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# Storys Creek Water Quality Monitoring Results

5 May 2004

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A Report to Mineral Resources Tasmania

L. Koehnken  
*Technical Advice on Water*



# 1 Introduction

Mineral Resources Tasmania (MRT) has implemented large-scale remediation works at the historic Storys Creek mine site in eastern central Tasmania, including the removal of the contents of a precipitation dam, closure of adits, removal of some tailings and implementation of an anoxic limestone drain. A 3-year water quality monitoring program was initiated in September 2003 to determine the concentrations and fluxes of pollutants and evaluate the efficacy of the remediation works.

This report summarises the results from the fourth quarterly water quality-monitoring run completed on May 5, 2004 and provides an overview of results from the first four monitoring runs.

# 2 Sampling details

Water quality and flow monitoring was completed on 5 May 2004 by L. Koehnken of Technical Advice on Water and Daniel Ray of DPIWE (Environment). Similar to the previous monitoring trips, water samples were collected from the Storys Creek catchment, lower Aberfoyle Creek, and from the South Esk River upstream and downstream of the confluence with Storys Creek as shown in Table 1.

Table 1 contains, an additional site compared to previous monitoring runs, ‘Storys Creek upstream of Side Creek’. This site was included in the February 2004 monitoring run, and provided an indication of what portion of the pollutant load is derived from the tailings and workings upstream of Side Creek, and what portion is derived from the Side Creek area. The February results showed that significant pollutant loads were derived from each of these areas, so the site has been included and will continue to be included in subsequent monitoring runs. The site has been designated number ‘7’ which was not used as a site number in previous investigations by Miedecke (1998, 2000).

At each of these sites pH, conductivity and temperature were measured *in situ* and a water sample was collected for subsequent analysis of metals, sulphate, fluoride and alkalinity.

**Table 1. Site number and location of monitoring points.**

Site Number	Site Location	Justification
ALD	Anoxic Drain outflow at Storys Creek	Provide indication of alkalinity input to underground workings
2	Storys Cr above mine workings	Provides background water quality and indication of upstream changes
5	Storys Cr below Precipitation Dam	Provide record of changes since dam removal – should continue to change as groundwater ‘flushes’ through system
7 New Site	Storys above Side Creek	Indicate pollutant load from upstream tailings vs downstream Side Creek
8	Storys Cr below Side Creek	Significant pollutant load enters via Side Creek-should reduce due to remediation works
10	Eastern Adit outflow	Adit plugged, monitoring of pH indicated effectiveness of works

13	Storys below Nisbet	Indicates inputs from diffuse sources downstream of Side Creek
14	Storys at Managers/Storys below Pumphouse*	Continue best long-term data collection point; indicates diffuse load entering between Nisbet and Pumphouse
21	Storys Above Aberfoyle	Final measurement of pollutant load in Storys Creek
23	Storys below Aberfoyle	Indicative of water entering South Esk
22	Aberfoyle Creek	Water is important for diluting Storys, and has elevated zinc values
24	South Esk above Storys	'Background' water quality in South Esk River
25	South Esk d/s Storys	Estimate of Storys Creek impact on S. Esk
4	Precip. dam outflow	Historic pollutant source
6	Side Creek	Historic pollutant source

**\*This site has been referred to as both Storys below Pumphouse and Storys at Manager's. In this and subsequent reports 'Storys at Manager's' will be used.**

At each river site in Storys Creek, the dimensions of the channel were measured (width, depth at various points) and flow measurements were made at 1 – 4 points across a transect at a depth of 0.6 of the water depth (from the surface). The flow estimates were used to establish fluxes at each of the sites. The 'Storys below Precipitation Dam' site flow measurement was used in the flux calculations for three sites (Storys Creek above mine, Storys below PPT dam, and Storys above Side Creek) because the site yields the most accurate flow estimate due to the presence of bedrock, resulting in a stable channel with confined flow.

Flow from the ALD, Precipitate Dam and Side Creek was measured using a calibrated bucket and stopwatch. Flow from the Eastern Adit was determined using the height of the water in the V-notch weir, and a USGS equation for calculating V-notch flow. Sedimentation of iron floc in the portal of the Eastern Adit is presently affecting the accuracy of the V-notch.

Conditions during sampling were fine, and followed several weeks of seasonal rainfall, with 20 mm of rain falling in the region during the last two weeks of April.

### 3 Results and discussion

Water quality results are presented in Table 2 and Table 3, and discussed in the following sections.

#### 3.1 Flows

On May 5, 2004, flow in Storys Creek varied between 100 and 200 l/s, increasing downstream. This flow is about double the flow measured during the last two monitoring runs, but still considered 'low' for the river based on the range of flows recorded by Miedecke, where flows between 250 - 350 l/s were common. However, the previous flow results based on the gauge boards at the 'Managers Residence' site may have over estimated low flows, as occurred in November 2003 when the flow measurements recorded a flow of about 50 l/s, and the gauge board and rating curve indicated a flow of >100 l/s. Unfortunately, because the gauge boards were lost in the

January flood, it was not possible to compare the two methods during the most recent monitoring.

Photos 1 and 2 compare flow in February with flow in May 2004 at the ‘Storys at Managers’ site. Although higher, the flow is well contained within the river channel.

Flow was present from the Precipitate Dam, Side Creek and the Eastern adit, although very low, measuring 0.02 l/s, 0.5 l/s and 0.5 l/s, respectively.



**Photo 1. & Photo 2 Storys Creek at Managers Residence, looking upstream Feb 2004 (left) and in May 2004 (right).**

The flow in lower Storys Creek compared to the flow in Aberfoyle Creek was proportionately greater as compared to the previous monitoring runs. Flow estimates indicate that lower Storys had three-times the flow of Aberfoyle Creek, whereas in the past flows in the two creeks were within ~30% of each other. Because the mouth of Aberfoyle Creek is a braided stream in thick cobble deposits, it may be that in May more of the flow was being transported subsurface than before, possibly due to the reworking of the cobbles during the January flood event.

### **3.2 Water quality results – concentrations**

Water quality results for May 2004 are presented in Table 2 and Table 3.

### **3.3 Anoxic Limestone Drain (ALD)**

The alkalinity in the water emanating from the ALD continues to be higher than background concentrations in Storys Creek as shown in Figure 3.1 which compares the May 04 results with previous monitoring runs and ‘background’ concentrations. All four sets of water quality results show that alkalinity in water from the ALD is 9 – 14 times greater than the ‘natural’ background in Storys Creek. This demonstrates the drain is continuing to impart alkalinity to the water and functioning well. Where and how the water is entering the underground workings is presently unclear, as the initial drain into the mine has blocked, resulting in the overflow of water from the channel. Although it appears that the water is continuing to enter the underground workings, as there is not a huge collection of water on the surface, it is unclear where the water is

entering. Cleaning out the initial drain would be advisable to maximise the benefit of the increased alkalinity on the production of acid drainage underground.

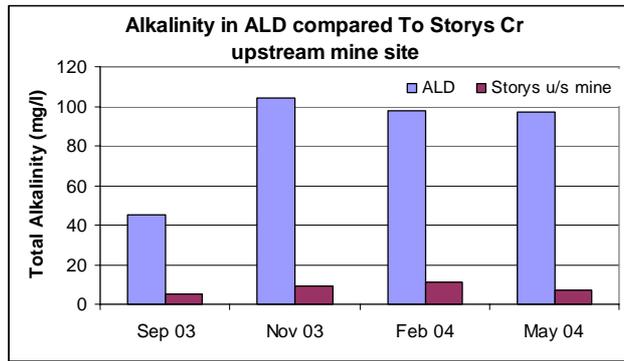


Figure 3.1. Alkalinity levels in water from the ALD compared to alkalinity levels in Storys Creek above the mine site.

Table 2. Water quality results and flow for Storys Creek monitoring, February 26, 2004. All units µg/L except Fluoride, Sulphate and Alkalinity, which are mg/l/

		Storys Ab Mine	Precip Dam Outflow	Storys Bel Precip	Storys Ab Side Cr	Storys Bel Side Cr	Storys Bel Nisbet	Storys at Manage r	Storys Ab Aber	Storys Bel Aber	Aber Ab Storys	S. Esk Ab Storys	S. Esk Bel Storys
<b>Date</b>		5 May04 0925	5 May04 1010	5 May04 1038	5 May04 1100	5 May04 1140	5 May04 1220	5 May04 1315	5 May04 1440	5 May04 1507	5 May04 1500	5 May04 1410	5 May04 1535
<b>Alkalinity Total</b>	mg/l CaCO <sub>3</sub>	7	12	7	7	3	4	3	1	8	29	24	23
<b>Fluoride</b>	mg/l	<0.02	1.3	0.04	0.09	0.57	0.36	0.29	0.29	0.46	1.1	0.02	0.06
<b>Sulphate</b>	mg/l	0.44	170	1.2	3.3	25	25	31	44	53	80	2.8	7.2
<b>Al Dis</b>	µg/l	22	24	22	81	97	<20	62	73	41	23	85	91
<b>Al Total</b>	µg/l	45	84	36	110	354	203	163	75	62	98	154	149
<b>As Dis</b>	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
<b>As Total</b>	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
<b>Cd Dis</b>	µg/l	<1	496	2	13	32	33	48	54	42	14	<1	3
<b>Cd Total</b>	µg/l	<1	497	2	14	33	34	49	55	43	15	<1	3
<b>Co Dis</b>	µg/l	<1	26	<1	<1	3	2	1	<1	<1	<1	<1	<1
<b>Co Total</b>	µg/l	<1	26	<1	<1	3	2	1	<1	<1	<1	<1	<1
<b>Cr Dis</b>	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<b>Cr Total</b>	µg/l	<1	<1	<1	13	<1	7	7	<1	<1	<1	<1	<1
<b>Cu Dis</b>	µg/l	<1	9	2	35	31	14	39	23	15	7	<1	1
<b>Cu Total</b>	µg/l	<1	12	2	40	50	41	58	25	18	8	<1	2
<b>Fe Dis</b>	µg/l	<20	<20	<20	31	<20	<20	<20	<20	<20	<20	201	214
<b>Fe Total</b>	µg/l	33	73	23	99	1280	627	301	29	39	<20	289	286
<b>Mn Dis</b>	µg/l	<5	2090	<5	15	287	177	118	38	26	<5	<5	<5
<b>Mn Total</b>	µg/l	<5	2090	<5	16	292	181	122	38	27	<5	<5	8
<b>Ni Dis</b>	µg/l	<1	46	<1	<1	5	4	4	3	3	2	<1	<1
<b>Ni Total</b>	µg/l	<1	46	<1	7	5	9	9	4	3	3	<1	1
<b>Pb Dis</b>	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
<b>Pb Total</b>	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
<b>Zn Dis</b>	µg/l	<1	16700	59	288	890	921	1230	1300	1040	419	<1	65
<b>Zn Total</b>	µg/l	2	16600	63	295	914	940	1270	1330	1060	429	<1	71
<b>Flow</b>	l/s	97	0.02	97	97	106	139	151	193	273	80		

Table 2 (continued)

		<b>ALD</b>	<b>SideCr</b>
<b>Date</b>		5 May 04 0925	May 04 1115
<b>Alkalinity Total</b>	mg/l CaCO <sub>3</sub>	97	<1
<b>Fluoride</b>	mg/l		4.7
<b>Sulphate</b>	mg/l		130
<b>Al Dis</b>	µg/l		4420
<b>Al Total</b>	µg/l		4390
<b>As Dis</b>	µg/l		<5
<b>As Total</b>	µg/l		<5
<b>Cd Dis</b>	µg/l		174
<b>Cd Total</b>	µg/l		172
<b>Co Dis</b>	µg/l		21
<b>Co Total</b>	µg/l		20
<b>Cr Dis</b>	µg/l		<1
<b>Cr Total</b>	µg/l		<1
<b>Cu Dis</b>	µg/l		398
<b>Cu Total</b>	µg/l		395
<b>Fe Dis</b>	µg/l		1490
<b>Fe Total</b>	µg/l		1520
<b>Mn Dis</b>	µg/l		1680
<b>Mn Total</b>	µg/l		1670
<b>Ni Dis</b>	µg/l		43
<b>Ni Total</b>	µg/l		43
<b>Pb Dis</b>	µg/l		<5
<b>Pb Total</b>	µg/l		<5
<b>Zn Dis</b>	µg/l		4940
<b>Zn Total</b>	µg/l		4900
<b>Flow</b>	l/s	0.5	0.5

Table 3. Flow, pH conductivity and temperature results collected in situ, 26 February 2004 and flux calculations based on flows and analytical results.

		Storys Ab Mine	Precip Dam Outflow	Storys Bel Precip	Storys Ab Side Cr	Storys Bel Side Cr	Storys Bel Nisbet	Storys at Manager	Storys Ab Aber	Storys Bel Aber	Aber Ab Storys	S. Esk Ab Storys	S. Esk Bel Storys
<b>Parameter</b>	Unit	5 May04 1010	5 May04 1030	5 May04 1038	5 May04 1100	5 May04 1140	5 May04 1220	5 May04 1315	5 May04 1440	5 May04 1507	5 May04 1500	5 May04 1410	5 May04 1535
<b>Flow</b>	l/s	97*	0.02	97	97*	106	139	151	193	273 <sup>#</sup>	80		
<b>pH (field)</b>	pH units	7.44	6.60	6.98	6.89	5.40	7.4	6.01	6.06	6.52	6.39	6.19	6.59
<b>Conductivity</b>	µS/cm	23.3	406	26.3	31.8	81.6	82.6	95.0	122.9	141.3	259	116.8	117.2
<b>Temp</b>	°C	5.0	3.9	5.0	5.5	6.1	6.7	7.2	6.5	7.9	10.1	8.9	8.8
<b>Zn tot flux</b>	kg/d	0.02	0.03	0.53	2.47	8.37	11.29	16.57	22.18	25.00	2.97		
<b>Cd tot flux</b>	kg/d	0.01	0.00	0.02	0.12	0.01	0.41	0.64	0.92	1.01	0.10		
<b>Mn tot flux</b>	kg/d	0.04	0.00	0.04	0.13	2.67	2.17	1.59	0.63	0.64	0.03		
<b>Fe tot flux</b>	kg/d	0.28	0.00	0.19	0.83	11.72	7.53	3.93	0.48	0.92	0.03		
<b>SO<sub>4</sub> flux</b>	kg/d	3.7	0.3	10.1	27.7	229.0	300	404	734	1250	553		

\*Flow estimate from Storys below Precip dam used.

<sup>#</sup>Calculated based on Storys above Aberfoyle & Aberfoyle above Storys

		ALD	Nisbet Cr	Side Creek	Eastern Adit
<b>Date</b>		5 May04 0925	5 May04 1210	5 May04 1115	5 May04 1230
<b>Flow</b>		0.5		0.5	<0.01
<b>pH (field)</b>	pH units	7.08	5.67	3.43	5.75
<b>Conductivity</b>	µS/cm	218	31.8	376	268
<b>Temperature</b>	°C	8.0	5.1	8.4	7.8

### **3.4 Metal concentrations in Storys Creek**

The results in Table 2 show that dissolved arsenic, chromium, iron, and lead levels are generally at or below detection levels, similar to previous runs. Dissolved chromium and nickel levels are also low except for the discharge from the Precipitate Dam, and the sites in Storys Creek immediately downstream.

Zinc and cadmium results for the Precipitate Dam, Storys below Side Creek and Storys at the Managers Residence are shown graphically in Figure 3.2. The graphs show that zinc and cadmium concentrations in the Precipitate Dam are similar to the two previous (low flow) monitoring runs.

Zinc and cadmium concentrations at Storys below Side Creek were lower in May 04 compared to the previous two monitoring runs, suggesting that the higher river flows were diluting zinc levels. However, zinc concentrations at the Managers Residence in May were similar to the two previous low-flow results. This is unusual in that zinc and cadmium concentrations have tended to decrease between the ‘Storys below Side Creek’ site and ‘Managers Site’ due to dilution provided by Nisbet Creek. In May 04, the concentrations actually increased between these two sites. The sulphate results showed the same trend, with values increasing downstream, rather than decreasing as in previous monitoring runs.

Figure 3.4 contains a graphical comparison of total zinc values in Storys Creek over the past four monitoring runs. In the September 03, November 03, and February 04 data, the Storys below Side Creek zinc value is the highest, with concentrations decreasing downstream, presumably due to the inflow of low zinc water. In May 04, zinc concentrations increased downstream, with the highest concentration recorded at Storys above Aberfoyle. This indicates that there were additional zinc sources to the river downstream of the mine site in May 04. A similar trend is evident with the cadmium and sulphate results, as shown in Figure 3.5.

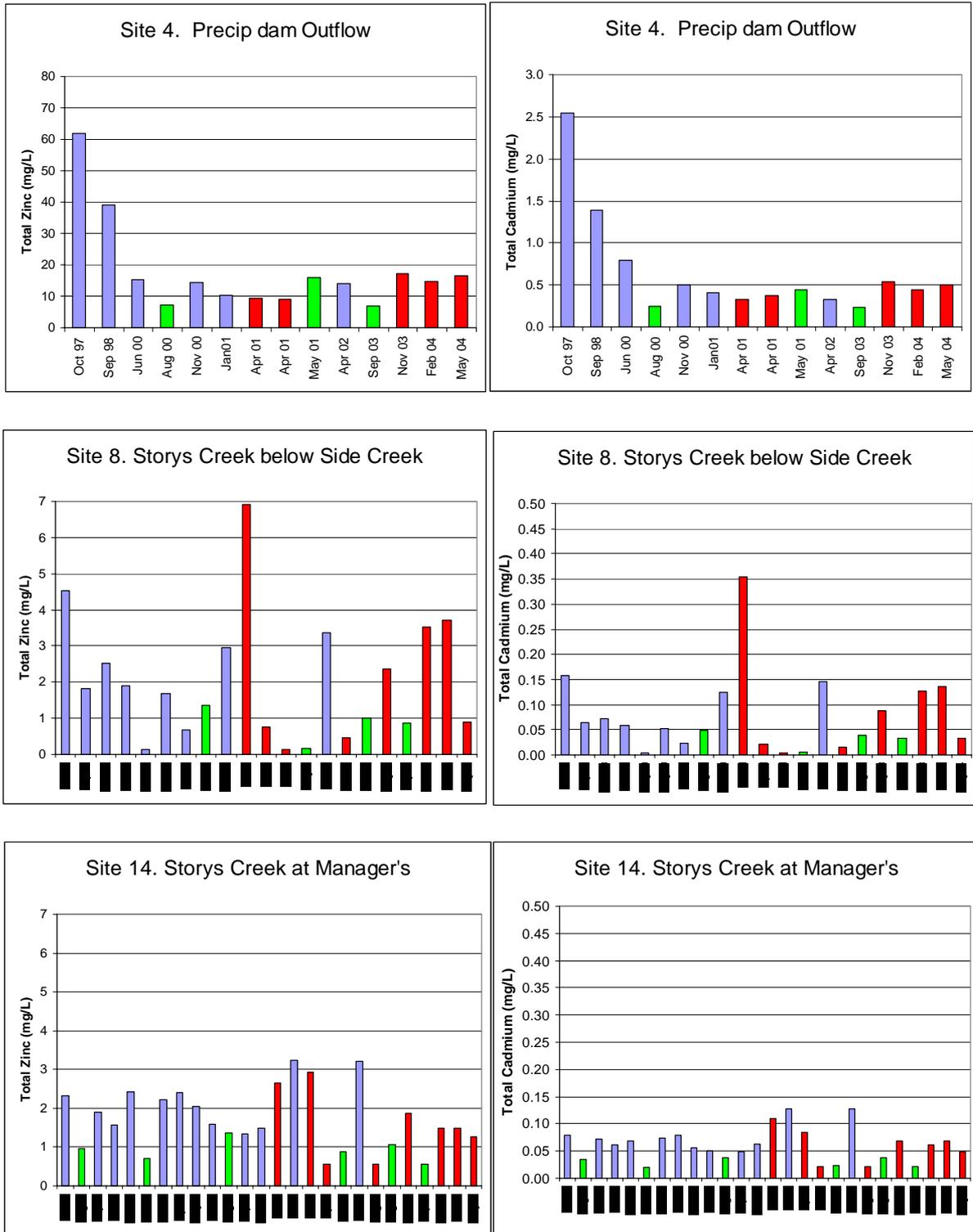


Figure 3.2 . Total zinc (left) and total cadmium (right) graphs comparing the February 2004 results with previous monitoring results. Red bars denote low flow (250 L/s), blue bars denote medium flows (250 – 350 L/s), and green bars denote high flow (>350 L/s). Note different scale for the Precipitate dam results.

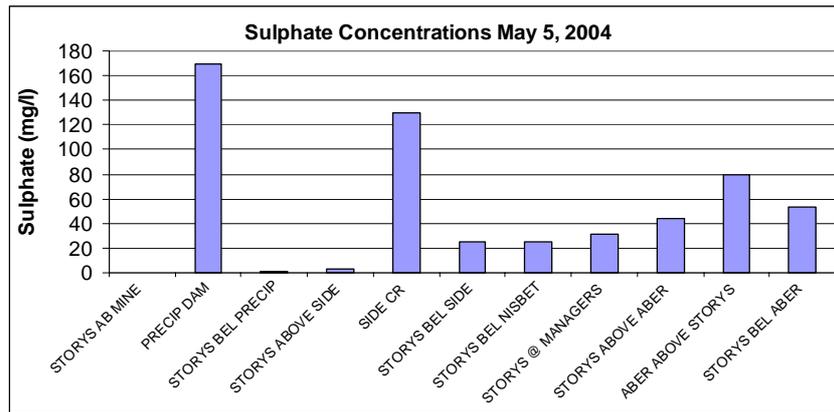


Figure 3.3. Sulphate concentrations at all monitoring sites on May 05, 2004.

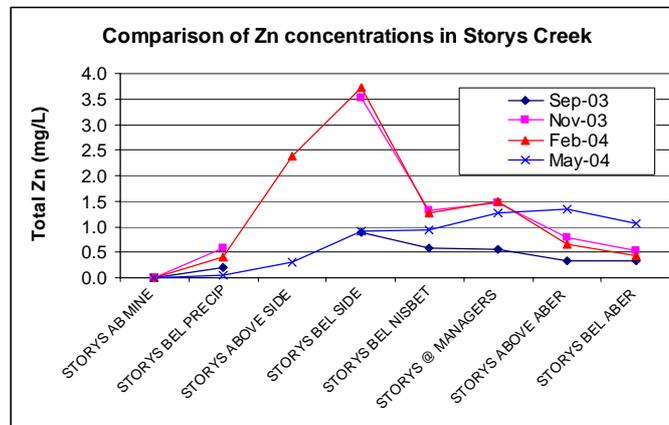


Figure 3.4. Comparison of zinc concentrations downstream in Storys Creek during the previous 4 sampling runs.

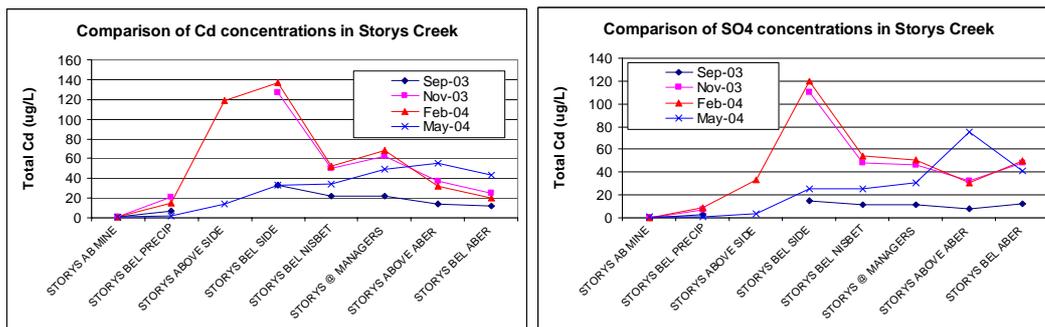


Figure 3.5. Comparison of total cadmium (left) and sulphate (right) concentrations downstream in Storys Creek during the previous 4 sampling runs.

The source of the zinc, cadmium and sulphate is unknown, although it could be attributable to the redistribution of metal bearing tailings and sediment during the large flood event in January 2004 in both the upper and lower river. This is discussed in Section 3.6, *Composition of flood deposited sediments*.

The relatively high zinc concentration in lower Storys Creek, combined with the zinc input from Aberfoyle Creek resulted in a large increase in zinc concentrations in the South Esk River, from <1 µg/l in the South Esk upstream of Storys Creek to 71 µg/l total zinc (65 µg/l dissolved zinc) in the South Esk below Storys Creek. This is the largest increase detected to date, with previous runs showing increases of less than 40µg/l. The dissolved zinc value of 65 µg/l downstream of Storys Creek is well in excess of the ANZECC (2002) zinc guideline value of 8 – 15 µg/l for modified ecosystems. None of the other measured parameters show a notable increase in the South Esk downstream of the confluence with Storys Creek.

### 3.5 Water quality – fluxes

Using the flow estimates and water quality results, fluxes for zinc, cadmium, iron, manganese and sulphate were determined, and are presented in Table 3, and graphically in Figure 3.6 and Figure 3.8. Figure 3.6 also contains flux estimates from February 2004 for comparison.

Figure 3.6 shows that in May 2004 the majority of zinc attributable to the mine site entered in the Side Creek area, with fluxes increasing down the length of the creek, reaching a maximum at the ‘Storys above Aberfoyle’ site. This is in sharp contrast with previous monitoring results, as shown by the comparison with February 2004 results, where zinc fluxes decrease downstream of the ‘Manager’s Residence’ site. Figure 3.6 shows that zinc fluxes were similar at the ‘Storys below Side Creek’ site in both February and May, indicating that the mine workings upstream of this site were contributing similar load to the river on each occasion, about 8kg zinc per day. In February this load remained relatively constant to the ‘Managers Residence’ site and then decreased downstream. In May, the zinc load doubled between the ‘Below Side Creek’ site and the ‘Managers’ site, and then increased by another 8 kg/day at the ‘Storys above Aberfoyle’ site.

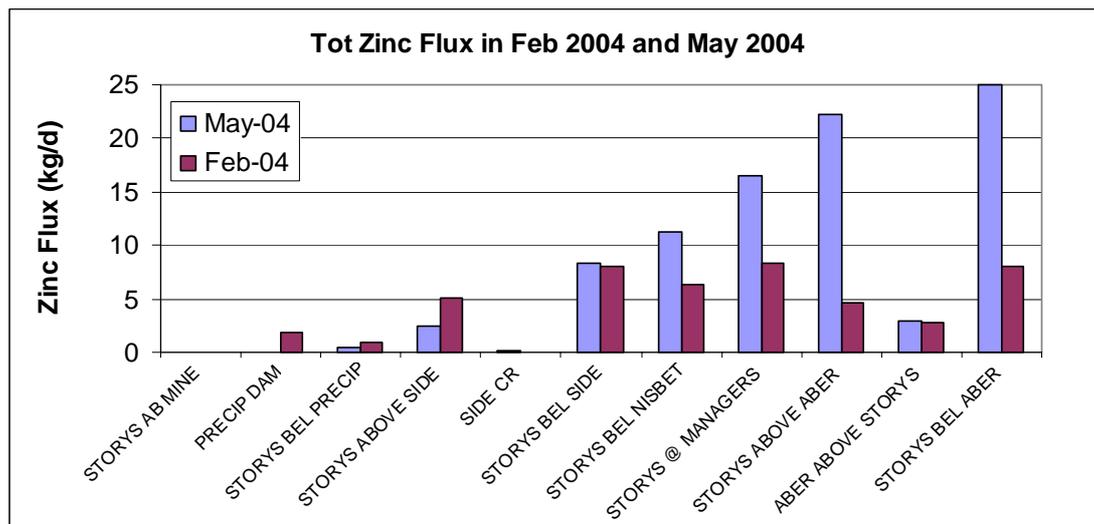


Figure 3.6. Total zinc fluxes for sites in Storys Creek, May 2004.

Previous monitoring had found a fairly consistent input from Aberfoyle Creek to lower Storys Creek, generally equivalent to ~50% of the ‘Storys Creek above

Aberfoyle’ input. In May 2004, the contribution from Aberfoyle Creek was similar in magnitude to February 2004, ~3 kg/day, but comprised <15% of the total load compared to the 22 kg/day zinc entering via Storys. The input from the mine site and Aberfoyle Creek in May are consistent with previous monitoring, with the input downstream of the mine site accounting for the large increase in zinc fluxes in Storys Creek.

Cadmium and sulphate fluxes show similar trends, with the fluxes increasing downstream of the ‘Managers Residence’ site in May 04 (Figure 3.7). The sulphate fluxes are especially interesting because previously, Aberfoyle Creek had contributed the majority of the sulphate to lower Storys Creek, whereas in May 2004, Storys Creek contributed ~700 kg/day as compared to 550 kg/day from Aberfoyle Creek.

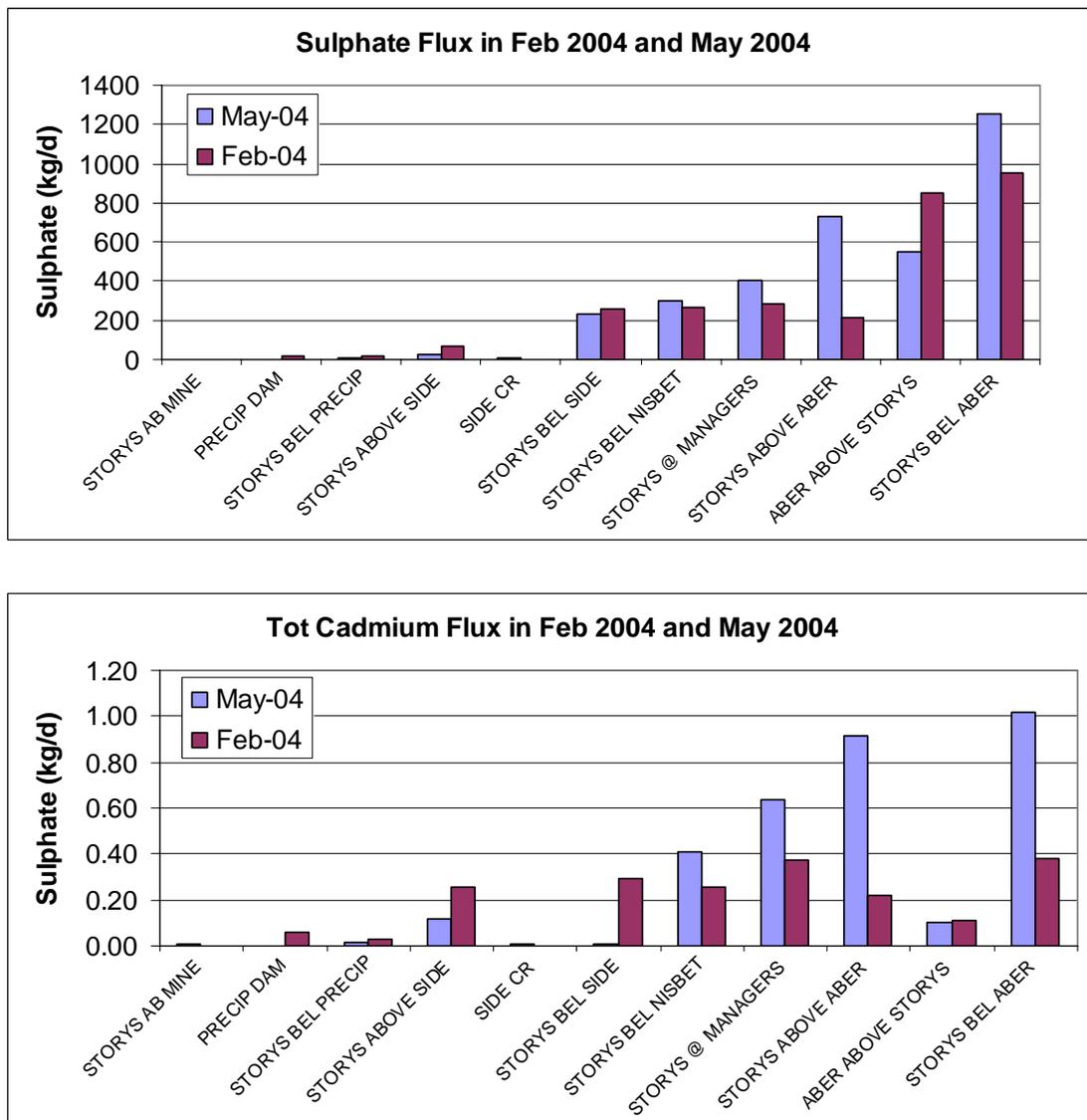


Figure 3.7. comparison of sulphate (top) and cadmium (bottom) fluxes in Storys Creek in February 2004 and May 2004.

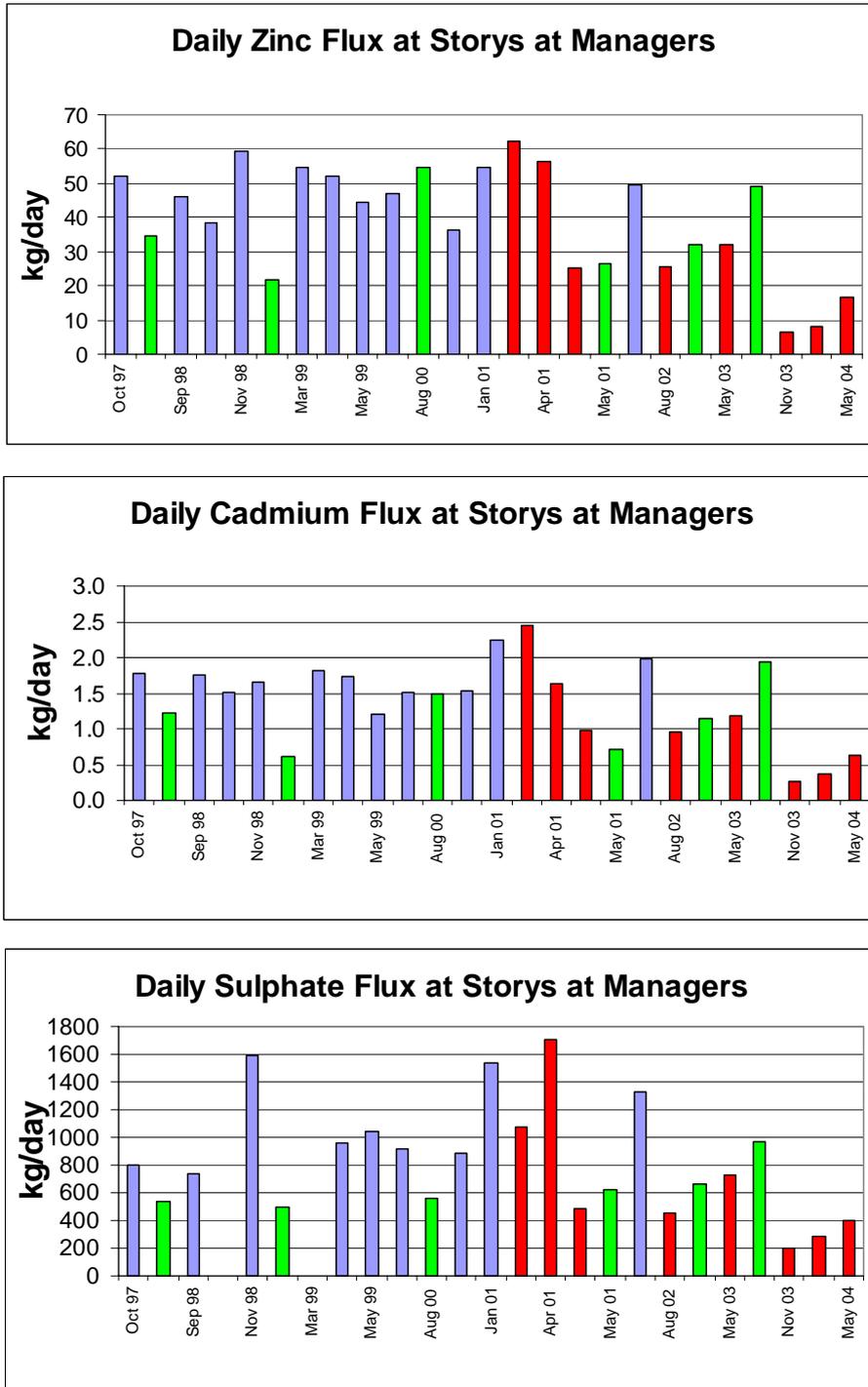


Figure 3.8. Daily total zinc, total cadmium and sulphate fluxes at Managers Site. Red denotes low flow (<250 l/s); blue denotes moderate flow (250 -350 l/s) and green denotes high flow (>350 l/s)

Figure 3.8 shows that in May, the cadmium and sulphate fluxes at the ‘Managers Residence’ were higher than during the previous two low-flow monitoring runs, but substantially less than the fluxes recorded in September 2003 during a high flow event.

### **3.6 Composition of flood deposited sediments**

Near the mine site in Storys Creek the January 2004 flood scoured and reworked large volumes of sediment from the banks near the mine site, especially near the base of the tailings deposits. Fine grained (silts and sands) deposits were common downstream of the mine site, especially in the vicinity of the Managers' Residence where the slope of the river decreases.

Downstream of Side Creek was another section of the river which was substantially reworked by the flood waters, as shown in Photos 3 and 4 taken below Nisbet Creek in September 2003 and May 2004, respectively. Photo 3, shows that prior to the large flood, the flow was confined to one channel. Following the January flood (Photo 4) the channel is less confined, and more braided. The reworking of the sediments by the flood resulted in the transport of fine grained material downstream, and exposed additional 'fresh' material to the river water.

This reworking of the channel and transport of sediment downstream is likely to account for the increased zinc, cadmium and sulphate concentrations downstream of the Managers Residence in May 2004 with the higher flows in May directly inundating some of the recently deposited material, and rainfall leaching material deposited higher on the banks.. The additional metals were not evident in the February 2004 monitoring run because flows were too low to contact the newly exposed sediment with river flow, and there was no rain to transport metals released from sediments on the banks.

This hypothesis is supported by the composition of fine sediment collected from Storys Creek at the Managers Residence and Storys Creek above Aberfoyle Creek in February 2004, following the flood. The material was present as overbank deposits on point bars in the river. The sediments appeared to be recently deposited and were undisturbed. Mineral Resources Tasmania separated the samples into sand (>63µm) and silt and clay (<63 µm) and analysed the material for major and minor constituents.

MRT found that the sediments contained predominately silica, aluminium and iron, consistent with being derived from the granitic hills in the catchment. Table 4 contains the metal and sulphur results from the samples, and shows that they are enriched with metals with respect to typical silicate rocks in both the sand and silt size classes.

**Table 4. Composition of sediments deposited during January 2004 large flood event.**

Site	Size Fraction	Zinc mg/kg	Cadmium mg/kg	Copper mg/kg	Arsenic mg/kg	Sulphur Wt %
Storys Cr at Managers 1	>63µm	840	29	360	67	0.2
Storys Cr at Managers 1	<63 µm	1400	51	720	100	0.3
Storys Cr at Managers 2	>63µm	1050	41	500	54	0.1
Storys Cr at Managers 2	<63 µm	980	33	480	79	0.2
Storys Cr upstream confluence with Aberfoyle Cr	>63µm	710	21	260	30	0.1
Storys Cr upstream confluence with Aberfoyle Cr	<63 µm	1250	49	460	58	0.2
Typical silicate rocks		<200	<1	<50	<5	

Although all the metals in Table 4 are elevated, only cadmium and zinc were found to be consistently higher than previous monitoring runs in lower Storys Creek. Arsenic values in the creek were <1 µg/l, and copper values, although elevated, were within the range of previous monitoring runs.

It is also possible that the January flood flushed any remaining limestone sand (deposited during the remediation works) from the river channel. Whilst this may be a contributing factor in the area of the mine site, it is unlikely to account for the additional inputs below the Managers residence because no limestone was deposited in this area, and historically, there have not been large inputs below this point in the river.





**Photo 3 and Photo 4. Downstream view of Storys Creek below Nisbet Creek in September 2003 (top) and May 2004 (bottom) showing the reworking of the river channel.**

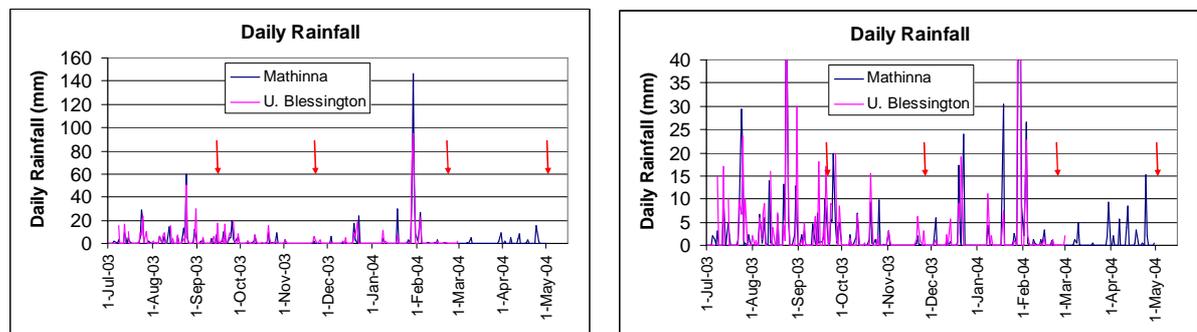
## 4 Overview of year 1 findings

Four monitoring runs have been completed during the first financial year of the Storys Creek monitoring program. This section summarises the water quality findings to date.

Daily rainfall totals beginning in July 2003 are shown in Figure 4.1 for Mathinna and Upper Blessington. These sites are in the vicinity of Storys Creek and display similar rainfall patterns to the Storys Creek catchment, with Upper Blessington the most similar. This assessment is based on a comparison of historic rainfall records completed by the Bureau of Meteorology in Hobart. In Figure 4.1 the left graph shows rainfall totals, with the right graph showing an enlargement of the 0 – 40 mm/day portion of the record. The red arrows indicate when water quality monitoring occurred in the catchment. Unfortunately, the records are currently only available through April 04 for Mathinna and May 04 for Upper Blessington, so there is no record for the few days between the end of April and the May 5<sup>th</sup> monitoring run.

The rainfall record includes a very high rainfall event in late January 2004, where over a two day period ~200 mm of rain fell at Mathinna and 140 mm at Upper Blessington. This event resulted in a 1 in fifty year flood event in some rivers in north eastern Tasmania, and a 1 in five year flood in rivers along the central east coast (DPIWE, 2004). The South Esk experienced extensive flooding, with the bridges both upstream and downstream of Storys Creek inundated.

The arrows show that water quality monitoring occurred during a wet period in September 2003, very dry periods in November 2003 and February 2004, and following wetter conditions in May 2004.



**Figure 4.1. Daily rainfall at Mathinna and Upper Blessington from 1 July 03 – 28 Feb 04 (Mathinna) and 30 April 04 (U. Blessington). Graph on right shows 0 – 40 mm portion of data in more detail. Red arrows indicate sampling dates. Data from Bureau of Meteorology.**

The following dot points summarise the findings of each of the monitoring runs:

- September 2003: Monitoring was completed under higher flows (~1000 l/s at Managers Residence) compared to any of the previous monitoring runs completed by Meidecke (1998, 2000). Zinc and other metal fluxes were similar to previous high flow monitoring results (Zinc ~50 kg/day, Figure 3.6).

Zinc inputs were greatest between the mine workings and below Side Creek, with zinc fluxes decreasing below the ‘Managers Residence’ site (Figure 4.2). Zinc concentrations in the South Esk were increased by about 30 µg/l due to the input of Storys Creek;

- November 2003 and February 2004: These runs were completed under very dry, low flow conditions (~50 l/s at Managers Residence) and returned very similar results. Zinc and other metal fluxes were low, with maximum fluxes (~5 kg/day) occurring at the Managers Residence site, a pattern similar to September. The impact of the zinc in Storys Creek and Aberfoyle Creek was to increase zinc values in the South Esk by about 30 µg/l in November, and 12 µg/l in February;
- May 2004: Monitoring was completed under slightly higher flow conditions (~150 l/s at Managers Residence), although still relatively low compared to historic flow data. Zinc fluxes from the mine site were similar in magnitude to the low flow monitoring runs, however, zinc fluxes increased downstream with the maximum occurring at the ‘Storys above Aberfoyle site’ (zinc~20 kg/day, Figure 4.2). The source of the metals in the lower river is most likely the fine grained sediments and tailings that were transported from upstream and deposited downstream during the large flow event in late January. Fresh material was also exposed throughout the length of the river due to the reworking of the channel during the flood. The additional inputs of zinc in the lower river increased the relative discharge of zinc in Storys Creek as compared to Aberfoyle Creek. During the previous three runs, Aberfoyle had contributed about half as much zinc as Storys to the lower river, whereas in May, Aberfoyle only contributed about 15% of the load of ‘Storys above Aberfoyle Creek’. The impact of the zinc on the South Esk River was to increase total zinc concentrations from <1 µg/l to 70µg/l.

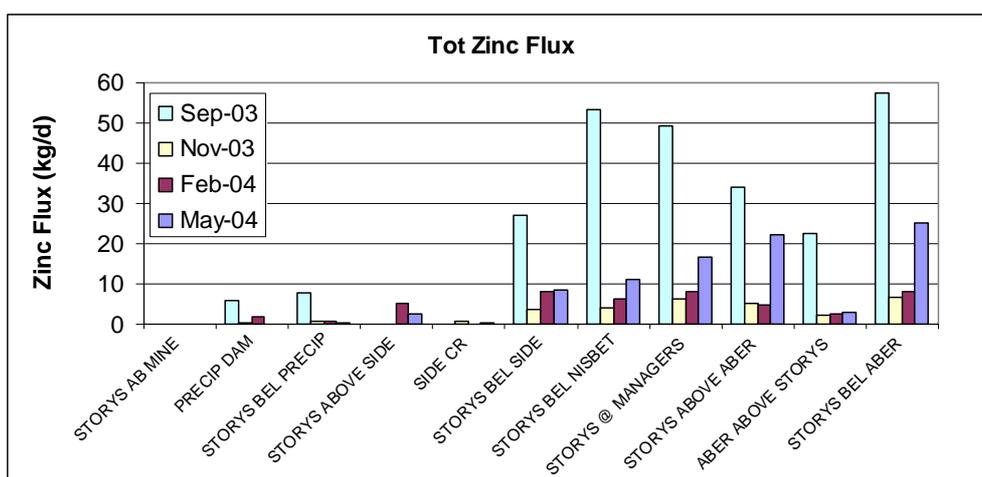


Figure 4.2. Summary of total zinc fluxes in Storys Creek during the four monitoring runs completed since September 2003.

#### 4.1 Impact of remediation works

Compared to pre-September 2003 monitoring, zinc fluxes from low flows have decreased since implementation of the remediation works (Figure 3.8), with all three

monitoring runs completed under low flows recording similar fluxes in the upper catchment near the mine site (Figure 4.2). The high flow monitoring in September, however, documented little change compared to pre-remediation fluxes.

These findings suggest that remediation works have successfully reduced metal release into the river during base flow conditions (Figure 3.8). It is likely that the removal of the precipitate dam, and plugging of adits have contributed to this decline, along with the input of alkalinity to the underground workings. It is unlikely the removal of a portion of the tailings deposits has greatly affected the base flow component, as groundwater does not flow through the majority of the tailings.

At high flows, metal transport into the river continues to occur, most likely due to the combined input of the tailings deposit at the mine site, and the tailings and sediment resident in the river channel. The increased fluxes downstream of the 'Managers Residence' site combined with the presence of high metal containing sediments supports this hypothesis. In May, the sediments resident in the river channel appear to have been a more significant source of metal to the river than the mine site. Subsequent monitoring will identify how long the in-stream sediments continue to contribute to metal fluxes in the river.

#### **4.2 Future monitoring**

An additional four monitoring runs will be completed in the 2004 / 2005 financial year. It is recommended that these runs focus on periods of medium to high flow so the relative contribution of metals from tailings deposit and from sediments and tailings in the river channel can be further quantified.

## References

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