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	12a			380850.000	5341210.000					Temperature	^{o}C	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
DELM	12a									Cu, Fe, Mn, Al (D)	mg/L	Daily	20/12/94	26/01/95
	12a									Cu, Fe, Mn, Al (D)	mg/L	Periodic	31/01/95 @ 20:00:00	08/03/95@ 00:00:00
	12a									Flow	L/s	Daily	20/12/94	26/01/95
	12a									Flow	L/s	Periodic	31/01/95 @ 20:00:00	08/03/95 @ 00:00:00
CMT	HCSD			380850.000	5341210.000					pH		Periodic	26/04/95 @ 00:00:00	Current
	HCSD									Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D), TSS	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCSD									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	HCSD									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current
Waste Rock Dump														
MLMRCL	32			381950.000	5341710.000	Toe of waste rock dump that ANSTO conducted work on				Temperature	^{o}C	Monthly	8/09/93	1/12/94
	32									pH		Monthly	8/09/93	1/12/94
	32									TSS	mg/L	Monthly	8/09/93	1/12/94
										Conductivity	µS/cm	Monthly	8/09/93	1/12/94
	32									Cu (T), Mn, Fe, SO_4, Cl	mg/L	Monthly	8/09/93	1/12/94

East Queen River

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Head East Queen River														
MLMRCL	4			381800.000	5345850.000	Sampled at mine water intake from East Queen River prior to introduction of water from Comstock diversion works				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/07/91	1/06/92
	4									pH		Monthly	1/07/91	1/06/92
										Conductivity	µS/cm	Monthly	1/07/91	1/12/94
	4									Temperature	^oC	Monthly	1/07/91	1/06/92
East Queen River above West Queen River														
HEC	664	-42:03:48.6	145:33:28.0	380674.998	5342150.003	East Queen River at bridge to hockey oval		100	1	Flow	L/s	Continuous	14/05/93 @ 10:00:00	28/03/95 @ 14:45:00
CMT	EQWQ	-42:03:48.6	145:33:28.0	380674.998	5342150.003					pH		Periodic	26/04/95 @ 00:00:00	Current
	EQWQ									TSS, Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D)	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	EQWQ									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	EQWQ									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current
MLMRCL	11	-42:03:48.6	145:33:28.0	380674.998	5342150.003					Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
										Conductivity	µS/cm	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	11									pH		Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00
	11									Temperature	^oC	Monthly	1/05/91 @ 00:00:00	1/12/94 @ 00:00:00

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
East Queen River above West Queen River (cont'd)														
DELM	11	-42:03:48.6	145:33:28.0	380674.998	5342150.003					Cu, Fe, Mn, Al (D)	mg/L	Daily	20/12/94	26/01/95
	11									Cu, Fe, Mn, Al (D)	mg/L	Periodic	31/01/95 @ 20:00:00	14/03/95 @00:00:00
	11									Flow	L/s	Daily	20/12/94	26/01/95
	11									Flow	L/s	Periodic	31/01/95 @ 20:00:00	14/03/95 @00:00:00
Below Cape Horn Workings Area														
MLMRCL	20a			381950.000	5343900.000					Temperature	^{o}C	Periodic	20/5/91	14/12/92
	20a									pH		Periodic	20/5/91	14/12/92
	20a									Conductivity	µS/cm	Periodic	20/5/91	14/12/92
	20a									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/5/91	14/12/92
Above Cape Horn workings area														
MLMRCL	21			382050.000	5343595.000					Temperature	^{o}C	Periodic	20/05/91	14/12/92
	21									pH		Periodic	20/05/91	14/12/92
	21									Conductivity	µS/cm	Periodic	20/05/91	14/12/92
	21									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/05/91	14/12/92
Miscellaneous waste rock dumps														
MLMRCL	26			382275.000	5343090.000	In culvert, beginning of the road to Comstock and Cape Horn workings				Temperature	^{o}C	Periodic	20/05/91	14/12/92
	26									pH		Periodic	20/05/91	14/12/92
	26									Conductivity	µS/cm	Periodic	20/05/91	14/12/92
	26									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/05/91	14/12/92

Idaho Creek

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Idaho Creek above Linda Creek														
HEC	775	-42:03:48.9	145:36:03.5	384249.999	5342200.000	Natural watercourse	2.3 km^2	100	1	Flow	L/s	Continuous	05/08/68 @ 11:26:58	13/01/95 @ 10:00:00
	775							450	1	Water temp lower	^oC		19/02/92 @ 14:00:00	13/01/95 @ 09:30:00
	775							822	1	Conductivity	µS/cm		05/08/86 @ 11:27:00	25/10/94 @ 16:00:00
	775							823	1	Conductivity	µS/cm uncomp		19/02/92 @ 14:00:00	13/01/95 @ 10:00:00
	775							30822	1	Conductivity	Counts	Uni log	05/08/86 @ 11:26:58	19/02/92 @ 11:00:00
	775							30822	2	Conductivity	Counts	Digitised	05/08/86 @ 11:27:00	19/02/92 @ 11:15:00
MLMRCL	25	-42:03:48.9	145:36:03.5	384249.999	5342200.000					Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	25									pH		Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	25									Temperature	^oC	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	25									Conductivity	µS/cm	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00

Comstock

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Comstock Creek above King River														
HEC	773	-42:02:12.5	145:37:08.7	385700.001	5345200.000	Controlled watercourse - drainage from Comstock Adit 5 diverted to East Queen Riv. King Riv now inundated by Lake Burbury	13.3 km^2	100	1	Flow	L/s	Continuous	04/10/78 @ 09:25:00	28/03/95 @ 18:00:00
	773							23600	40	Copper (T)	mg/l	Periodic	01/03/91 @ 00:00:00	01/08/94 @ 00:00:00
	773							30822	1	Conductivity	Counts	Continuous	06/08/86 @ 14:48:00	28/03/95 @ 18:00:00
	773							30822	2	Conductivity	Counts	Digitised	06/08/86 @ 14:48:00	28/03/95 @ 18:00:00
Head of Comstock Creek														
MLMRCL	2			383515.000	5345500.000					Temperature	^{o}C	Periodic	20/5/91	14/12/92
										pH		Periodic	20/5/91	14/12/92
										Conductivity	µS/cm	Periodic	20/5/91	14/12/92
										Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/5/91	14/12/92
King River above Comstock														
HEC	781	-42:03:24.1	145:39:50.3	389450.002	5343050.001	Natural watercourse. King River now inundated by Lake Burbury	270.7 km^2	100	1	Flow	L/s	Continuous	05/10/78 @ 09:10:00	03/03/87 @ 12:22:58
	781							30822	1	Conductivity	Counts	Uni Log	05/09/86 @ 09:17:00	03/03/87 @ 12:22:58

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Comstock Mine Water														
MLMRCL	1					Below Comstock open-cut workings				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	1									pH		Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	1									Temperature	^oC	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	1									Conductivity	µS/cm	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
Comstock Creek below workings														
MLMRCL	3a			383800.000	5345510.000	Runoff from Comstock workings minus adit 5 diversion (discharges to East Queen River from July 1991)				Temperature	^oC		01/06/74	01/11/76
	3a									Conductivity	µS/cm		01/06/74	01/11/76
	3a									Al, As, Cd, Cl, Cr, Cu, Fe, Hg, Mn, Ni, Pb, SO_4, Zn, (all T&D) TDS, TSS	mg/L	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	3a									Temperature	^oC	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	3a									Conductivity	µS/cm	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
CMT	CCW									pH		Periodic	26/04/95 @ 00:00:00	Current
	CCW									TSS, Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D)	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	CCW									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	CCW									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Comstock Creek above Lake Burbury														
MLMRCL	17a					Controlled watercourse				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	17a									pH		Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	17a									Conductivity	µS/cm	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	17a									Temperature	^oC	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
Comstock adit 7														
MLMRCL	19			383710.000	5345460.000	Controlled watercourse				Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	19									pH		Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	19									Conductivity	µS/cm	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	19									Temperature	^oC	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00

Linda Creek

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Linda Creek above King River														
HEC	776	-42:04:29.3	145:38:04.5	387050.000	5341000.002	Natural watercourse. King River now inundated by Lake Burbury	Currently 4.6 km^2. Prior to diversion 14.6 km^2	100	1	Flow	L/s	Continuous	04/10/78 @ 11:00:00	19/06/79 @ 00:07:00
	776							14010	1	Flow (estimate)	m^3/sec	Calculated	26/08/86 @ 14:00:00	15/08/94 @ 00:00:00
	776							23600	40	Cu (T)	mg/l	Periodic	01/03/91 @ 00:00:00	01/08/94 @ 00:00:00
Linda Creek above Lake Burbury														
MLMRCL	16									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	16									pH		Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	16									Conductivity	µS/cm	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	16									Temperature	^oC	Monthly	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Linda Creek below White Creek														
MLMRCL	18					Incorporating runoff from E areas of the lease site, including Linda Creek (apart from Linda Creek diversions into the North Lyell Tunnel), Brown Creek, White Creek, Idaho Creek and Iron Blow seepage				Temperature	^{o}C	Periodic	01/06/74	01/11/76
	18									Conductivity	µS/cm	Periodic	01/06/74	01/11/76
	18									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	01/05/91	01/12/94
	18									Temperature	^{o}C	Periodic	1/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	18									pH		Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	18									Conductivity	µS/cm	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
Linda Creek above White Creek														
MLMRCL	22									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L		01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	22									pH		Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	22									Conductivity	µS/cm	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	22									Temperature	^{o}C	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Head of White Creek														
MLMRCL	23									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	23									pH		Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	23									Conductivity	µS/cm	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	23									Temperature	^oC	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
White Creek above Linda Creek														
MLMRCL	24									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	24									pH		Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	24									Conductivity	µS/cm	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	24									Temperature	^oC	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
Tharsis Adit														
MLMRCL	31			383305.000	5343000.000					Temperature	^oC	Periodic	08/09/93 @ 00:00:00	05/01/94 @ 00:00:00
	31									pH		Periodic	08/09/93	05/01/94
	31									Conductivity	µS/cm	Periodic	08/09/93	05/01/94
	31									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	08/09/93	05/01/94

Queen River

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Queen River at Queenstown														
MLMRCL	14					Represents a composite of runoff from NW and W areas of the lease site and Haulage Creek discharge (incorporating tailings, waste rock dump seepage, Lyell tharsis and adit 5 diversion waters)				Temperature	^{o}C		01/06/74 @ 00:00:00	01/11/76 @ 00:00:00
	14									Conductivity	µS/cm		01/06/74 @ 00:00:00	01/11/76 @ 00:00:00
	14									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	14									Temperature	^{o}C		01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	14									Conductivity	µS/cm		01/05/91 @ 00:00:00	01/12/94 @ 00:00:00
	14									Cu, Fe, Mn, Al (D)	mg/L	Daily	17/12/94 @ 00:00:00	26/01/95 @ 00:00:00
DELM	14									Cu, Fe, Mn, Al (D)	mg/L	Periodic	31/01/95 @ 00:00:00	09/03/95 @00:00:00
	14									Flow	L/s	Daily	17/12/94 @ 00:00:00	26/01/95 @ 00:00:00
	14									Flow	L/s	Periodic	31/01/95 @ 00:00:00	09/03/95 @00:00:00
	14									pH		Periodic	26/04/95 @ 00:00:00	Current
CMT	QRQ									Fe, Mn, Zn, Cu, Pb, Al, Hg, SO_4, Fl (T&D), TSS	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	QRQ									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Queen River below Filter House														
MLMRCL	13			380780.000	5342260.000					Temperature	^{o}C	Periodic	20/05/91	14/12/92
	13									pH		Periodic	20/05/91	14/12/92
	13									Conductivity	µS/cm	Periodic	20/05/91	14/12/92
	13									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/05/91	14/12/92
Queen River above Conglomerate Creek														
MLMRCL	15									Temperature	^{o}C	Periodic	20/5/91	14/12/92
	15									pH		Periodic	20/05/91	14/12/92
	15									Conductivity	µS/cm	Periodic	20/05/91	14/12/92
	15									Fe, Cu (T), Al, Zn, Mn, SO_4, Cl, As (T), Hg (T), Ni, Cd, Cr, TDS, TSS	mg/L	Periodic	20/05/91	14/12/92
Queen River at Lynchford														
HEC	860	-42:08:10.7	145:31:25.5	378000.000	5334020.000	Controlled watercourse	78.3 km^2	10	1	Rainfall	mm	Continuous	28/08/85 @ 14:35:00	08/05/91 @ 11:09:00
	860							100	1	Flow	L/s	Continuous	16/08/86 @ 21:00:00	16/05/95 @ 16:15:00
	860							15408	1	pH - meter installed		Continuous	03/05/95 @ 17:45:00	16/05/95 @ 16:15:00
DELM	2									Cu, Fe, Mn, Al (D)	mg/L	Daily	17/12/94 @ 00:00:00	25/01/95 @ 00:00:00
	2									Cu, Fe, Mn, Al (D)	mg/L	Periodic	26/01/95 @ 00:00:00	4/05/95 @ 00:00:00
	2									Flow	L/s	Daily	17/12/94 @ 00:00:00	25/1/95 @ 00:00:00
	2									Flow	L/s	Periodic	26/01/95 @ 00:00:00	4/05/95 @ 00:00:00

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
Conglomerate Creek														
MLMRCL	27									Fe, Cu, Al, Zn, Mn, SO_4, Cl, TDS, TSS	mg/L	Periodic	03/06/91 @ 00:00:00	01/12/92 @ 00:00:00
	27									pH		Periodic	03/06/91 @ 00:00:00	01/12/92 @ 00:00:00
	27									Temperature	^{o}C	Periodic	03/06/91 @ 00:00:00	01/12/92 @ 00:00:00
Princess Creek below tailings dam site														
CMT	PCTD									pH	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	PCTD									TSS, Fe, Mn, Zn, Cu, Pb, Al, Hg (T&D)	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	PCTD									SO_4, Fl	mg/L	Periodic	26/04/95 @ 00:00:00	Current
	PCTD									Flow	cumecs	Periodic	26/04/95 @ 00:00:00	Current

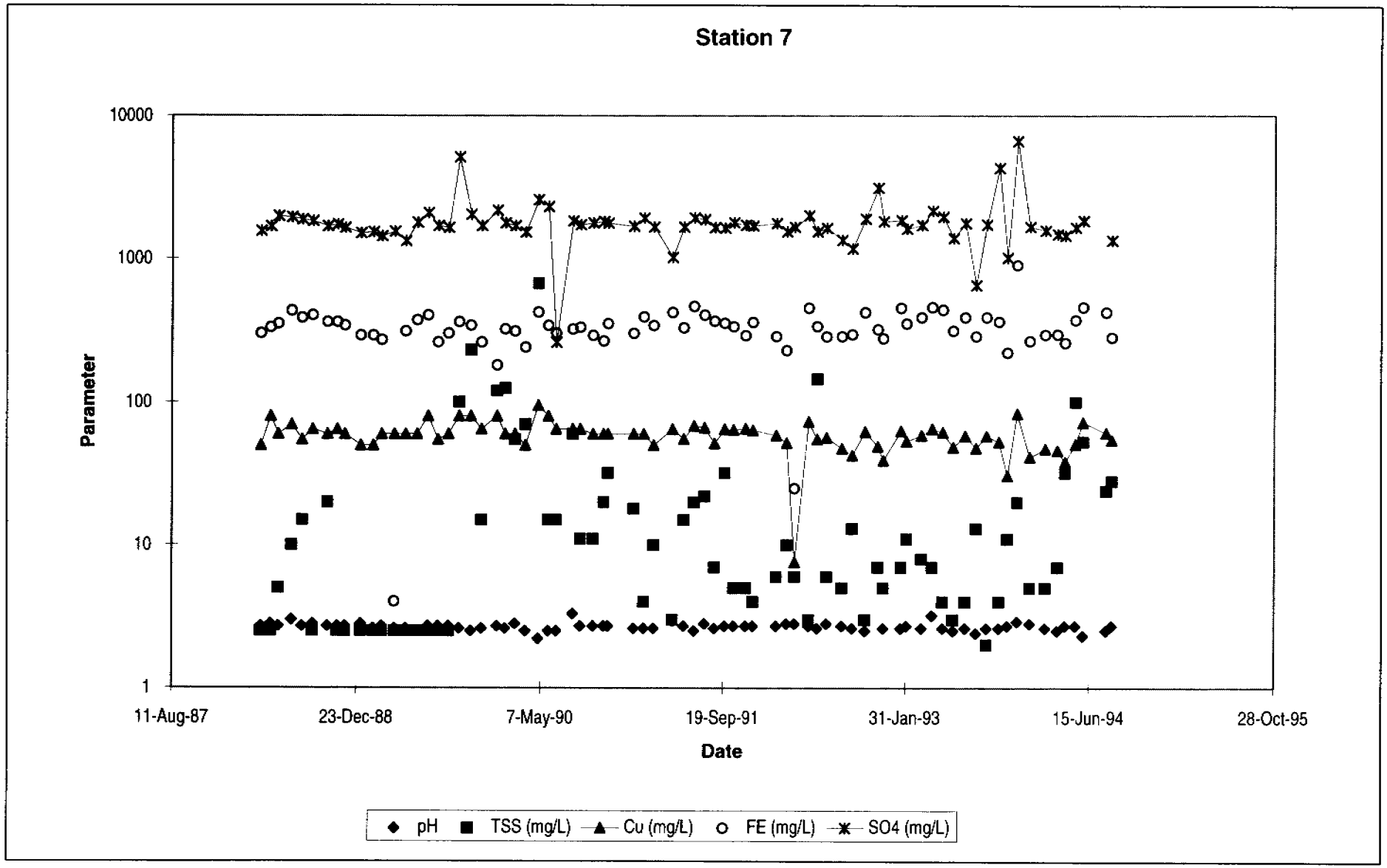
King River

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
King River above Teepookana														
HEC	704	-42:11:40.2	145:26:37.2	371500.000	5327439.999			100	1	Flow	L/s	Continuous	29/06/94 @ 12:00:00	31/03/95 @ 12:45:00
	704							405	1	Air Temp	^{o}C	Continuous	29/06/94 @ 12:00:00	31/03/95 @ 12:45:00
King River above mouth to Macquarie Harbour														
HEC	711	-42:11:50.4	145:24:07.0	368060.000	5327059.998	Between delta and Teepookana Bridge				Flow	L/s	Continuous	06/12/94 @ 16:00:00	13/04/95 @ 16:00:00
										Cu, Fe, Mn, Al (all D)	mg/L	Continuous	06/12/94 @ 16:00:00	13/04/95 @ 16:00:00
King River above Queen River														
MLMRCL	30									Temperature	^{o}C	Periodic	07/09/92	01/12/94
										pH		Periodic	07/09/92	01/12/94
										Conductivity	µS/cm	Periodic	07/09/92	01/12/94
										Al, As, Cd, Cl, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn, (all D), SO_4,TDS, TSS	mg/L	Periodic	07/09/92	01/12/94
King River below Queen River														
HEC	403	-42:09:27.0	145:31:45.5	378499.998	5331674.999	King River below Crotty Dam; Queen River confluence	675.8 km^2	100	1	Flow	L/s	Continuous	03/10/91 @ 12:35:10	27/03/95 @ 14:00:00
DELM	3									Flow	L/s	Continuous	03/10/91 @ 12:35:10	27/03/95 @ 14:00:00

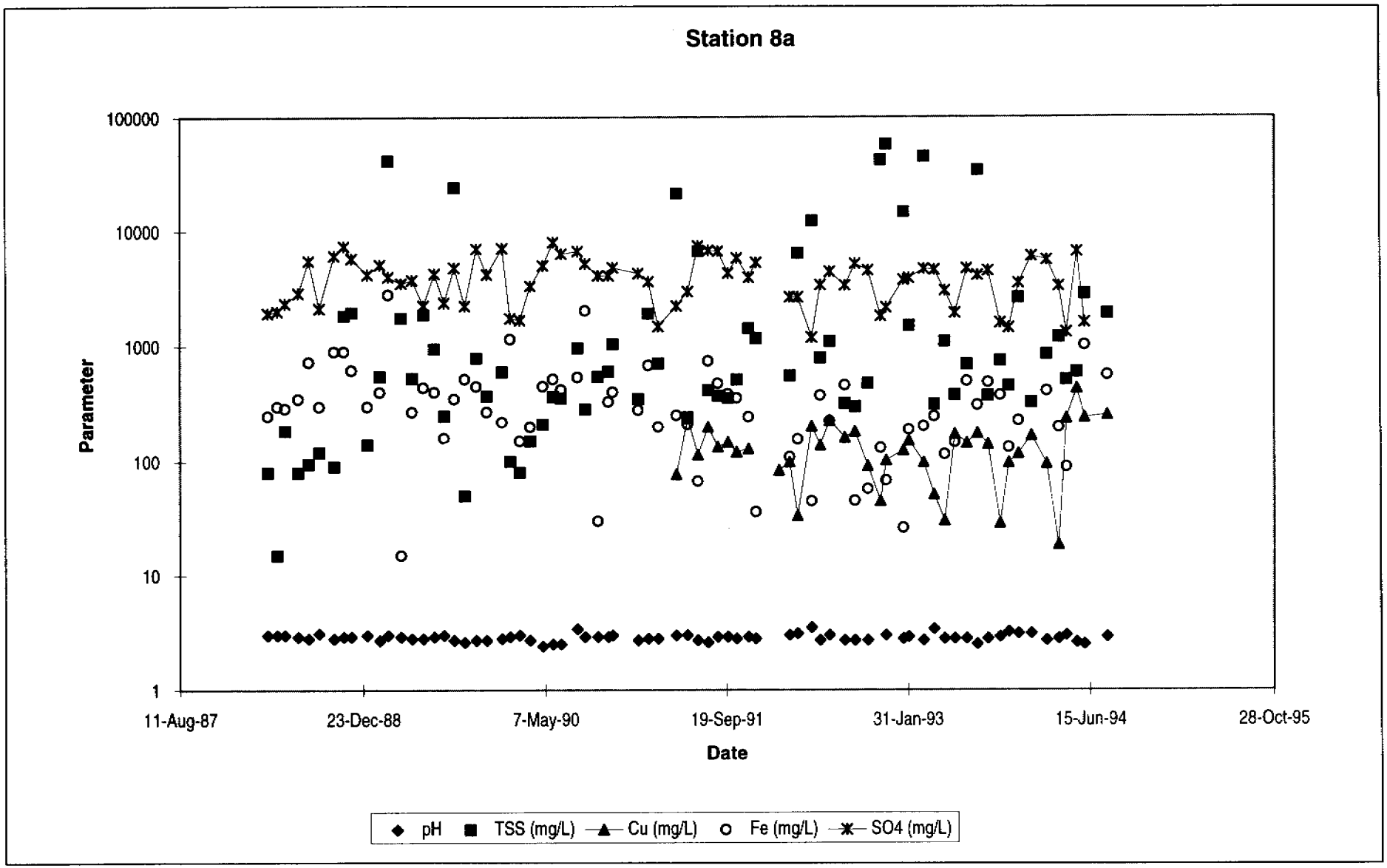
Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
King River below Cutten Creek														
HEC	851	-42:11:53.5	145:24:48.1	369004.736	5326983.356	Tidal; zero gauge = -0.22 m;catchment area 71.5 km^2 between Sailor Jack and Cutten Creek	802.5 km^2	100	1	Flow	L/s	Continuous	15/01/86 @ 11:39:48	17/05/95 @ 08:45:00
	851							15408	1	pH - meter installed		Continuous	05/05/95 @ 12:15:00	17/05/95 @ 08:45:00
King River below Sailor Jack														
HEC	841	-42:10:45.4	145:29:29.4	375419.999	5329199.999	Natural watercourse controlled after 25/7/91; catchment area = 170km^2 between Crotty dam and Sailor Jack; Crotty dam to source = 561km^2	731 km^2	100	1	Flow	L/s	Continuous	23/01/85 @ 07:55:00	13/04/95 @ 10:30:00
DELM	4									Flow	L/s	Continuous	23/01/85 @ 07:55:00	13/04/95 @ 10:30:00
King River below Quarter-mile Bridge														
DELM	13					Controlled watercourse				Flow	L/s	Periodic	29/6/94 @ 00:00:00	4/5/95 @ 00:00:00
King River at Teepookana														
MLMRCL	28						792.5 km^2			Al, As (T), Cd, Cl, Cr, Cu, Fe, Hg (T), Mn, Ni, Pb, SO_4 (T), Zn, TDS, TSS	mg/L	Periodic	01/06/74	01/11/76
	28									Temperature	^oC	Periodic	01/06/74	01/11/76
	28									Conductivity	µS/cm	Periodic	01/06/74	01/11/76
	28									Al, As (T), Cd, Cl, Cr, Cu, Fe, Hg (T), Mn, Ni, Pb, SO_4 (T), TDS, TSS, Zn	mg/L	Periodic	01/05/91	01/12/94
	28									Temperature	^oC	Periodic	01/05/91	01/12/94
	28									Conductivity	µS/cm	Periodic	01/05/91	01/12/94
DELM	15									Flow	L/s	Periodic	15/10/86	04/05/65
HEC	706									Flow	L/s	Periodic	15/10/86	04/05/65

Source	Site no	Latitude	Longitude	Easting	Northing	Description	Catchment	Parameter	Variable	Parameter name	Units	Qualifier	Start	End
King River above Delta														
HEC	723	-42:11:40.7	145:21:47.3	364849.999	5327300.000	Teepookana forestry access gate above delta	813 km^2	23600	40	Cu (T)	N/A	Periodic	01/03/91 @ 00:00:00	01/08/94 @ 00:00:00
MLMRCL	29									pH		Periodic	01/06/74	01/11/76
	29									Temperature	^{o}C	Periodic	01/06/74	01/11/76
	29									Al, As, Cd, Cl, Cr, Cu, Fe, Hg, Mn, Ni,, Zn, Pb, SO_4,TDS, TSS	mg/L	Periodic	01/05/91	01/12/94
										Temperature	^{o}C	Periodic	01/05/91	01/12/94
	29									pH		Periodic	01/05/91	01/12/94

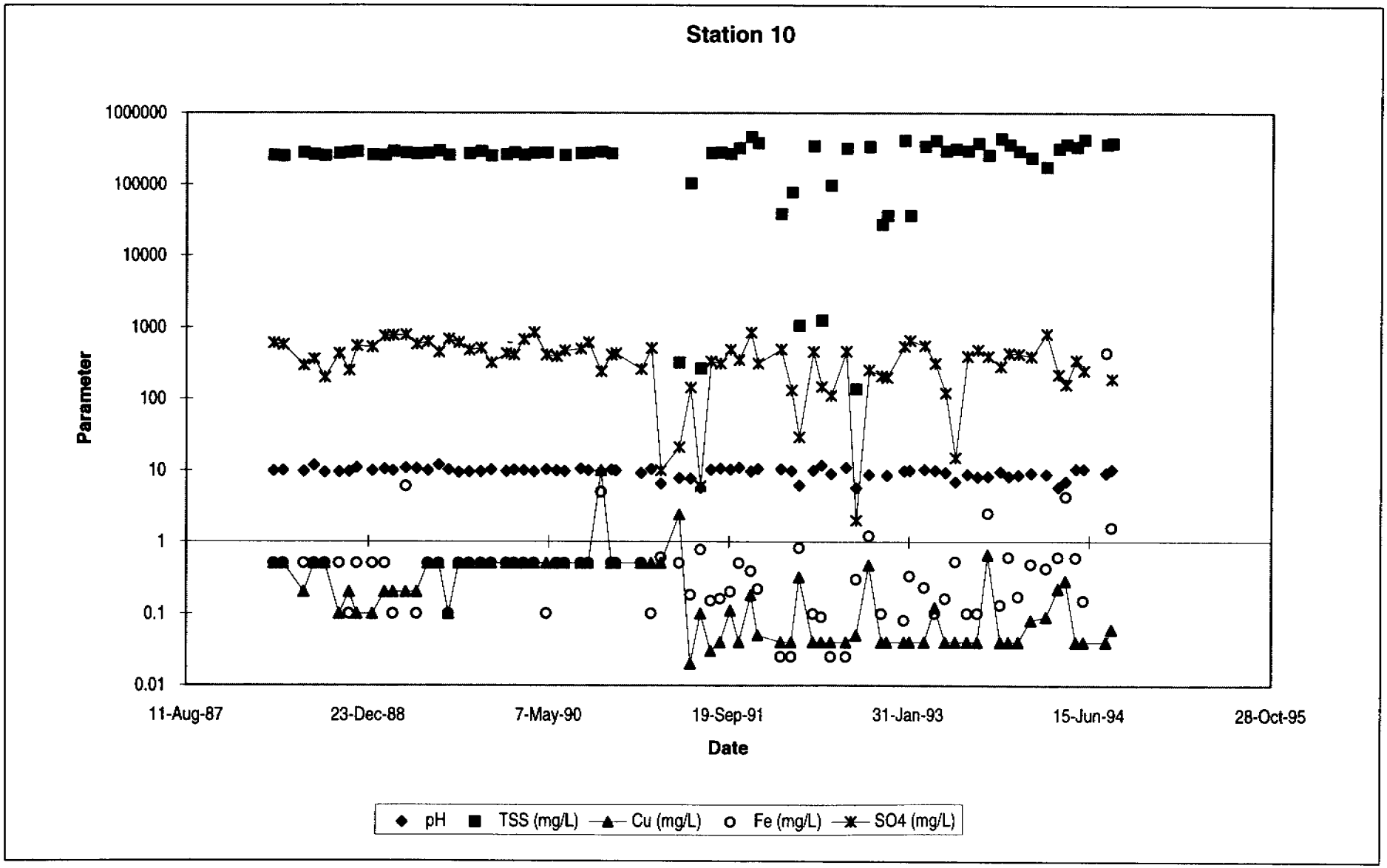
Appendix C Water quality parameters for stations 7, 8a and 10



Appendix C. Water quality parameters for station 7



Appendix C. Water quality parameters for station 8a



Appendix C. Water quality parameters for station 10