MINERAL RESOURCES TASMANIA

# STORYS CREEK
# ACID DRAINAGE REMEDIATION

## REPORT ON REMEDIATION WORKS
## AUTUMN 2000

## JULY 2000



John Miedecke and Partners Pty Ltd • July 2000

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# 1.0 INTRODUCTION

The Storys Creek/Rossarden remediation project is a cooperative project between Mineral Resources Tasmania (MRT), the Department of the Primary Industry Water and Environment (DPIWE) and the Commonwealth Department of the Environment. The aim is to design and implement a remediation strategy for the Storys Creek and Rossarden abandoned mine sites to reduce acid and heavy metal discharge into the South Esk River system.

Mineral Resources Tasmania is supervising the acid drainage remediation works at the old abandoned mine workings at Storys Creek and Rossarden. The remediation works are being funded by the State Government though the Rehabilitation of Mining Lands Trust. The Commonwealth through Riverworks Tasmania funded the investigations and trials.

The aim is to design and implement a remediation strategy for the Storys Creek and Rossarden abandoned mine sites to reduce acid and heavy metal discharge into the South Esk River system.

Figure 1 shows the location of the study area and major catchments.

An interim data report was completed and submitted in September 1997 (John Miedecke and Partners Pty Ltd, (JMP) 1997) and a Preliminary Report in March 1998 (JMP, 1998). The Preliminary Report has been followed by on site trials and the Final Report contained the results of the trials and recommendations on the remediation of the study area has been completed (JMP 2000a). The summary of the report is included in Appendix A. The investigations and trials were funded by the Commonwealth through Riverworks Tasmania.

In summer and autumn of this year (2000) large scale remediation works were completed.

This report describes the works carried out and includes preliminary recommendations for ongoing remediation.

# 2.0 POLLUTION SOURCES AND LOADS

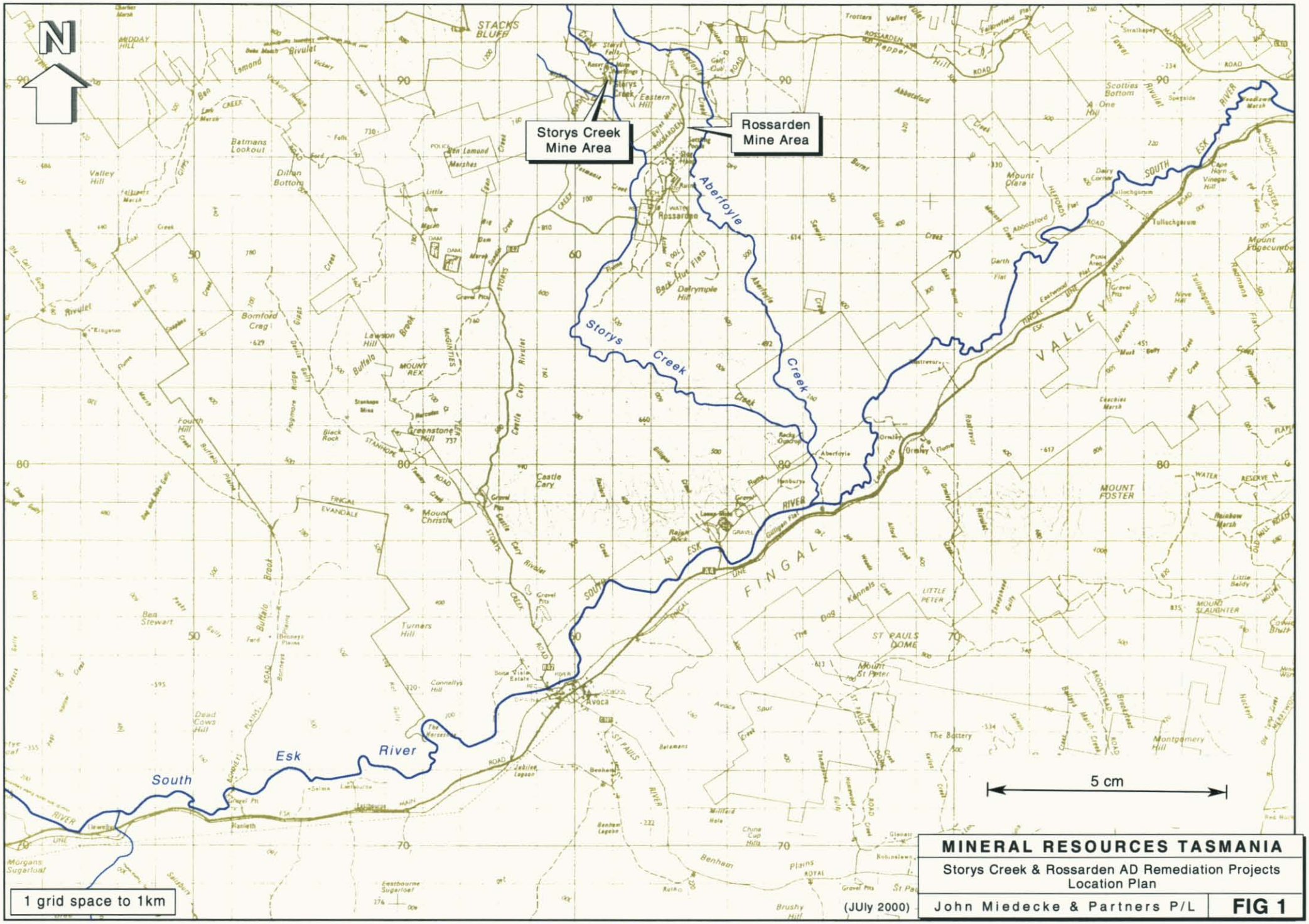
## 2.1 Storys Creek Catchment Loads

The Storys Creek catchment comprises the main acid drainage sources and contributes over 70% of the total Zn, Cd and Cu loads and most of the acidity to the South Esk River.

Figure 2 shows the estimated pollutant loads in Storys Creek as the % of the loads at Rossarden.

Most of the loads are above Rossarden, and therefore contribute most of the loads from the study area.

A review of water quality indicated that there is an improving trend. This was partly attributed to a reduction in the overall oxidation rate as physically stable oxidation profiles develop over time in the creek-bank deposited tailings.

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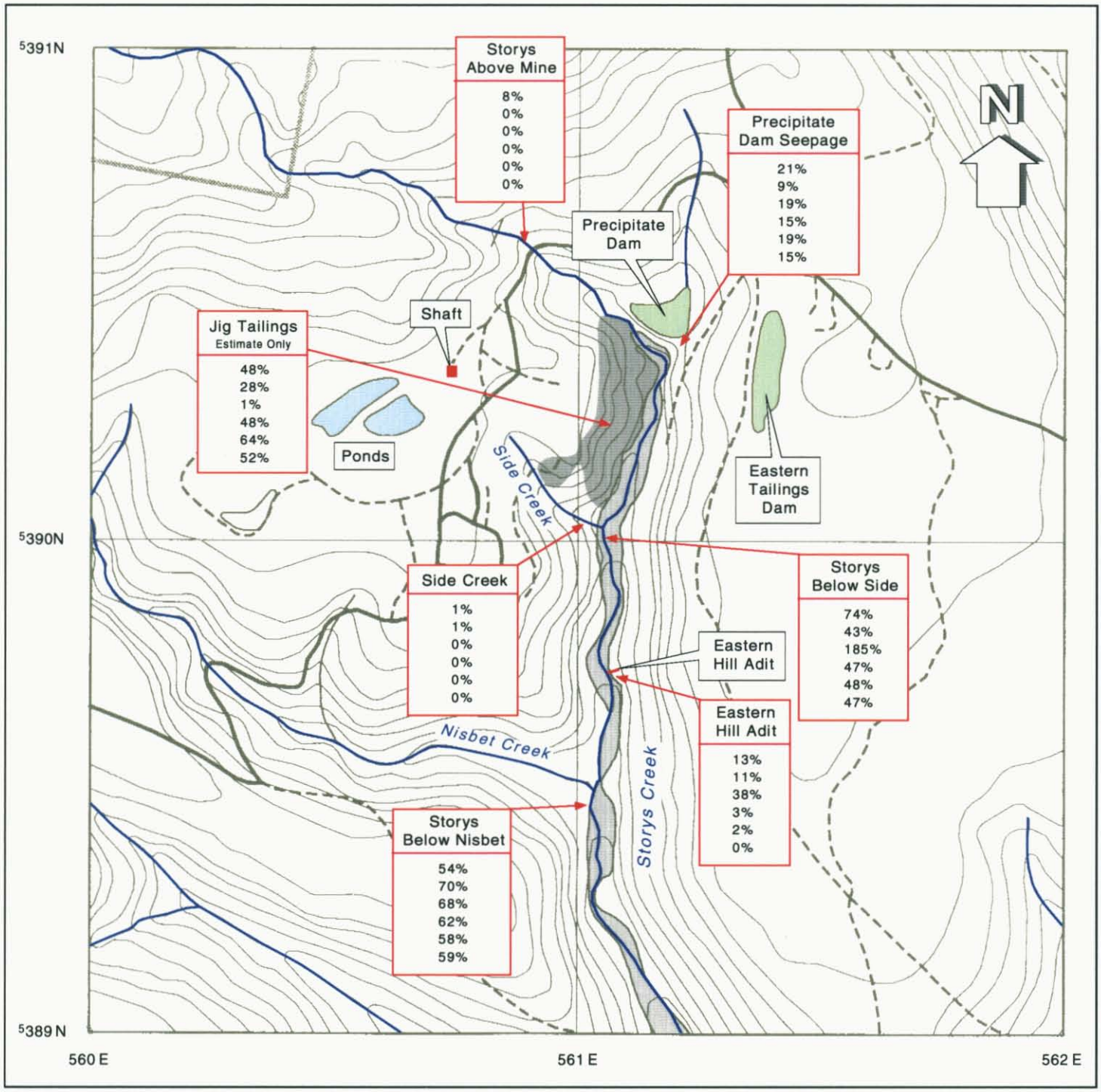
Storys Creek & Rossarden AD Remediation Projects
Location Plan

John Miedecke & Partners P/L

**FIG 1**




1 grid space to 1km

| Storys Below Rossarden |
|---|
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |

Legend

- Acidity
- $SO_4$
- Fe
- Zn
- Cd
- Cu

5 cm

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Storys Creek & Rossarden AD Remediation Projects
Storys Creek -Sources & Loads
(% of loads in Storys Creek at Rossarden)

John Miedecke & Partners P/L

**FIG 2**

(July 2000))

The data shows that the major metal loads are from seepage from the Jig Tailings, the Precipitate Dam and from the materials deposited in the creek. The trials and investigations have identified that the Jig Tailings – both the existing dumps on the edge of the creek, and the large amounts of material which is now incorporated in the creek banks and floor, are a major pollutant source. They contribute high loads of acidity, sulphate and metals.

Drainage from the Jig Tailings on the slopes above the creek near the mine were identified as the single biggest identified source of contaminants albeit a diffuse source after rainfall.

The data indicates that the deposited tailings in Storys Creek contribute about 280 kgSO4/day, while the Storys mine site (ie Storys Creek below the mine) contributes approximately 200 kgSO4/day. Of the mine site sources, approximately 66% are from the Jig Tailings.

It is estimated that the area of deposited tailings in the creek deposits is about 17ha, and therefore the sulphate release rate is about 16 kgSO4/day.

The acidity data indicated that the introduction of systems to provide alkalinity could be highly effective in ameliorating the residual acid drainage impacts in the Storys Creek catchment. Treatment of point sources would also have beneficial effects.

The main sources are discussed below and are shown in Figures 2 and 3.

## 2.2 Storys Creek Catchment Sources

### 2.2.1 Precipitate Dam

Leachates from the Precipitate Dam have been identified as the major point source of acidity and metals (approximately 20%) of loads in Storys Creek.

It was concluded that the previous remedial works (capping) has been largely ineffective in reducing infiltration, but may have had beneficial effects on surface runoff quality.

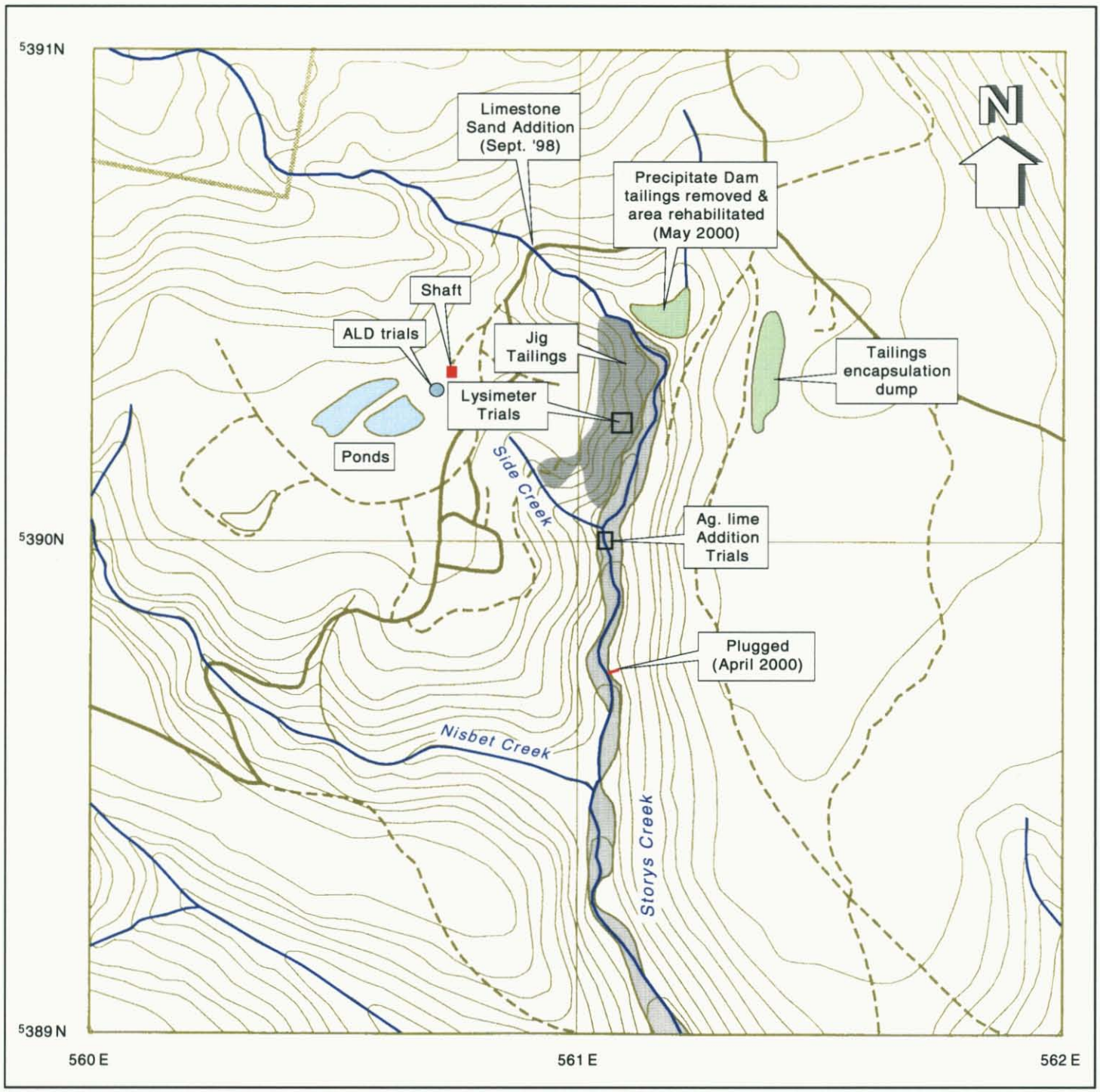
The contents of this dam were relocated to a new disposal site in the summer of 1999 and 2000 where the tailings were treated with lime, compacted and encapsulated in a dump. These works are reported in a report by John Miedecke and Partners (JMP 2000b).

### 2.2.2 Jig Tailings

Large quantities of jig tailings have been deposited on the slopes of Storys Creek near the mine (see photographs). The quantities are estimated to be approximately 50,000 cubic metres.

The load calculations indicate that the Jig Tailings are the major source of contamination to Storys Creek.

Laboratory trials using jig tailings and large scale lysimeter trials demonstrated that the addition of alkalinity can significantly reduce the contaminant loads, but that removal and encapsulation was the only long term solution.




1 grid space to 1km

5 cm

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Storys Creek & Rossarden AD Remediation Projects
Remediation Works - Storys Creek Mine Area

John Miedecke & Partners P/L | **FIG 3**

(July 2000)

A trial removal of approximately 2000m3 was conducted in May 2000.

The proposed design is contained in a report by John Miedecke and Partners (JMP, 2000c).

### 2.2.3 Side Creek Adits (Story Mine)

The Side Creek Adit discharges have generally been low in flows and were not evident during the study period. It was concluded that the works in Storys Creek creek bed have resulted in affects on the groundwater regime, and that mine drainage from the abandoned mine workings are now expressing themselves as subsurface discharges to the creek bed, rather than obvious surface flows.

It was therefore not possible to quantify the loads, but these are still expected to be significant.

A trial anoxic limestone drain (ALD) system was constructed in1999 and was successful in generating significant alkalinity in clean waters. A design for a large scale ALD is contained in a report by John Miedecke and Partners (JMP, 2000d).

### 2.2.4 Creek Bed and Bank Deposits

The creek has a long history of disturbance and transport of mine waste materials, being disturbed by past alluvial mining, massive flooding and various tailings and mine water discharges. The majority of waste materials are deposited in the stream bed between the mine and Rossarden township. The water quality data indicates that the major metal inputs occur prior to Rossarden.

Investigations confirmed that a major source of contaminants in Storys Creek was from these waters contained in the bank deposits and sediments. As the creek rises and falls, a significant flux of metals is expected to be released into the creek waters.

The laboratory and creek bank trials, plus the jig tailings lysimeter tests also confirmed that the coarser jig tailings materials sourced from the eroding jig tails adjoining the creek are the major source of contamination.

### 2.2.5 Eastern Hill Adit

The Adit contributed significant metal loads to Storys Creek (mainly Fe) and the constructed wetlands are having no beneficial effects on water quality.

The adit was plugged in April 2000. These works are reported in a report by John Miedecke and Partners (JMP 2000b).

# 3.0 REMEDIATION TRIALS

## 3.1 Background

The acidity data indicated that the introduction of systems to provide alkalinity could be highly effective in ameliorating the residual acid drainage

impacts in the Storys Creek catchment. Treatment of point sources would also have beneficial effects.

Following recommendations in the Preliminary Report (JMP 1998) a series of onsite trials were conducted at Storys Creek. These are reported in JMP 2000a and are summarized below.

## 3.2 Remediation Trials

The trials evaluated the feasibility of remediation options at various sites (refer Figure 3). The trials were concentrated on the Storys Creek mine area, as this was the major source of contaminants and investigated methods of alkalinity addition. These trials concentrated on methods of adding alkalinity to the ground and surface waters and to acid generating sources to reduce oxidation and neutralise and precipitate released metals at the source.

They consisted of:

- limestone sand addition to Storys Creek;
- construction of an trial anoxic limestone drain; and
- crushed limestone application to jig tailings and tailings deposits.

The poor water quality data base was expanded by site specific monitoring to establish effectiveness of the trials.

All trials demonstrated that alkalinity addition is both feasible and effective.

# 4.0 REMEDIATION WORKS

## 4.1 Background

Based on the review of the water quality data and the results of the trials, it was apparent that the mine rocks and waste materials are essentially devoid of any acid neutralising capacity. The water in Storys Creek above the mine also contains very little buffering capacity. As a result, even a small acid input from the mine site lowers the pH sufficiently and any released metals from the site will remain mobile.

Pollutant loads, including acidity, are generally low and are amenable to alkalinity addition to buffer acid drainage for the non point sources, raise pH, remove metals from solution and precipitate metals in the creek bed as colloids and precipitates. Some point sources are amenable to encapsulation and blocking.

Specific recommendations made in the Final Report (JMP2000a) were:

- periodic limestone sand addition to Storys Creek flows to raise the pH of the waters;
- Precipitate Dam relocation and encapsulation;
- alkalinity addition to the Storys Creek mine workings by the construction of an anoxic limestone drain upstream;

- removal and encapsulation of the jig tailings (with a short term remediation by crushed limestone addition to the surface);
- application of crushed limestone to tailings deposits on the creek banks;
- blocking of Eastern Hill Adit ;
- works to reduce infiltration to the Rossarden mine workings.

The addition of limestone sands was deferred to allow the monitoring of the effectiveness of the creek bank limestone addition. Access roads were constructed to allow periodic limestone addition. These are discussed in Section 4.2.

The Precipitate Dam tailings were removed and the contents encapsulated in a new dump and the site was rehabilitated. The Eastern Hill adit was blocked. These works are reported in JMP 2000b.

A design study was completed for a large scale anoxic limestone drain to generate alkalinity addition to the Storys Creek mine workings These works are reported in JMP 2000d

A design study was completed for the removal and encapsulation of the jig tailings. These works are reported in JMP 2000c. Crushed limestone was applied to the surface of the tailings. This is discussed in Section 4.3.

Crushed limestone was applied to tailings deposits on the creek banks between Rossarden and Storys Creek. This is discussed in Section 4.4

Drainage works to reduce infiltration to the Rossarden mine workings were carried out. These are discussed in Section 4.5.

## 4.2 Storys Creek Alkalinity Addition Access Roads

The trial addition of 240 tonnes in 1998 was successful in improving water quality in Storys Creek.

No further limestone sand additions were made as it was decided to monitor the effectiveness of the creek bank treatment.

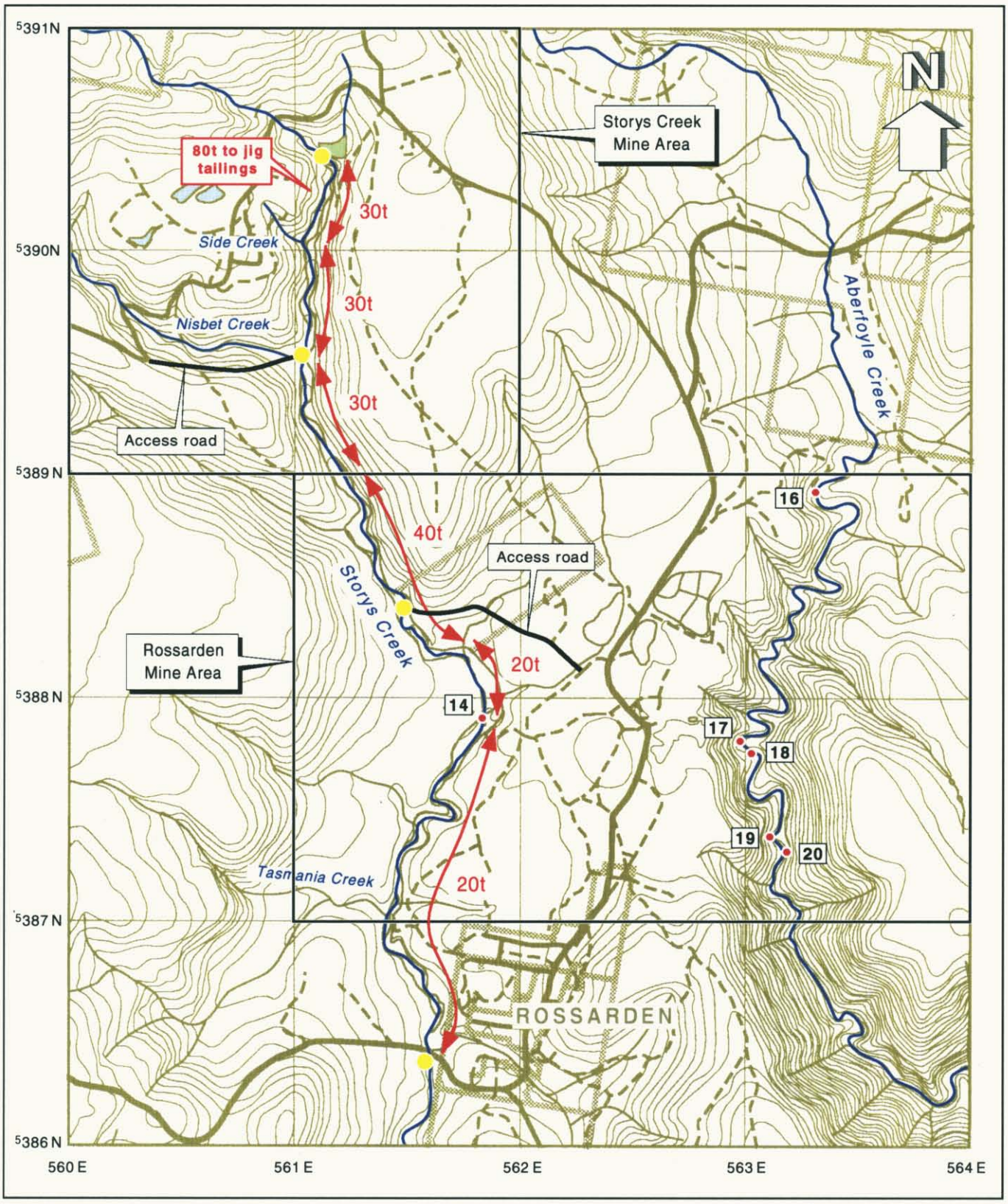
Access roads were constructed to the creek at the following locations:

- Near the Precipitate Dam:
- Nisbett Creek;
- Above Station 14; and
- Rossarden Bridge.

The location of these roads is shown in Figure 4. These were also used for access for the limestone spreading on the Creek banks and are now available for periodic limestone sand addition direct to the creek.

## 4.3 Crushed Limestone Addition to Jig Tailings

A dozer was used to construct access roads over the surface of the Jig Tailings dumps. (see Figures 3 and 4).




1 grid space to 1km

- 14. Storys below mine managers residence
- Limestone addition point
- Crushed limestone added to stream banks (tonnes)

5 cm

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Storys Creek & Rossarden AD Remediation Projects
Access Roads & Limestone Addition

John Miedecke & Partners P/L | **FIG 4**

(July 2000)

Eighty (80) tonnes of limestone was applied over accessible parts of the dump by a MAN fertiliser spreader. As this machine was only capable of spreading a distance of 6 to 7 metres each side of the truck and to the rear, some areas could not be treated.

## 4.4 Crushed Limestone to Stream Bank Deposits

A dozer was used to construct access roads over the surface of the creek banks and in the base of the Creek from the Rossarden Bridge to Storys Creek.

A total of 170 tonnes of limestone was applied over accessible areas by a MAN fertiliser spreader (see Figure 4). Most areas were treated, however some were impractical to treat because of access and topography.

It was noted that the major Jig Tailings deposits in the creek itself, as expected, were located between Storys creek and Station 14. It may be practical to remove these materials and encapsulate them at the existing dump site.

## 4.5 Rossarden Mine Area Drainage Diversion

Drainage works to reduce infiltration to the Rossarden mine workings were carried out near the Rossarden water supply dams. The main area of infiltration the workings has been identified as near the main shaft ( refer Figure 5).

Bedrock in the area is only covered by a shallow clay layer and infiltration through the exposed bedrock is suspected.

It had been noted that the embankments of the water supply dam were leaking and seepage was ponding in channels around the embankments. A channel was excavated to drain the area and the channel on the eastern side excavated and backfilled with clay to provide free draining and cover bedrock (see Photographs). Excavated materials were used to construct a wetland in the Precipitate Dam area.

# 5.0 WATER QUALITY MONITORING

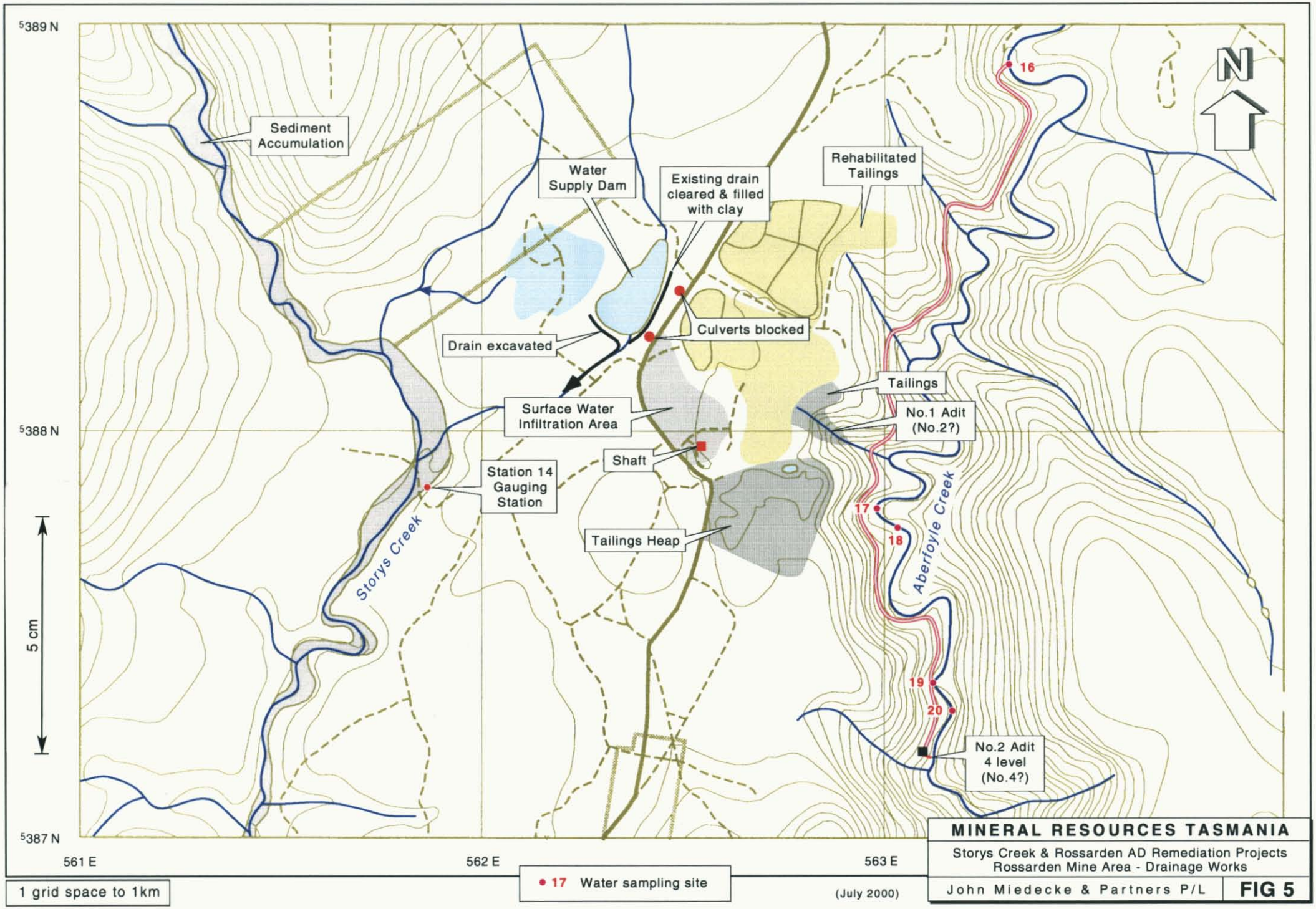
## 5.1 Flow Gauging

A flow gauging station has been established at Station 14, located just above Rossarden (refer Figure 4). The HEC has established a rating curve for the Station and the station is being used to correlate water quality and creek flows.

## 5.2 Water Quality Monitoring

As the funding for the recommended water quality program utilising continuous recording stations was not available, an opportunistic sampling program is being carried out.

This consisted of spot sampling at various locations. These samplings were correlated with the reading of the gauge heights at Station 14, notes on creek flows and appearance, and a subjective measure of rainfall in the


5389 N
5388 N
5387 N
561 E
562 E
563 E
N
Sediment Accumulation
Water Supply Dam
Existing drain cleared & filled with clay
Rehabilitated Tailings
Culverts blocked
Drain excavated
Surface Water Infiltration Area
Tailings
No.1 Adit (No.2?)
Shaft
Station 14 Gauging Station
Storys Creek
Tailings Heap
Aberfoyle Creek
No.2 Adit 4 level (No.4?)
16
17
18
19
20
5 cm
1 grid space to 1km
• 17 Water sampling site
(July 2000)
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Storys Creek & Rossarden AD Remediation Projects
Rossarden Mine Area - Drainage Works
John Miedecke & Partners P/L
FIG 5

preceeding few days, from either evidence of rain, local contacts or rainfall records are being made.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

The remediation works which were carried out in Autumn this year (2000) were successfully implemented and water quality monitoring is continuing.

In all cases, the works were found to be feasible and the following recommendations are made. These will be subject to review after water quality monitoring.

Specific recommendations are:

- yearly limestone sand addition to Storys Creek flows to raise the pH of the waters;
- alkalinity addition to the Storys Creek mine workings by the construction of an anoxic limestone drain upstream;
- removal and encapsulation of the jig tailings to the new tailings disposal area;
- progressive removal of Jig Tailings deposits in the creek itself and encapsulation of the jig tailings to the new tailings disposal area;
- annual application of crushed limestone to tailings deposits on the creek banks ; and
- aquatic fauna monitoring in the S Esk river.

The recommendations (with estimates of costs) are summarised in Table 1

**Table 1 Summary of Recommendations**

| Location | Treatment | Cost |
|---|---|---|
| | **Storys Creek Catchment** | |
| **Storys Creek flows** | Limestone sand addition to creek for creek flows at four locations. Initial 100 tonnes<br>Periodic replenishment on yearly basis | $5500 |
| **Mine drainage** | Alkalinity addition via Anoxic Limestone Drain alkalinity generation cells to drain to mine workings | $70,000 |
| **Jig Tailings Deposits** | Long term relocation and encapsulation | $410,000 |
| **Creek Bank Deposits** | Limestone to creek banks.<br>Periodic replenishment on yearly basis | $12,000 |
| **Monitoring** | Periodic water quality and flow monitoring at Station 14, SEsk river.<br>Biological monitoring at S Esk river, Storys Creek and Aberfoyle Creek to measure improvements. | $5000<br>$7500 |

## REFERENCES

Miedecke 1997; John Miedecke and Partners, 1997. Storys Creek/Rossarden Acid Drainage Remediation Study - Stage 1 Interim Report. September 1997.

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Miedecke 1999. Storys Creek/Rossarden Acid Drainage Remediation Study – Precipitate Dam Relocation Design Report. John Miedecke and Partners, 1997 March 1999.

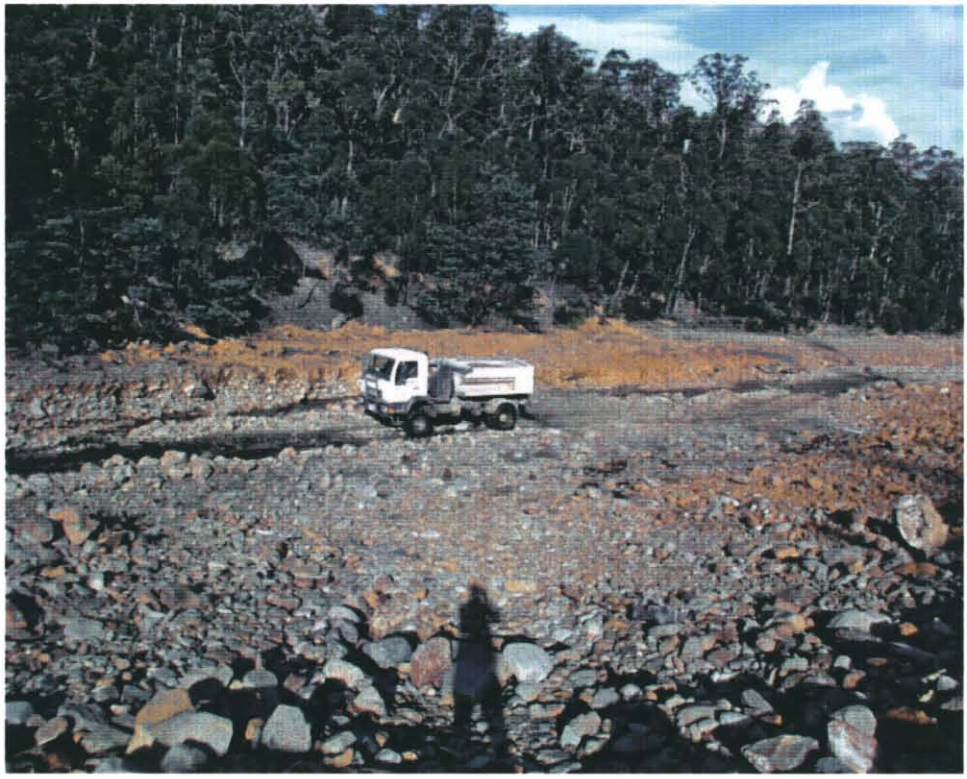
Miedecke 2000a. Storys Creek/Rossarden Acid Drainage Remediation Study – Final Report John Miedecke and Partners, June 2000.

Miedecke 2000b. Storys Creek Remediation . Precipitate Dam Relocation Construction Report John Miedecke and Partners, July 2000.

Miedecke 2000c. Storys Creek Remediation . Jig Tailings Relocation Design Report John Miedecke and Partners, July 2000.

Miedecke 2000d. Storys Creek Remediation . Anoxic Limestone Drain Design Report John Miedecke and Partners, July 2000.

Spreading limestone in Storys Creek



Spreading limestone in Storys Creek

April 2000. Precipitate Dam - completed tailings removal

April 2000. Rossarden Water Supply Dam Drain Clay filled

April 2000. Rossarden Water Supply Dam Drain