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See File 680583 PT2
8/4/98

Mineral Resources Tasmania

"The Rehabilitation of Abandoned Tin Mines in North Eastern Tasmania"

WATER QUALITY ASSESSMENT REPORT

Prepared By

SEMF

SCIENTISTS
ENGINEERS
MANAGERS &
FACILITATORS

FEBRUARY 1998

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1.0 INTRODUCTION

Whilst Mineral Resources Tasmania do not promote the active use of a number of lakes and water impoundments across the study area for the rehabilitation of abandoned tin mines in the north east of Tasmania, they are reported by many local residents and tourist agencies to be widely accepted as being suitable for use by recreational campers and local residents.

Due to the proximity of these lakes to abandoned mining operations, the sediment contained within the majority of them is derived from depositional outwash tailings and are in some cases situated near kaolinite outcrops which are highly erodible and prone to leaching of it's aluminium component into surrounding waters.

In addition, acid discharges occur across the three mine sites and a preliminary sample from a location at the Endurance mine "S2.1" showed extremely high levels of Aluminium.

Given this, a base (one off) water sampling program was undertaken over all accessible lakes and water courses in the vicinity of three mines; Monarch, Star Hill and Endurance. The sampling was conducted in January 1998. The results of the sampling program would be used to determine whether any harmful metals are present in soluble form, and if so in what concentrations, and ultimately whether these lakes are suitable for recreational and drinking water purposes.

2.0 EVALUATION METHODOLOGY

The water quality assessment report includes the collation, preparation and review of information for the three mine sites as detailed below:

1. An historical review of sample information and regional hydrology.
2. Flow rate calculation of streams and discharges, taken from site measurements, and database information on NE Tasmania.
3. A calculation of mass loading of Aluminium (the dominant contaminant), in solution within relevant streams and discharge sources.
4. The completion of a sampling program at the three mines for heavy metals and comparison of sampling results against ANZECC Guidelines for Freshwater Aquatic Ecosystem Guidelines and NHRMC & ARMCANZ Australian Drinking Water Guidelines.

3.0 HISTORICAL REVIEW

No historical water quality information, collected in the last five to ten years, was located for the north east region, nor the mines sites specifically. The local Waterwatch Group conduct regular microbiological sampling of watercourses in the Gladstone area and although they do monitor pH, unfortunately no records are retained. Analysis for heavy metals is not included in their monitoring program.

4.0 STREAM FLOW RATES AND DISCHARGES

Detailed flow rates in (litres per second) were calculated at the period of sampling at all streams and associated rivers and are as detailed in Tables 6.2, 6.4 and 6.5. Utilising this information, approximate median flows were calculated utilising data from the Australian Rainfall and Runoff 1987 (*A Guide to Flood Estimation*) and calculation of individual catchment areas.

5.0 MASS LOADINGS

For the purpose of accuracy, mass loadings of Aluminium (the contaminant of most concern) has been calculated on flow rates measured during the period of sampling from individual water courses and are as detailed in Tables 6.2, 6.4 and 6.5.

As significant dilution and an associated reduction in contact time occur during periods of median and peak flow, definitive determinations on median mass loadings cannot be made without additional sampling. However they are expected to be significantly greater than those mass loading figures identified in the January 1998 monitoring run.

6.0 WATER QUALITY

6.1 Monarch Mine

Due to the small nature of the watercourses and lakes sampled they are not named at the 1:25,000 scale, so the location of the sampling sites at the Monarch Mine have been shown on Figure 1 (Appendix A) and the type of water body or watercourse sampled described in Table 6.1.

Table 6.1: Monarch Mine Sampling Site Descriptions

Monitoring Point	Location Description
M1	Outwash lagoon
M2	Background groundwater
M3	Wetland feeding into S1.1 gully
M4	Lake
M5	Start of creek
M6	Mid way along creek (old mullock heap cutting)

Table 6.2: Monarch Mine Water Quality Analysis Results

Metals/Flows	ANZECC Guidelines	Units	M1	M2	M3	M4	M5	M6
pH	6.5-9.0		**3.7**	6.7	6.6	**6.3**	7.2	**5.8**
TSS	*	mg/L	577	3	37	210	<1	9
SO_4	-	mg/L	58	19	5.4	9.0	2.3	7.5
Al	**	µg/L	**13300**	77	**1950**	**2710**	**672**	**1030**
Cd	0.2-2.0	µg/L	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
Co	-	µg/L	7	<1	<1	<1	<1	3
Cr	10.0	µg/L	**11**	<1	3	3	3	7
Cu	2.0-5.0	µg/L	**9**	<1	*5*	*4*	*4*	*3*
Fe	1000	µg/L	**160000**	498	**14800**	**1320**	**2030**	**3580**
Mn	-	µg/L	60	12	33	10	13	7
Ni	15.0-150.0	µg/L	8	<1	2	6	4	**176**
Pb	1.0-5.0	µg/L	**12**	<1	*4*	*5*	2	<1
Sn	0.008	µg/L	**637**	**12**	**59**	**6**	**5**	**13**
Zn	5.0-50.0	µg/L	*41*	<1	*13*	*9*	*31*	*9*
Median Flow (l/sec)	-	-	14.8	na	8.9	na	6.4	15.3
Sampled Flow (l/sec)	-	-	na	na	1.3	na	0.7	2.0
Mass Loading Al (kg per day)	-	-	na	na	**0.213**	na	**0.04**	**0.177**

LEGEND

Bold Exceeds (or is beyond range of) the ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
Italics Meets ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
* TSS <10% change in seasonal mean concentration.
** Al <5.0 if pH <= 6.5, and <100.0 if pH > 6.5.
na Not Applicable
nd Not determinable

All of the sampled waterbodies and watercourses at Monarch Mine showed one or more heavy metals to be in excess of the ANZECC guidelines for freshwater aquatic ecosystems (ANZECC, 1992).

The background water sample for this area (M2) was found to contain levels of tin in excess of the ANZECC guidelines, all other parameters met or were within the range of ANZECC guidelines.

All other samples exhibited very high levels of aluminium, iron and tin, well in excess of the ANZECC guidelines, with the sample from mid way along the creek (M6) having high nickel and the lake (M4) having a more acidic pH than prescribed for a freshwater aquatic ecosystem.

The outwash lagoon, M1, showed the most heavy metal contamination, with aluminium, chromium, copper, iron, lead and tin in excess of the ANZECC guidelines and a pH level more acidic than that prescribed in the guidelines. The tin level in the water sample from this location was almost 80,000 times the prescribed limit, while the aluminium level was approximately 2,500 times, and the iron was 160 times the prescribed limit.

6.2 Star Hill Mine

The sampling sites at the Star Hill Mine are shown on Figures 2 and 3 (Appendix A), and the type of water body or watercourse sampled is described as in Table 6.3.

Table 6.3: Star Hill Mine Sampling Site Descriptions

Monitoring Point	Location Description
S1	Small sediment retention dam
S2	Large sediment retention dam
S3	Dam outflow
S4	Influent creek to Ringarooma River
S5	Significant dam (wall about to breach)
S6	Remnant lake
S7	Lake
S8	Lake
S9	Lake
S10	Dam wall seepage
S11	Man-made lake
S12	Star Hill lake

The analytical results for this sampling program of Star Hill are provided in Table 6.4.

All of the waterbodies or watercourses sampled in the vicinity of Star Hill Mine provided very high aluminium and tin levels, well in excess of the ANZECC guidelines. Many of the sites sampled provided levels of chromium, copper, iron, lead, and zinc in excess of the ANZECC guidelines and pH levels below that prescribed for a freshwater aquatic ecosystem.

The most highly contaminated of the waterbodies and watercourses at Star Hill mine are the Large sediment retention dam (S2), dam outflow (S3), the influent creek to the Ringarooma River (S4), the significant dam (S5), the dam wall seepage (S10), and the man-made lake (S11).

Of these the most highly contaminated location was the large sediment retention dam (S2), which was found to contain levels of aluminium almost 90000 times the ANZECC guideline for an aquatic freshwater ecosystem, tin almost 52000 times, iron 112 times, lead 31 times, zinc almost 3 times, copper almost 13 times, and chromium 15 times the ANZECC guideline. The pH at this location was recorded to be acidic (5.9) and below the prescribed range for an aquatic ecosystem.

6.3 Endurance Mine

The sampling sites at the Endurance Mine are shown on Figures 4 and 5 (Appendix A), and the type of water body or watercourse sampled is described in Table 6.6.

Table 6.6: Endurance Mine Sampling Site Descriptions

Monitoring Point	Location Description
E1	Stream
E2	Creek drains from lake (Cat's gully)
E3	Lake
E4	Blue lake proper (southern side)
E5	Blue lake proper (camping area)
E6	Stream (Ruby Creek)
E7	Stream
E8	Creek
E9	Lake
E10	Lake

The analytical results for all ten of the Endurance sampling sites in Table 6.5 exhibited pH below the prescribed ANZECC pH range, most likely facilitating the high levels of aluminium and tin in solution (up to 10000 and 51000 times the ANZECC guideline respectively).

As found for the Monarch and Star Hill Mines, high levels of copper, iron and lead were found in many samples, specifically the stream and creeks samples E1, E2, E7 and E8.

Chromium and nickel were not shown to be a problem at the Endurance Mine water sampling sites.

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Table 6.4: Star Hill Mine Water Quality Analysis Results

Metals/Flows	ANZECC Guidelines	Units	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
pH	6.5-9.0		**6.0**	**5.9**	6.9	**5.8**	6.9	**5.1**	**5.1**	**5.0**	**4.4**	6.5	8.1	**5.1**
TSS	*	mg/L	11	86200	16	141	<1	12	21	26	6	287	141	6
SO_4	-	mg/L	4.5	11	6.2	0.5	2.5	5.2	5.3	7.1	8.5	2.1	3.3	2.6
Al	**	µg/L	**2090**	**449000**	**10200**	**2830**	**227**	**139**	**96**	**959**	**161**	**2830**	**2740**	**93**
Cd	0.2-2.0	µg/L	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
Co	-	µg/L	<1	9	<1	<1	<1	<1	<1	<1	<1	3	<1	<1
Cr	10.0	µg/L	1	**152**	5	**12**	2	<1	<1	6	<1	6	4	<1
Cu	2.0-5.0	µg/L	<1	**63**	**8**	**6**	*4*	<1	<1	*4*	<1	**11**	*5*	*<1*
Fe	1000	µg/L	623	**112000**	**2560**	**60300**	**2420**	159	202	376	35	**22000**	7020	288
Mn	-	µg/L	11	267	9	78	10	14	15	28	18	640	122	12
Ni	15.0-150.0	µg/L	<1	*36*	*24*	4	2	<1	<1	3	<1	5	2	<1
Pb	1.0-5.0	µg/L	<1	**155**	*5*	*3*	<1	<1	<1	*3*	<1	**8**	<1	<1
Sn	0.008	µg/L	**20**	**415**	**14**	**261**	**7**	**<1**	**3**	**<1**	**<1**	**78**	**23**	**9**
Zn	5.0-50.0	µg/L	3	**135**	*21*	*15*	*5*	4	*6*	*41*	*37*	*21*	*8*	2
Median Flow (l/sec)	-	-	na	na	5.3	32.8	na	na	na	na	na	nd	na	na
Sampled Flow (l/sec)	-	-	na	na	na	7.9	na	na	na	na	na	0.9	na	na
Mass Loading Al (kg per day)	-	-	na	na	na	**1.9**	na	na	na	na	na	**0.217**	na	na

LEGEND

Bold Exceeds (or is beyond range of) the ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).

Italics Meets ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).

* TSS <10% change in seasonal mean concentration.

** Al <5.0 if pH <= 6.5, and <100.0 if pH > 6.5.

na Not Applicable

nd Not determinable

Blue Lake.

Table 6.5: Endurance Mine Water Quality Analysis Results Ruby Ck.

Metals/Flows	ANZECC Guidelines	Units	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
pH	6.5-9.0		**4.7**	**3.6**	**3.6**	**3.7**	**3.6**	**2.7**	**2.8**	**6.0**	**5.0**	**4.5**
TSS	*	mg/L	27	47	49	52	52	862	393	17	4.5	11
SO_4	-	mg/L	141	1510	<1	<1	<1	4	249	535	<1	<1
Al	**	µg/L	**8520**	**11000**	**1910**	**2450**	**2440**	**52400**	**21100**	**3110**	**87**	**120**
Cd	0.2-2.0	µg/L	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
Co	-	µg/L	1	1	1	<1	<1	13	5	3	<1	<1
Cr	10.0	µg/L	7	6	<1	<1	<1	3	6	6	<1	<1
Cu	2.0-5.0	µg/L	**9**	**9**	<1	<1	<1	<1	**6**	**19**	<1	<1
Fe	1000	µg/L	**32800**	**7260**	692	560	632	**80000**	**46700**	**39800**	245	41
Mn	-	µg/L	38	26	29	16	17	189	69	46	12	8
Ni	15.0-150.0	µg/L	5	4	<1	<1	<1	*16*	8	6	<1	<1
Pb	1.0-5.0	µg/L	**12**	**9**	<1	<1	*2*	*3*	**7**	*5*	<1	<1
Sn	0.008	µg/L	**138**	**32**	**2**	**<1**	**21**	**408**	**215**	**163**	**7**	**<1**
Zn	5.0-50.0	µg/L	*24*	*24*	*14*	*8*	*8*	**175**	**53**	*33*	2	*5*
Median Flow (l/sec)	-	-	12.5	nd	na	na	na	21.9	14.8	nd	na	na
Sampled Flow (l/sec)	-	-	2.8	5.1	na	na	na	8.3	6.1	1.2	na	na
Mass Loading Al (kg per day)	-	-	**2.06**	**4.84**	na	na	na	**37.5**	**11.12**	**0.32**	na	na

LEGEND
Bold Exceeds (or is beyond range of) the ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
Italics Meets ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
* TSS <10% change in seasonal mean concentration.
** Al <5.0 if pH <= 6.5, and <100.0 if pH > 6.5.
na Not Applicable
nd Not determinable

6.4 Comparison to Background

A background sample was collected from the northern side of the Bells Bridge on the Ringarooma River for comparison purposes. As most studied mines report to the Ringarooma catchment, the result of this sample provides a useful indicator on the state of regional water quality.

Table 6.2: Background Sample R1 Water Quality Analysis Results
(Northern Side of Bells Bridge)

Metals	ANZECC Guidelines	Units	R1
pH	6.5-9.0		6.9
TSS	*	mg/L	**1.8**
SO_4	-	mg/L	30
Al	**	µg/L	**723**
Cd	0.2-2.0	µg/L	*<1*
Co	-	µg/L	3
Cr	10.0	µg/L	6
Cu	2.0-5.0	µg/L	**11**
Fe	1000	µg/L	**2090**
Mn	-	µg/L	217
Ni	15.0-150.0	µg/L	*7*
Pb	1.0-5.0	µg/L	*5*
Sn	0.008	µg/L	**5**
Zn	5.0-50.0	µg/L	*27*

LEGEND

Bold Exceeds (or is beyond range of) the ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
Italics Meets ANZECC Guidelines for Freshwater Aquatic Ecosystems (ANZECC, 1992).
* TSS <10% change in seasonal mean concentration.
** Al <5.0 if pH <= 6.5, and <100.0 if pH > 6.5.
na Not Applicable
nd Not determinable

7.0 RECOMMENDATIONS

As detailed in the water analysis section of this report, extreme levels of metals (Aluminium, Tin and Iron) exist in solution across the Monarch, Star Hill and Endurance mines and throughout the Ringarooma catchment in general. It is hypothesised that the source of these metals, in particular Aluminium relates directly to the extensive gravel depositional plains across the extraction areas and the relative abundance of Kaoline and the associated Kaolinite clay mineral.

A systematic combination of reactionary events across each of the studied mine sites has led to the extreme levels of metals within adjacent water retention basins and associated streams. The predominantly gravel (granite zoned) tailings across the mines contain moderate levels of Pyrite (FeS_2) which through oxidation (enhanced by the porous nature of tailings material) has lead to the formation of acid drainage streams with pH values varying between 2.8 and 5.9. Such acid drainage percolates through the depositional tailings plains, across underlying and adjacent Kaoline surfaces into stream and lake systems. As this drainage progresses residual metals (Tin and Iron) are drawn into solution and as these streams interact with Kaolin interfaces Aluminium is drawn into solution.

Kaoline and associated Kaolinite ($Al_2O_3.2SiO_2.2H_2O$.) material (the most refractory of all clays) has extreme dispersability, being highly prone to mass movement and resultant stream sedimentation. As acidic waters and subsurface flows move across these landforms Aluminium is drawn into solution. The resultant erosion exposes fresh Kaolinite and the process continues.

To assist in the quantification of Aluminium levels within the environment it's effects at significantly lower levels than those encountered in this study have been detailed in section below.

Human Health

The effects of Aluminium on humans are largely undetermined with speculation that continual exposure to Aluminium in solution may have some influence on Alzeimers and other neurological disorders. A review of public health information indicates that excess levels of Aluminium in recreational waters may be astringent to mucus membranes.

A review of public health information indicates that an obligation exists on people in control of water used for recreation purposes to ensure that they are not harmful to human users (Section 6 Public health Act, *Water Quality Guidelines.*)

Environmental Health

As previously detailed results from water analysis of the Ringarooma River indicate that the general catchment contains levels of Tin and Aluminium that will be detrimental to ecosystem function. Given the levels encountered it is anticipated that most single celled aquatic plants can not survive in the region and that other aquatic plants are significantly inhibited.

Vegetative Development

Excess concentrations of non-essential elements (such as aluminium, cadmium, zinc, and copper) in soils can be injurious to some plants and not others. This is due to genetic variation in plants varying the amount of damage and symptoms expressed by different

Stunts root growth in plants.
8.5.

plant species based on their level of sensitivity or tolerance to some elements present. For example small amounts of nickel may injure some plant species, while large amounts of aluminium may be tolerated.

Injury due to high concentrations of non-essential elements is observed as interference with cellular absorption, or the function of other elements, resulting in deficiency symptoms being expressed.

In addition, if soil is too acidic the growth of some plants may be impaired, this is due to mineral salts being more soluble in acidic solutions, resulting in mineral deficiency symptoms being expressed. It should be noted that aluminium is a mineral often associated with mineral deficiency problems in low pH soils.

8.0 CONCLUSIONS

Water quality information has been critically reviewed against Public Health standards, ANZECC Guidelines and MRT Rehabilitation priorities. From this review the following management strategies have been formulated.

- The lakes, dams, lagoons and sediment retention basins scattered across the Monarch, Star Hill and Endurance mine sites contain the highest levels of Aluminium and Tin within the region. This is a result of the accumulation of suspended metals, and bound metals (Kaolinite) from influent streams. These structures are performing a vital function in the prevention of Aluminium laden sediment and acid waters from impacting off site into adjacent streams and catchments. As such it is essential that these structures are maintained and continue to operate as sediment retention basins.

- The most cost effective method of removing Aluminium from solution within acid streams is through the implementation of successive alkalinity producing wetlands. Such systems will raise existing pH levels from acid to near neutral ensuing metal precipitation from solution. As many natural wetlands exist across the Monarch, Star Hill and Endurance mine sites, these can be re-engineered so that Aluminium and Tin removal can be successfully achieved with minimal costs. Utilising an established SEMF design, it is anticipated that up to 80% of Aluminium and up to 55% of Tin can be removed from a 10.2 (l/sec) influent stream. In addition the enhancement of existing wetlands is in line with the desired revegetation outcomes set by MRT.

- To ensure that recreational users (including non intentional users) are informed of the potential hazards associated with high levels of Aluminium and Tin and low levels of pH within water bodies across the Monarch, Star Hill and Endurance mine sites, it is essential that Warning Signs and/or gates be erected. These gates will prevent access to particular sites and the Warning Signs identify that swimming and in some instances water contact be avoided. Such preventative measures shall also protect MRT from potential liability issues associated with these environments.

- Vegetative development across Monarch, Star Hill and Endurance mine sites, particularly the areas with white Kaolinite clays, have been significantly hampered by high levels of Aluminium and erosional activities. High sodium levels across much of the mine areas have encouraged disaggregation of clay particles leading to dispersion and high solubility within water. Such activity causes the undercutting and collapse of any semi-rigid structures like gabions through tunnel gullying and leads to acid laden sub surface waters. It is proposed that the sodium ions be replaced by calcium, in the form of hydrated lime ("limil") as 1-2% by volume, or gypsum spreading at 2.5-5 tonnes/hectare. This activity will bind the Kaolinite preventing erosion. The slight raising of pH should also enhance revegetation efforts and assist in the precipitation of metals from solution

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The Institute of Engineers Australia (1987) Australian Rainfall and Runoff *(A Guide To Flood Estimation).*

Salisbury & Ross (1985) Plant Physiology, Third Edition, Wadsworth Publishing Company.

LIMITATIONS STATEMENT

This Water Quality Assessment Report has been prepared in accordance with the scope of services set out in the contract between SEMF Holdings Pty Ltd (SEMF) and Mineral Resources Tasmania ('the Client'). To the best of SEMF's knowledge, the proposal presented herein represents the Client's intentions at the time of printing of the Report. However, the passage of time, manifestation of latent conditions or impacts of future events may result in the actual project and its impact differing from that described in this Report. In preparing this Report, SEMF has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations referenced herein. Except as otherwise stated in this Report, SEMF has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

Prepared by SEMF Holdings Pty Ltd
Published by SEMF Holdings Pty Ltd

February 1998

APPENDIX A

Water Quality Sampling Locations

February 1998

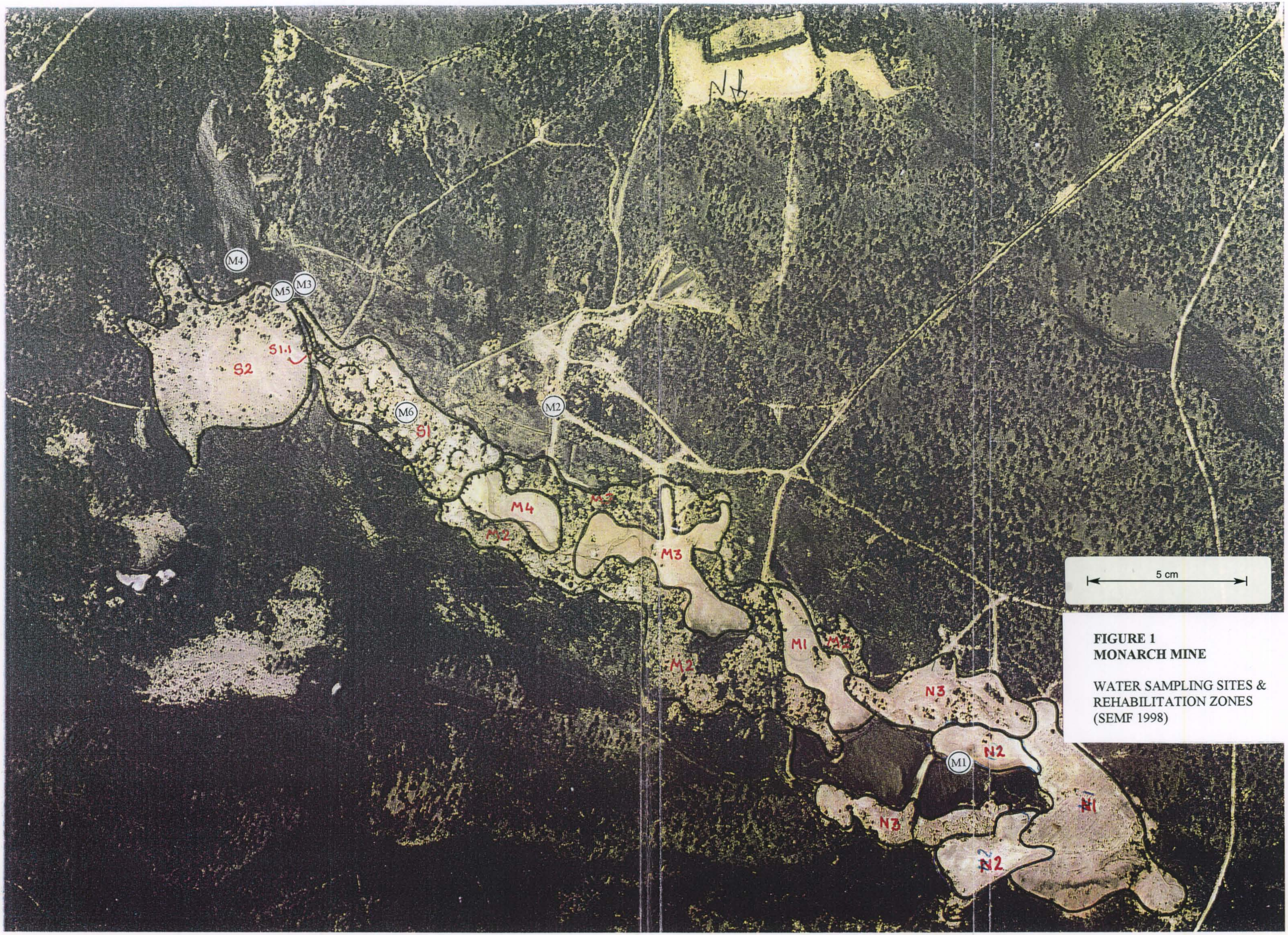

FIGURE 1
MONARCH MINE

WATER SAMPLING SITES &
REHABILITATION ZONES
(SEMF 1998)

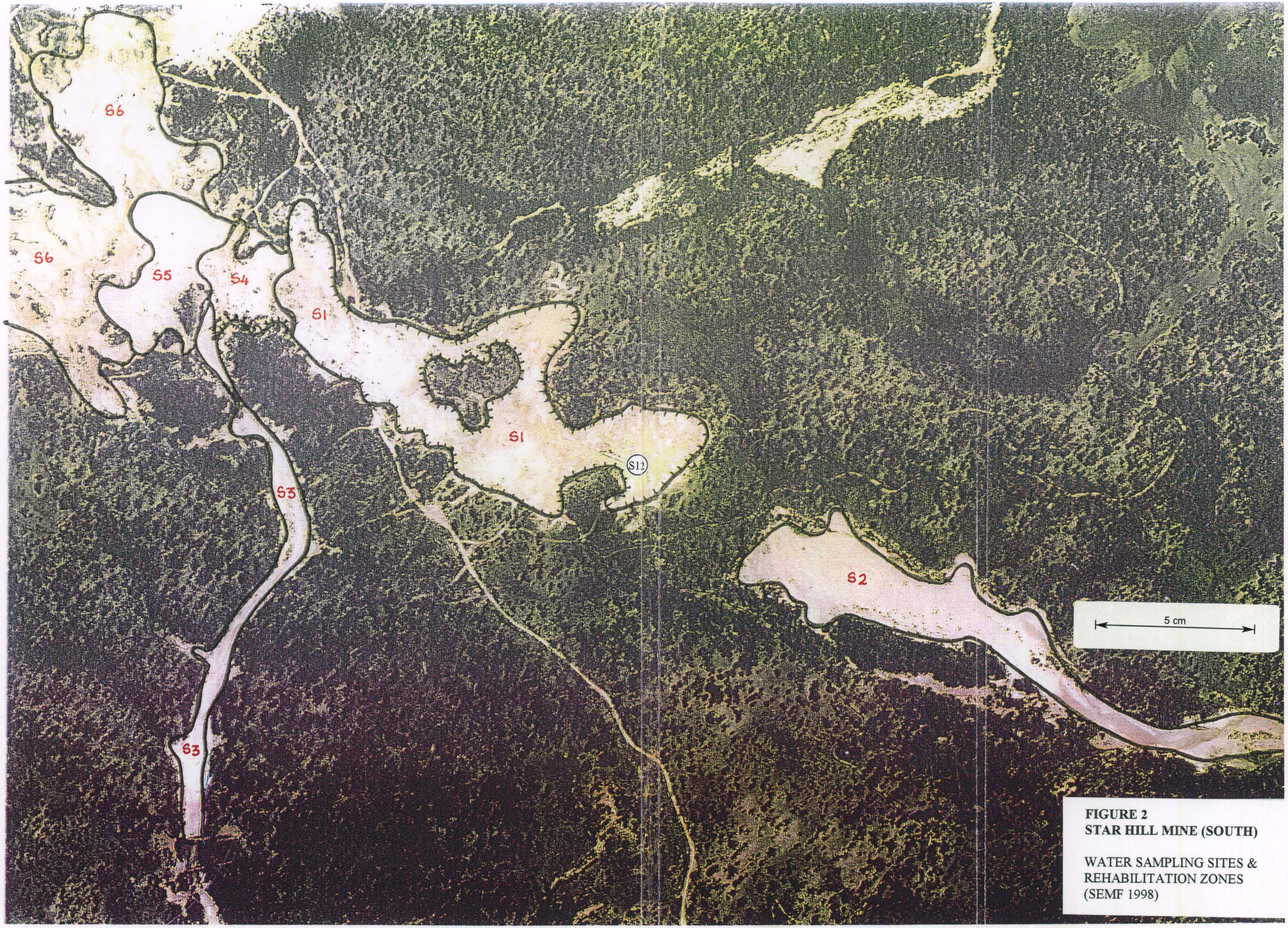

FIGURE 2
STAR HILL MINE (SOUTH)

WATER SAMPLING SITES &
REHABILITATION ZONES
(SEMF 1998)


5 cm
FIGURE 3
STAR HILL MINE (NORTH)
WATER SAMPLING SITES &
REHABILITATION ZONES
(SEMF 1998)
S11
S10
S8
M2
S2
S3
M3
M4
M4
M5
S4
S5
M8
S6
M1
S8
S7
S9
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M8
S6
M7
M6
S5

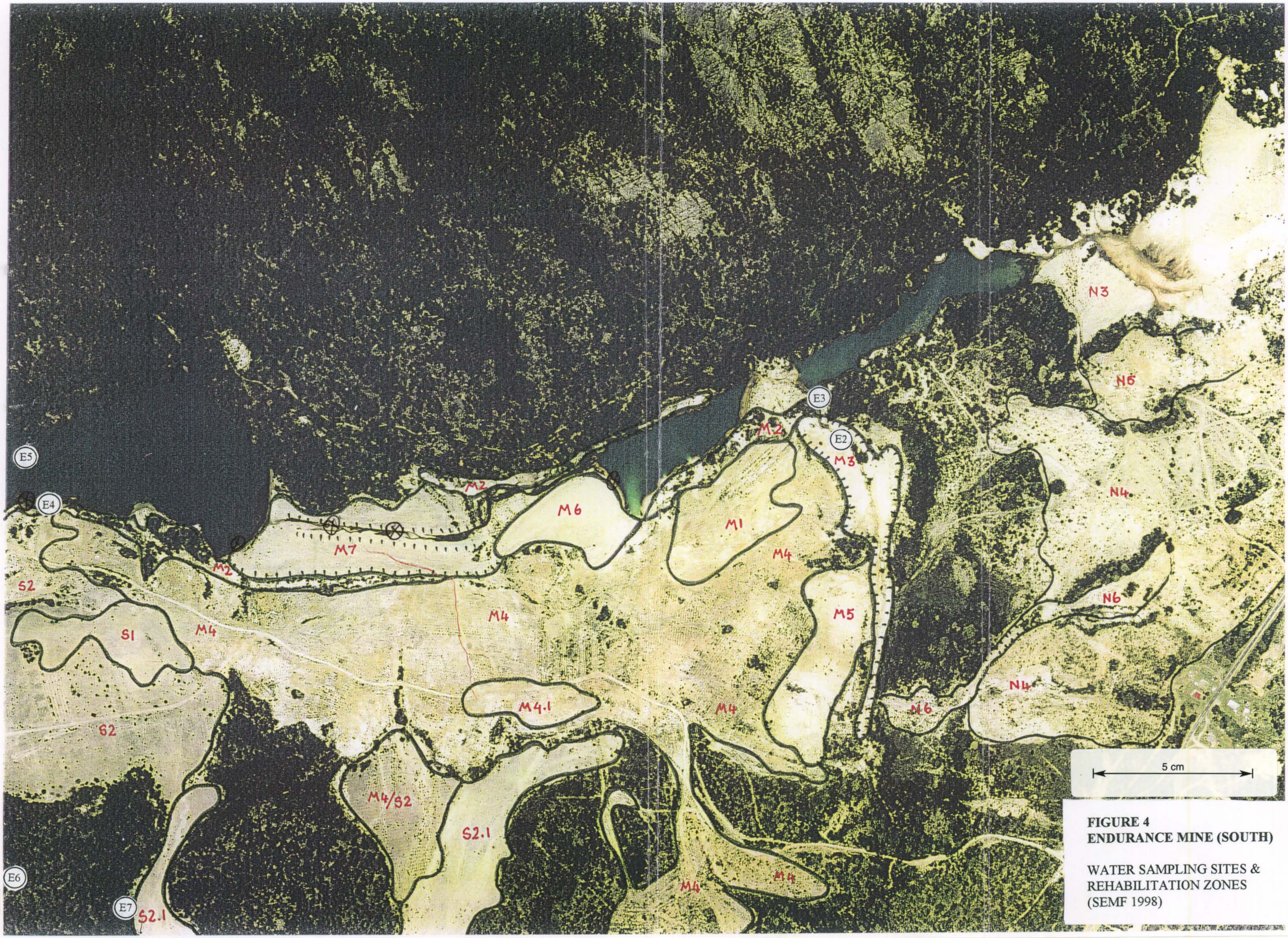

FIGURE 4
ENDURANCE MINE (SOUTH)

WATER SAMPLING SITES &
REHABILITATION ZONES
(SEMF 1998)

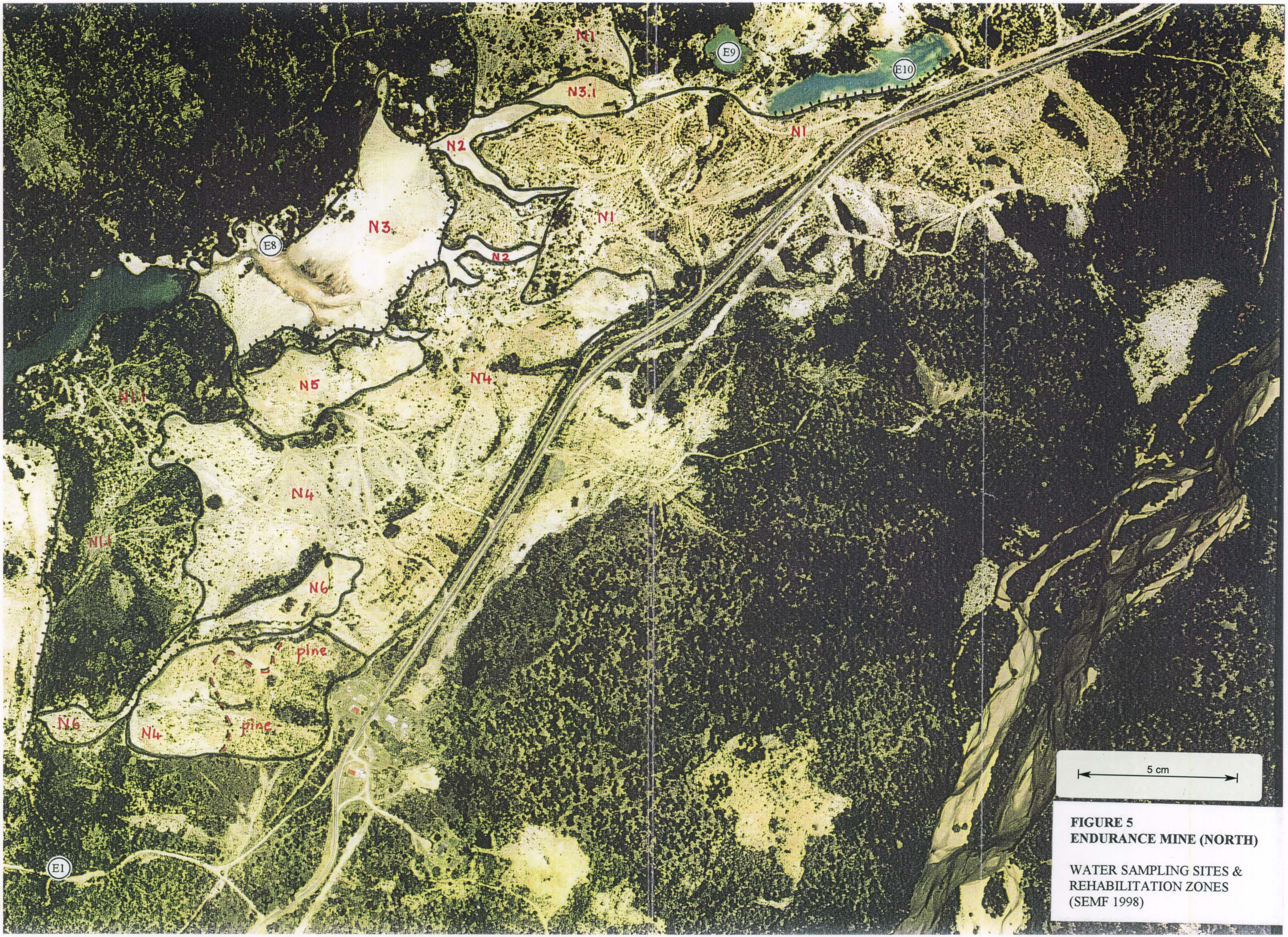

FIGURE 5
ENDURANCE MINE (NORTH)

WATER SAMPLING SITES & REHABILITATION ZONES (SEMF 1998)

APPENDIX B

Water Quality Analytical Results

February 1998

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Report Number: 8761
Submitted By: S. Talbot
Reported To: S. Talbot
Test Method: APHA 3120

Lab. No: 9800091-980119
Date Received: 15/1/98
Date Reported: 3/2/98

SEMF Holdings Water Samples - Total Metals

Lab. No.	Sample ID	Date Sampled	Al µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	Mn µg/L	Ni µg/L	Pb µg/L	Sn µg/L	Zn µg/L
980091	M1	13/1/98	13 300	<1	7	11	9	160 000	60	8	12	637	41
980092	M2	13/1/98	77	<1	<1	<1	<1	498	12	<1	<1	12	<1
980093	M3	13/1/98	1 950	<1	<1	3	5	14 800	33	2	4	59	13
980094	M4	13/1/98	2 710	<1	<1	3	4	1 320	10	6	5	6	9
980095	M5	13/1/98	672	<1	<1	3	4	2 030	13	4	2	5	31
980096	M6	13/1/98	1 030	<1	3	7	3	3 580	7	176	<1	13	9
980097	S1	13/1/98	2 090	<1	<1	1	<1	623	11	<1	<1	20	3
980098	S2	13/1/98	449 000	<1	9	152	63	112 000	267	36	155	415	135
980099	S3	13/1/98	10 200	<1	<1	5	8	2 560	9	24	5	14	21
980100	S4	13/1/98	2 830	<1	<1	12	6	60 300	78	4	3	261	15

Lab. No.	Sample ID	Date Sampled	Al µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	Mn µg/L	Ni µg/L	Pb µg/L	Sn µg/L	Zn µg/L
980101	S5	13/1/98	227	<1	<1	2	4	2 420	10	2	<1	7	5
980102	S6	13/1/98	139	<1	<1	<1	<1	159	14	<1	<1	<1	4
980103	S7	13/1/98	96	<1	<1	<1	<1	202	15	<1	<1	3	6
980104	S8	13/1/98	959	<1	<1	6	4	376	28	3	3	<1	41
980105	S9	13/1/98	161	<1	<1	<1	<1	35	18	<1	<1	<1	37
980106	S10	13/1/98	2 830	<1	3	6	11	22 000	640	5	8	78	21
980107	S11	13/1/98	2 740	<1	<1	4	5	7 020	122	2	<1	23	8
980108	E1	14/1/98	8 520	<1	1	7	9	32 800	38	5	12	138	24
980109	E2	14/1/98	11 000	<1	1	6	9	7 260	26	4	9	32	24
980110	E3	14/1/98	1 910	<1	1	<1	<1	692	29	<1	<1	2	14
980111	E4	14/1/98	2 450	<1	<1	<1	<1	560	16	<1	<1	<1	8
980112	E5	14/1/98	2 440	<1	<1	<1	<1	632	17	<1	2	21	8
980113	E6	14/1/98	52 400	<1	13	3	<1	80 000	189	16	3	408	175
980114	E7	14/1/98	21 100	<1	5	6	6	46 700	69	8	7	215	53
980115	E8	14/1/98	3 110	<1	3	6	19	39 800	46	6	5	163	33
980116	E9	14/1/98	87	<1	<1	<1	<1	245	12	<1	<1	7	2
980117	E10	14/1/98	120	<1	<1	<1	<1	41	8	<1	<1	<1	5

Lab. No.	Sample ID	Date Sampled	Al µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	Mn µg/L	Ni µg/L	Pb µg/L	Sn µg/L	Zn µg/L
980118	R1	14/1/98	723	<1	3	6	11	2 090	217	7	5	5	27
980119	S12	14/1/98	93	<1	<1	<1	<1	288	12	<1	<1	9	2
Field Blank			<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

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Report Number: 8761-1
Submitted By: S. Talbot
Reported To: S. Talbot
Test Method: APHA 4500, 2540, 4110

Lab. No: 980091-980119
Date Received: 15/1/98
Date Reported: 4/2/98

SEMF Holdings Water Samples

Lab. No.	Sample ID	pH	SO_4 mg/L	TSS mg/L
980091	M1	3.7	58	577
980092	M2	6.7	19	3
980093	M3	6.6	5.4	37
980094	M4	6.3	9.0	210
980095	M5	7.2	2.3	<1
980096	M6	5.8	7.5	9
980097	S1	6.0	4.5	11
980098	S2	5.9	11	86 200
980099	S3	6.9	6.2	16
980100	S4	5.8	0.5	141
980101	S5	6.9	2.5	<1
980102	S6	5.1	5.2	12
980103	S7	5.1	5.3	21
980104	S8	5.0	7.1	26
980105	S9	4.4	8.5	6
980106	S10	6.5	2.1	287
980107	S11	8.1	3.3	141
980108	E1	4.7	27	141

Report No: 8761-1

Lab. No.	Sample ID	pH	SO_4 mg/L	TSS mg/L
980109	E2	3.6	47	1 510
980110	E3	3.6	49	<1
980111	E4	3.7	52	<1
980112	E5	3.6	52	<1
980113	E6	2.7	862	4
980114	E7	2.8	393	249
980115	E8	6.0	17	535
980116	E9	5.0	4.5	<1
980117	E10	4.5	11	<1
980118	R1	6.9	1.8	30
980119	S12	5.1	2.6	6

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