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Samatosum's Mine Drainage

Matthew Bliss, Brent Hamblin, Craig Ford
Inmet Mining Corporation

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agenda

- about Inmet and opening comments
- about Samatosum and history
- closure plan
- rehabilitation activities
- water quality
- managing waste rock drainage
- summary and conclusions
- the neighbours
- closing comments

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about Inmet

Inmet Mining Corporation is a Canadian based international mining company.

Its mining operations produce copper, zinc and gold, and Inmet's growth strategy is focused on finding quality base metal reserves.

Inmet's operating base consists of four competitive mining operations: Çayeli, Pyhäsalmi, Troilus and Ok Tedi.

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opening comments

Samatosum's mine and waste rock drainage has evolved since the closure plan was developed.

Operational challenges and capital project assessment, associated with variable flow and water quality, are managed with the help of monitoring programs.

The current relative stability of the site's drainage chemistry is being managed with the help of a regularly reviewed management system.

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about Samatosum

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about Samatosum

Closed open pit and underground base metal mine

- 75 kilometres north of Kamloops, 15 kilometres east of Barriere
- 289 hectare lease at 1000 to 1500m elevation AMSL

Operated from 1989 to 1992 at 500 tonnes per day

- 566,000 tonnes mined to produce silver, lead and zinc concentrate
- 3,014,000 m^3, or 8.14 million tonnes of waste rock (layered)
- 422,462 m^3, or 542,000 tonnes of sub-aqueous tailings

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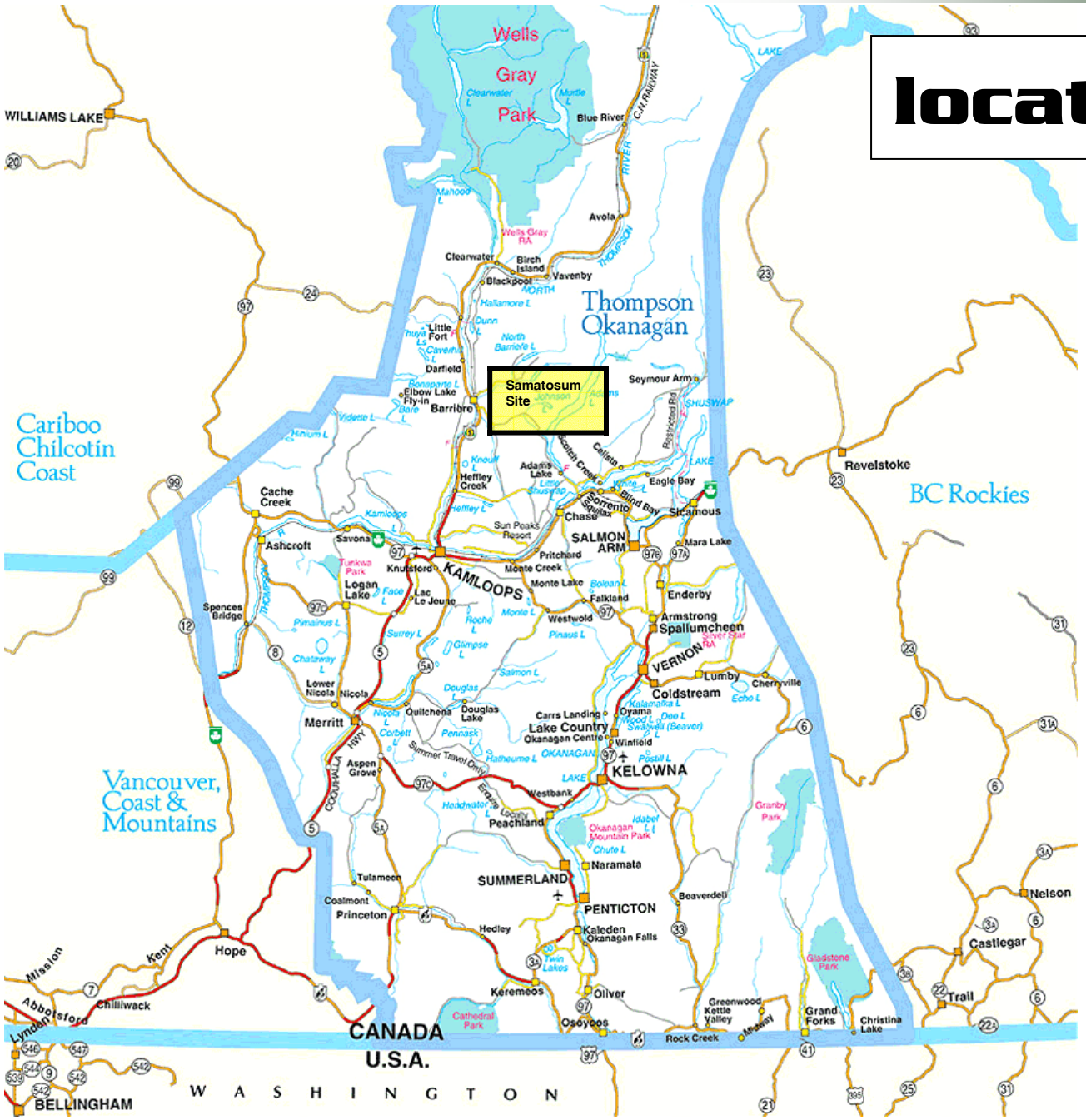
location



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about Samatosum

Samatosum is part of the Adams Lake watershed

- twelve kilometres upstream of Sinmax Creek
- two kilometres downstream of the Johnson Lake Resort
- receives 50-60% runoff, 850 mm annual precipitation

Currently, the site consists of

- a reclaimed tailings pond,
- a flooded open pit and re-vegetated waste rock,
- collection and diversion ditches, sumps, and pipelines
- an HDS plant, sedimentation pond, and sludge storage ponds

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Samatosum history

1983 – gold discovered at Rea Gold

1986 – silver and zinc discovered at Samatosum

1989 – production began

1992 – production ceased

1995 – tailings water cover installed

1996 – low density lime treatment of mine drainage

1998 – HDS plant commissioned to treat mine drainage

2001 – surge pond capacity increased

2003 – automation improvements

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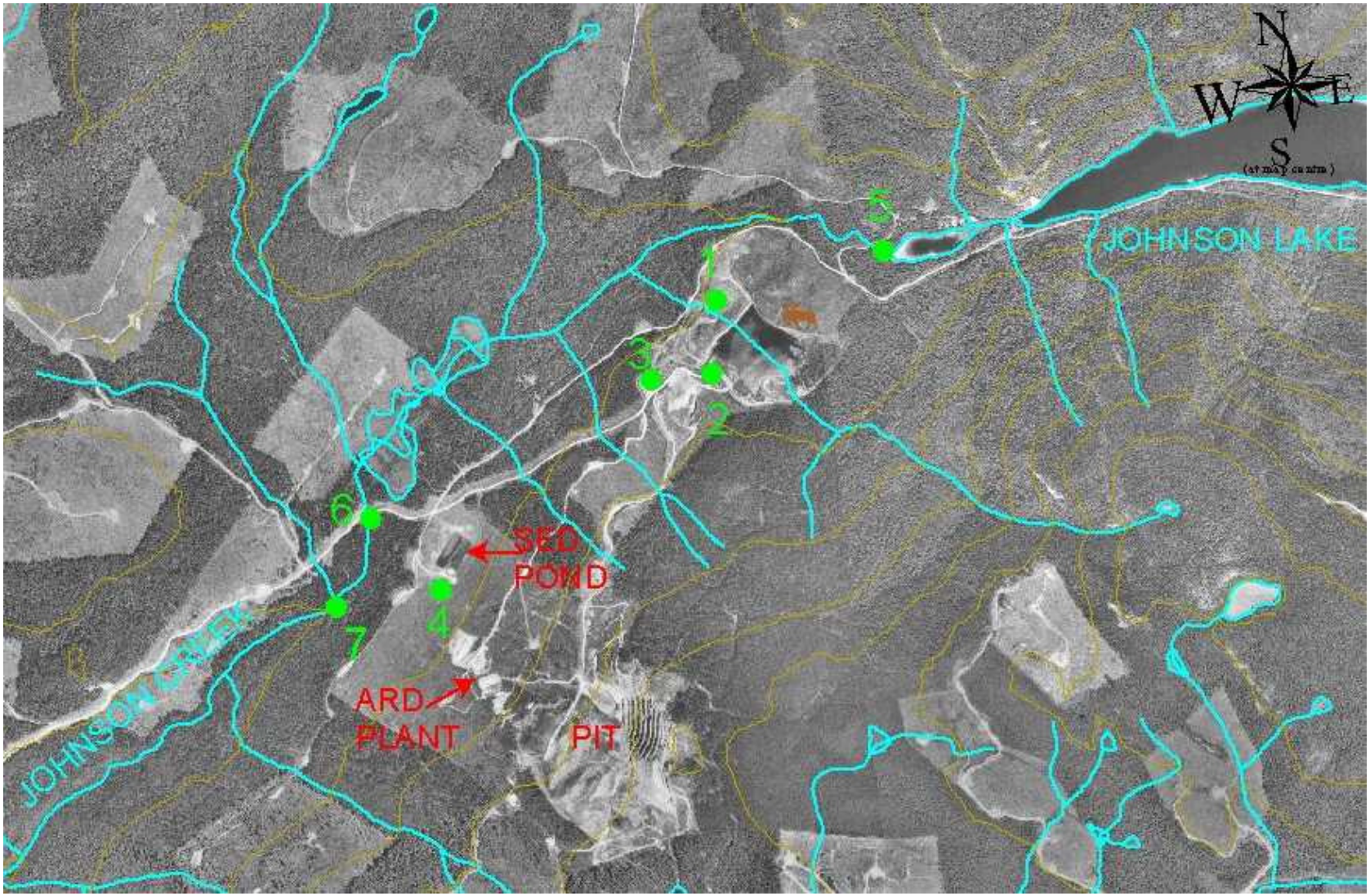
plan map of Samatosum



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Samatosum closure plan

The closure plan was an integral part of the operating plan.

Samatosum's reclamation permit was issued in 1989.

The closure plan, negotiated with the Province, adopts a standard approach to rehabilitation

- waste rock was segregated and deposited as planned
- infrastructure was removed to ensure public safety
- slopes were stabilized
- disturbed areas were re-vegetated
- water quality monitoring continued to track performance

The objective was to return the property to the Crown within three to five years after mine closure.

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rehabilitation activities

Between 1992 and 1995 Inmet performed:

- dismantling, slope stabilization, re-vegetation
- tailings re-grading and water cover installation
- water quality monitoring
- environmental and geotechnical surveys and investigations

From 1993 to 1996 the layered waste rock system was reassessed

- sporadic acid drainage was observed at the pit
- increasing metal concentration in pit and waste rock drainage
- lime addition required for mine and waste rock drainage

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rehabilitation activities

Within a few years of closure it was clear that the layered waste rock system would not adequately protect Johnson Creek, therefore Samatosum

- established infrastructure the required for water treatment
- initiated lime treatment from simple to more efficient systems; manual → low density system → HDS plant
- continued and at times, expanded monitoring programs
- developed and implemented a management system
- worked with Inmet to develop and implement risk assessment and audit tools to supplement the management system
- increased capacity for mine and waste rock drainage
- improved plant automation to reduce risk and response time

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rehabilitation activities

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rehabilitation activities

Samatosum water quality

Flooded open pit drainage

- is connected to underground workings
- has low pH and high metals

Waste rock drainage discharges at two sumps

- western area (sump 6A) has elevated metals
- eastern area (sump 6B) has elevated metals and sulphate

Tailings water cover

- operates as designed and does not require treatment

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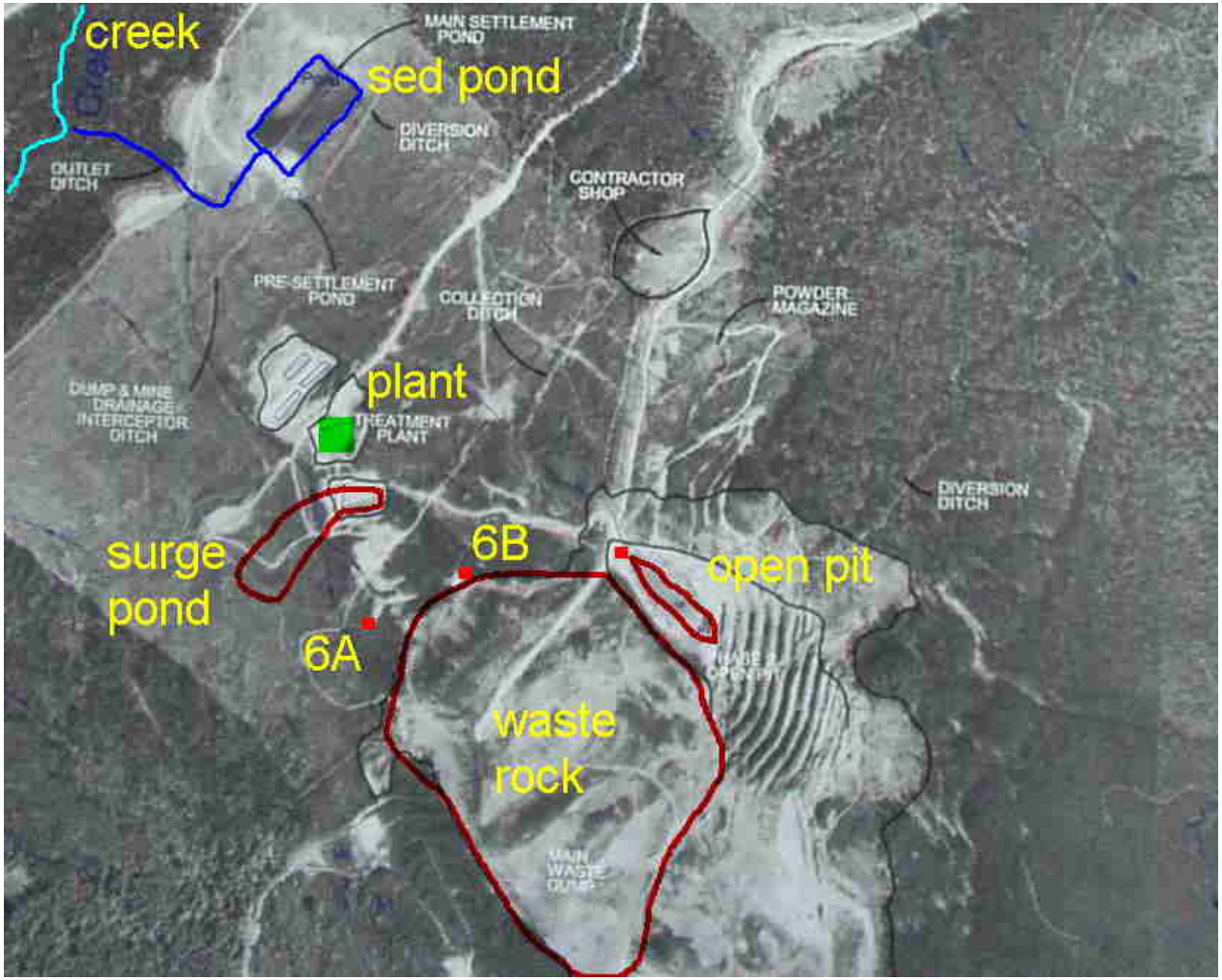
pit and waste rock



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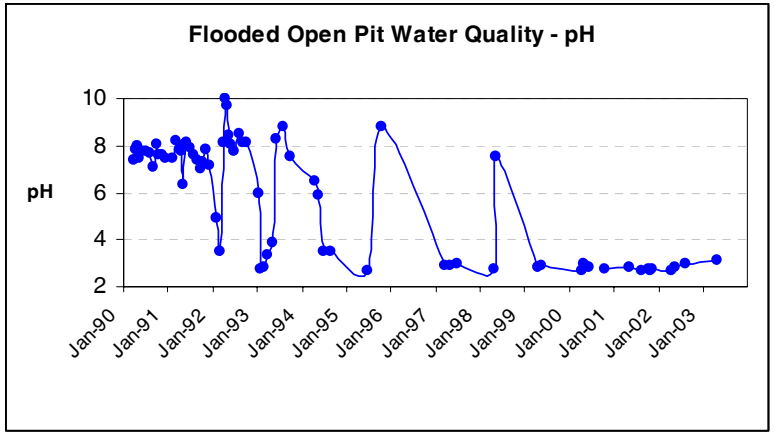
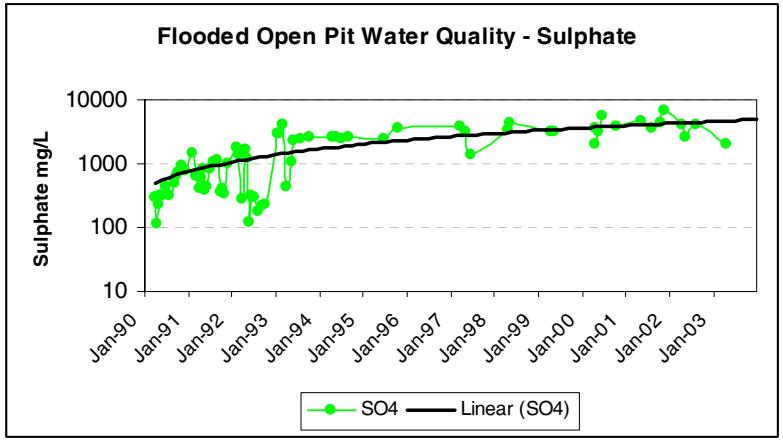
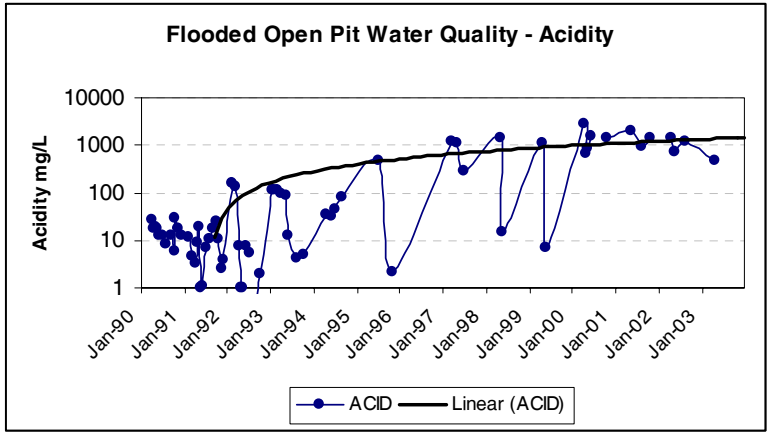
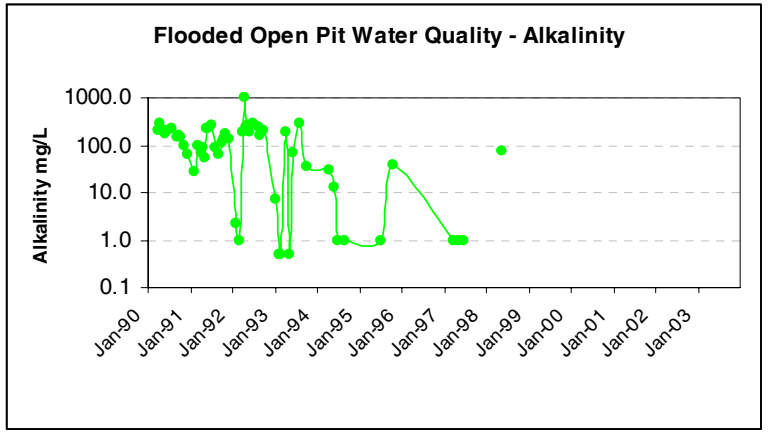
flooded open pit water quality









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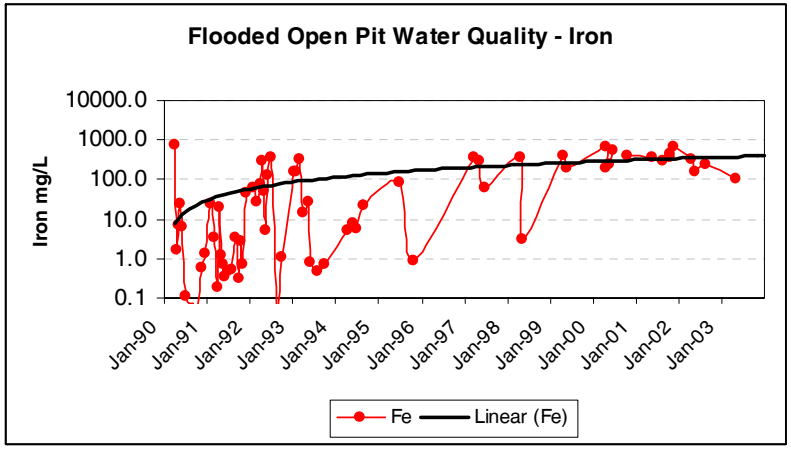
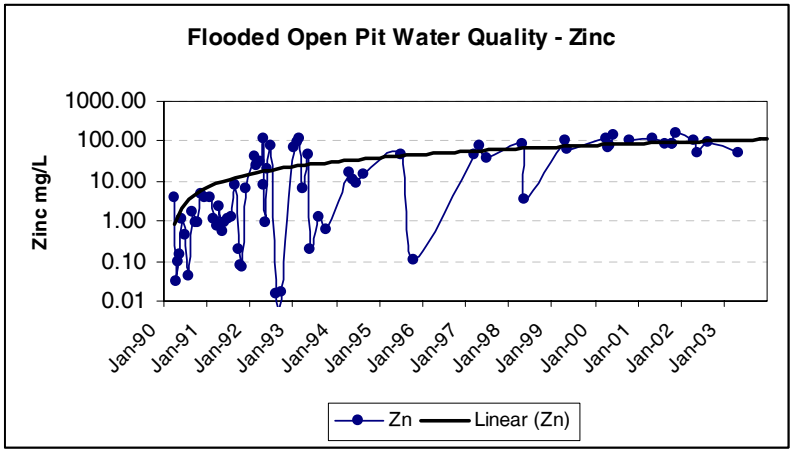
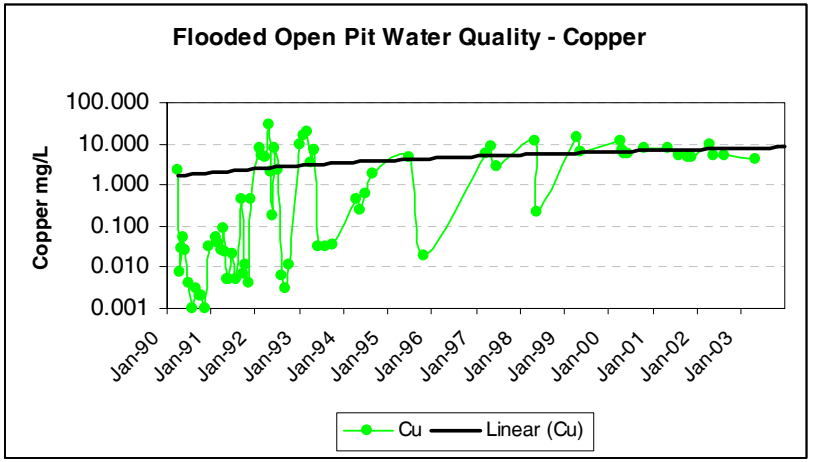
flooded open pit water quality







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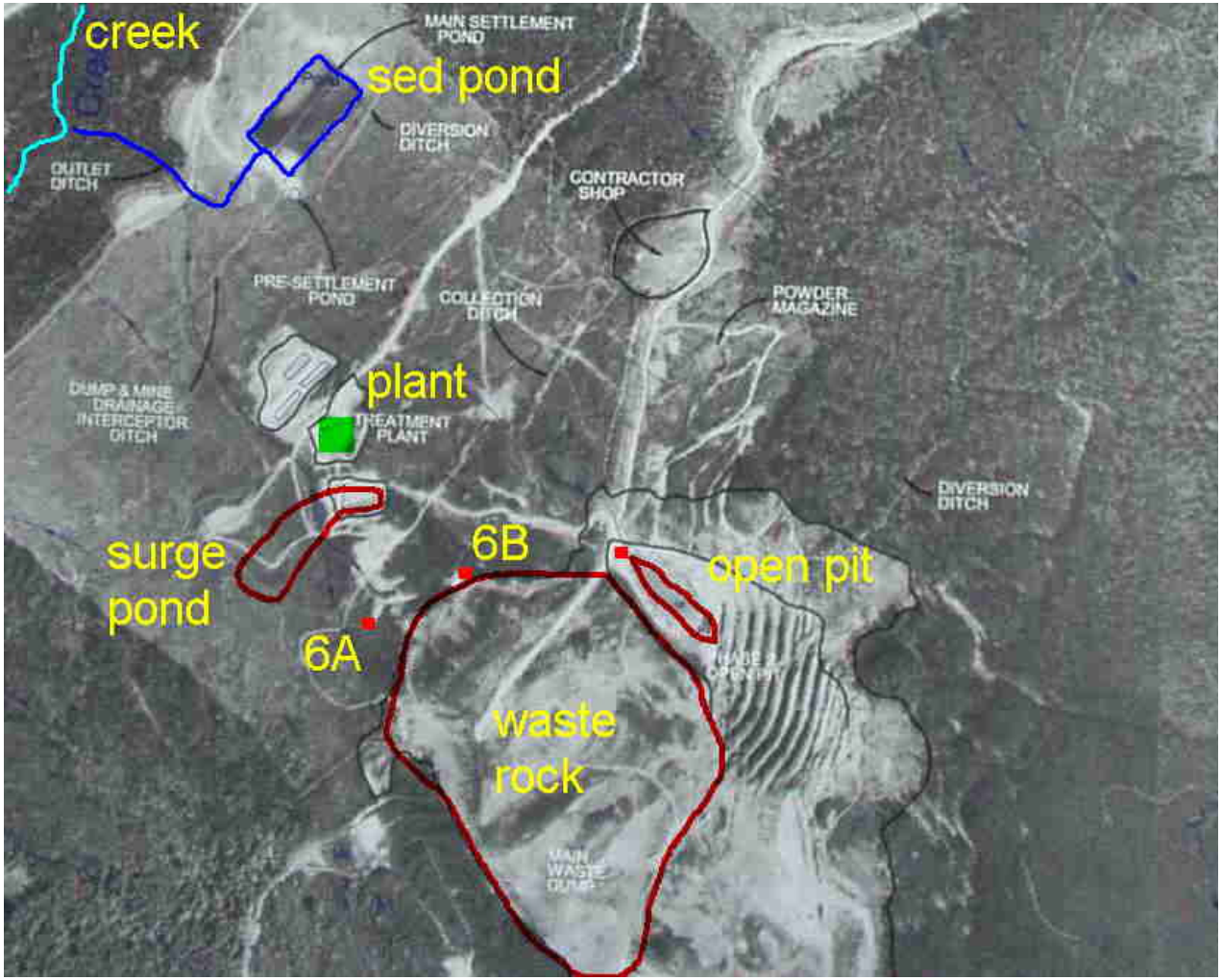
pit and waste rock



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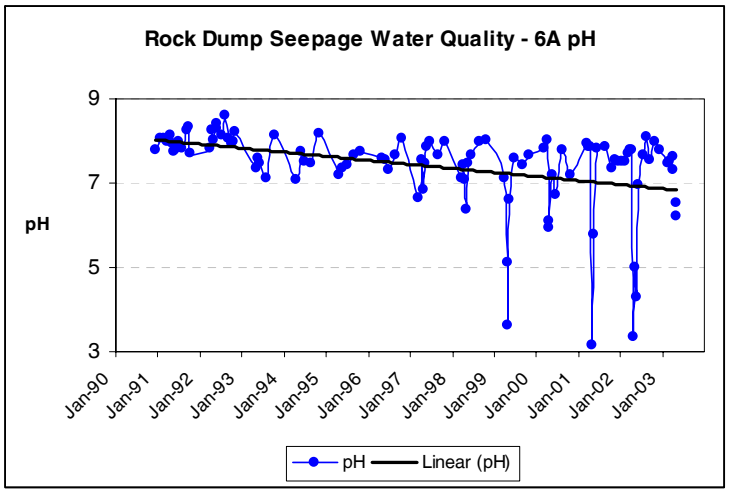
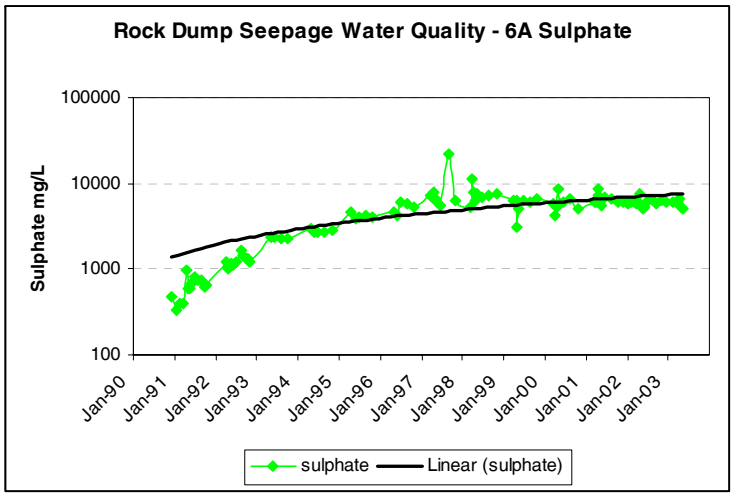
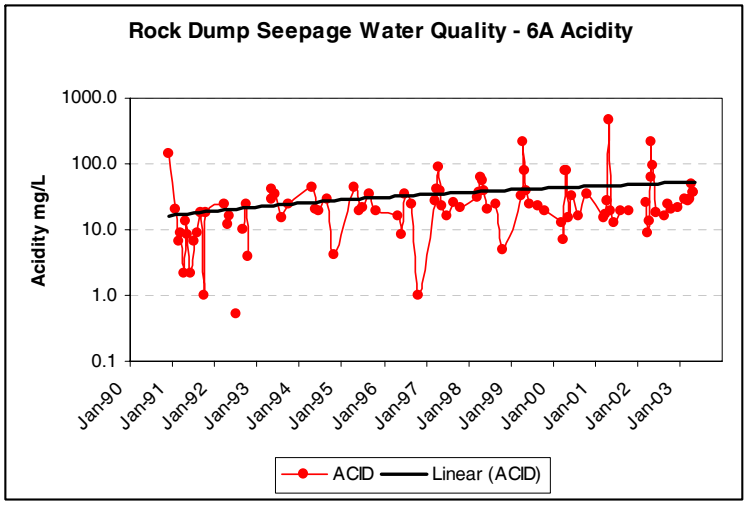
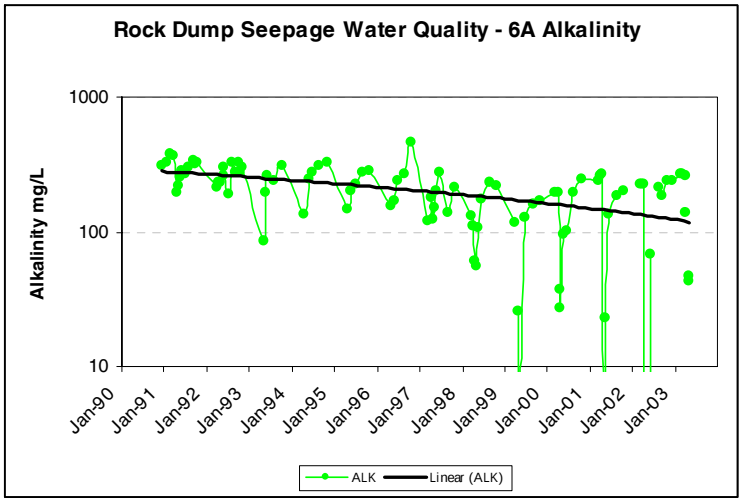
waste rock water quality - west









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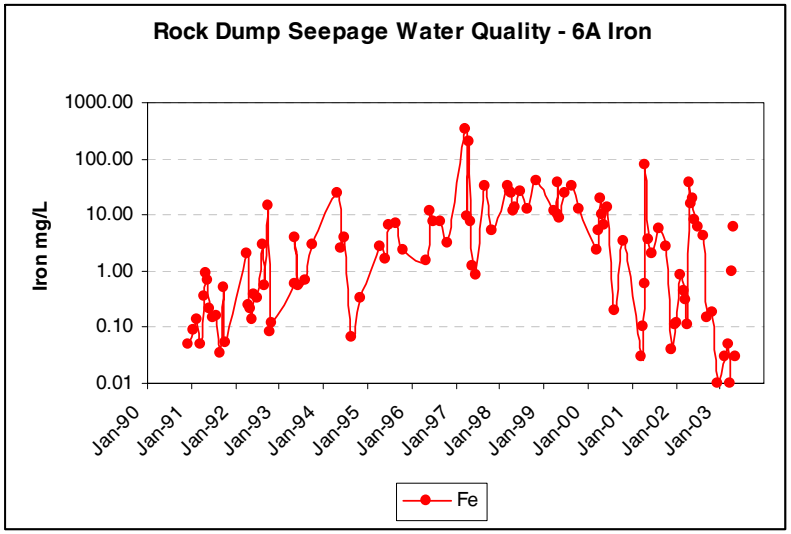

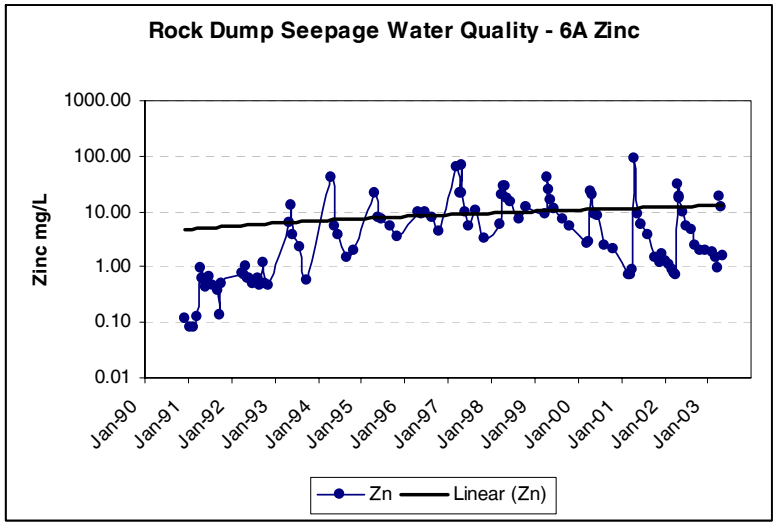

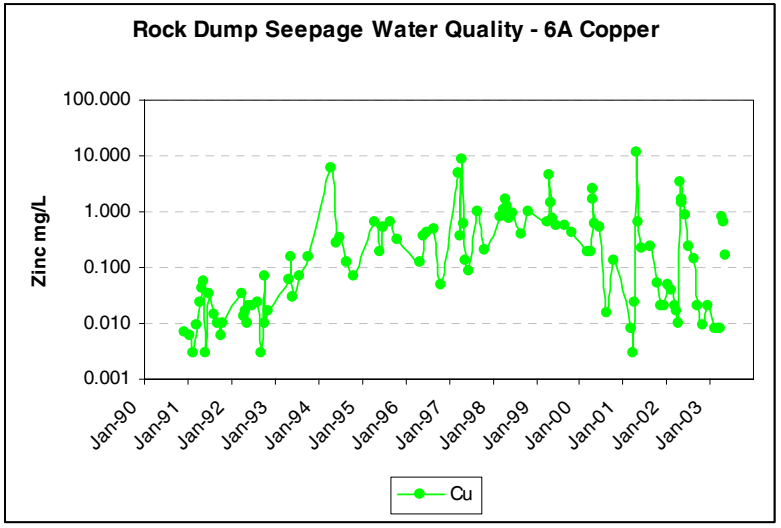

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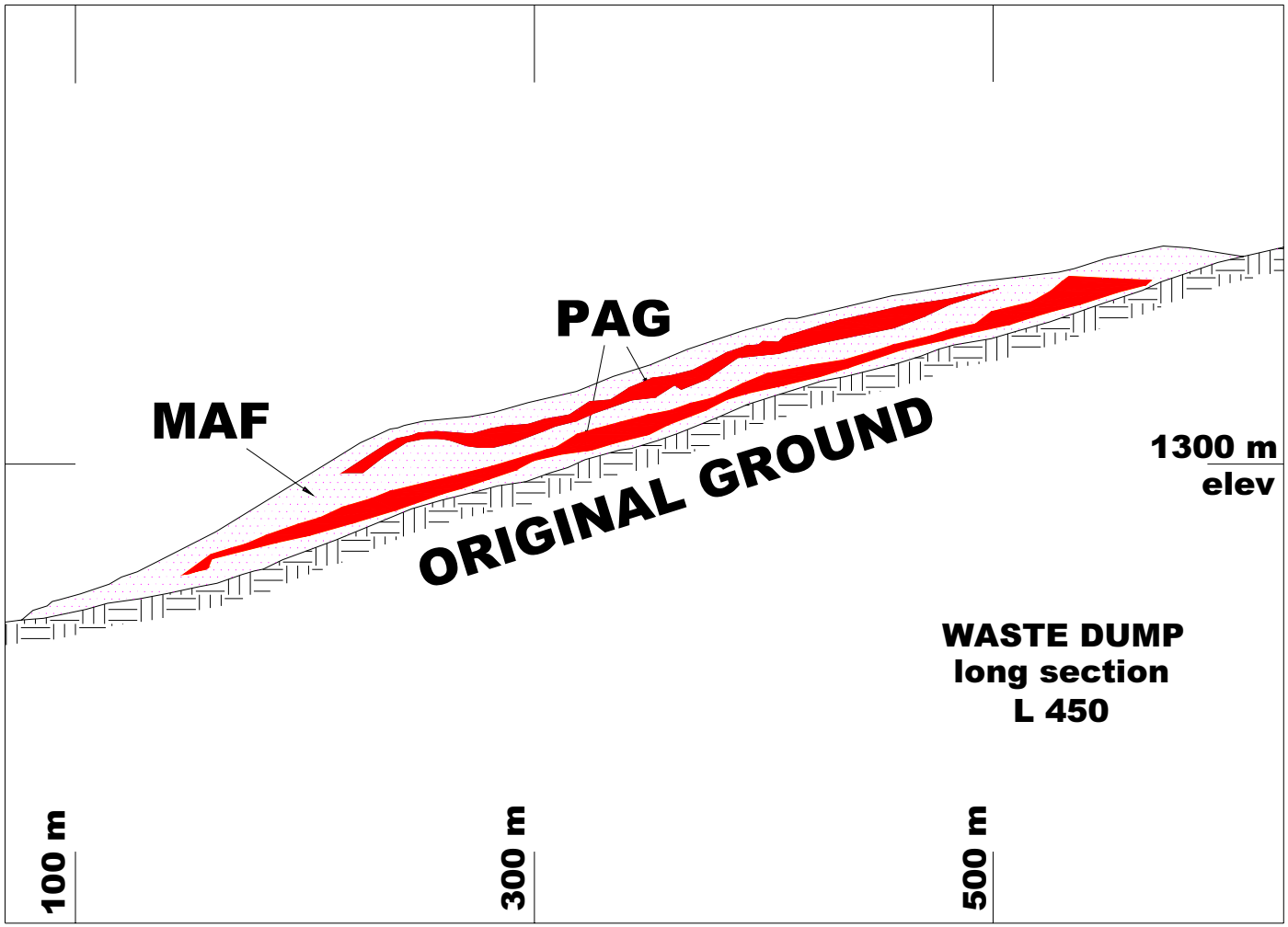
waste rock



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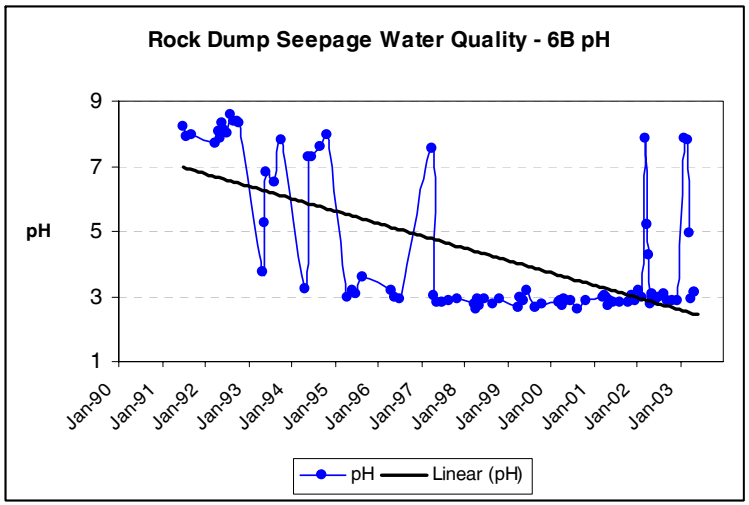
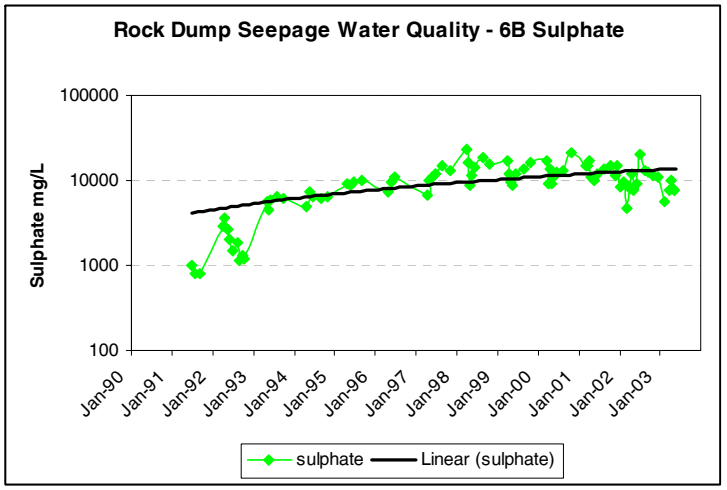
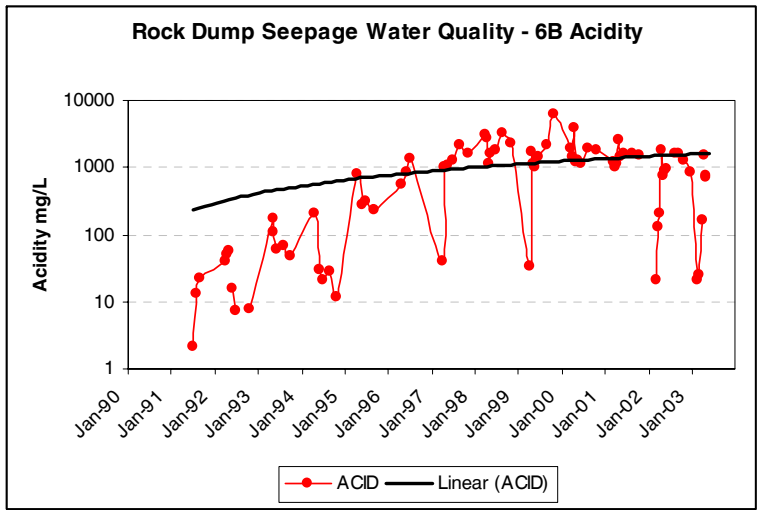
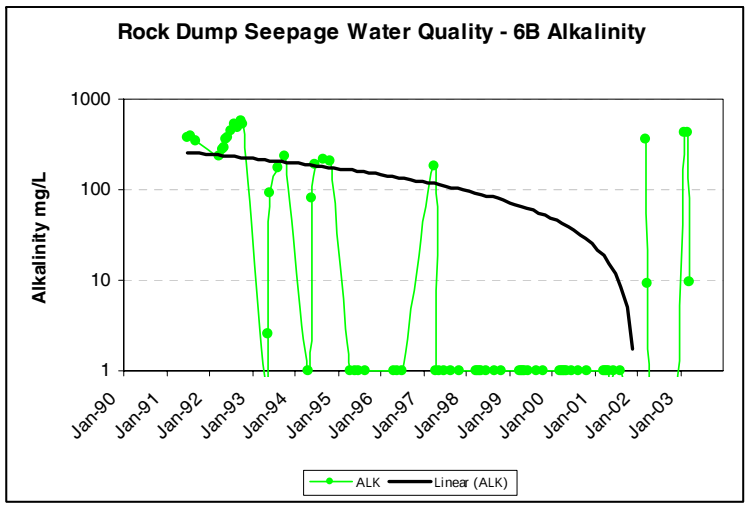
waste rock water quality - east









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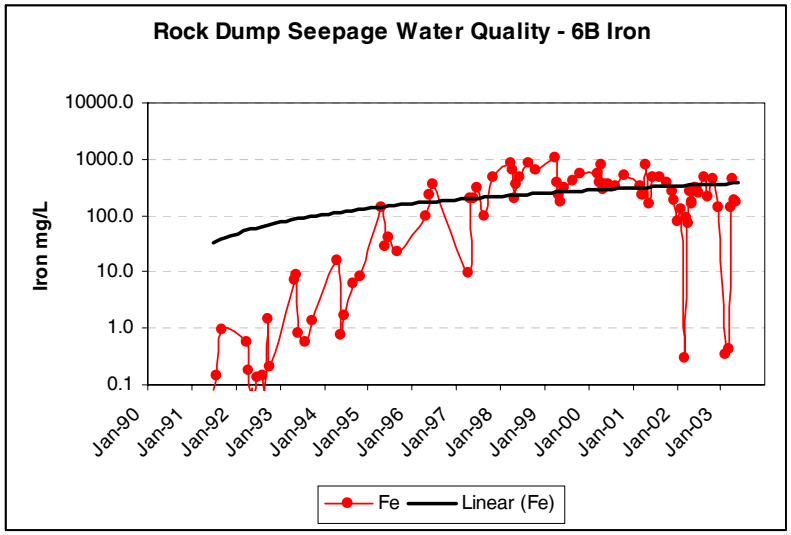

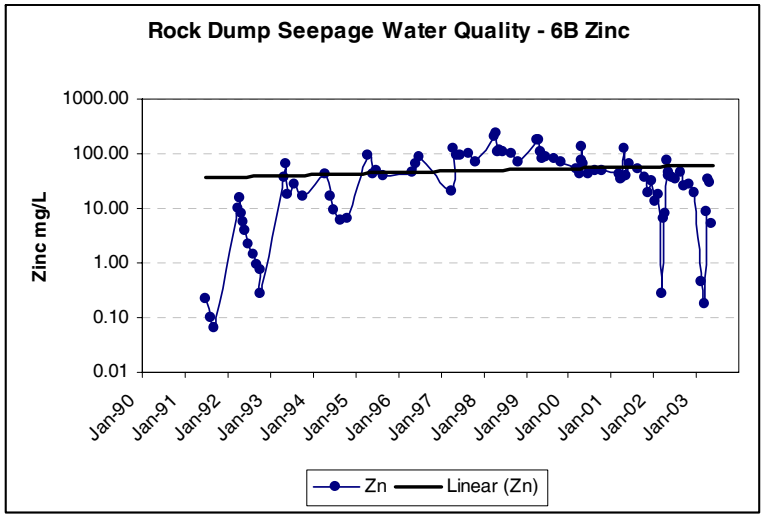

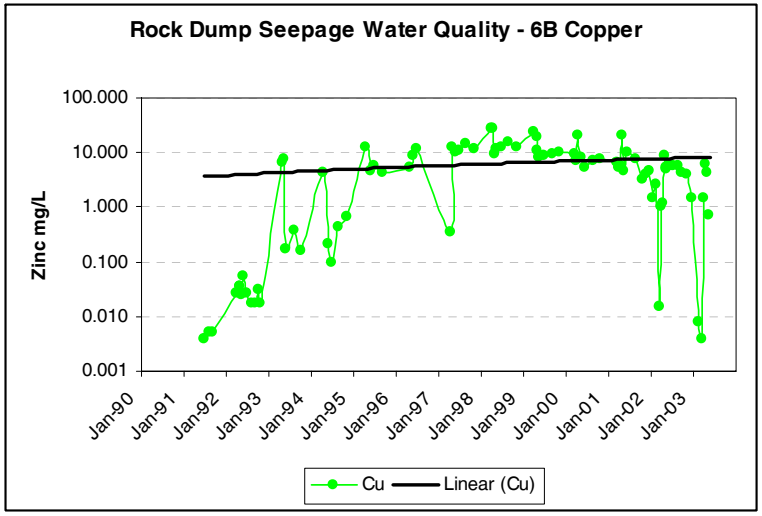

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managing waste rock drainage

Waste rock flows vary throughout the year, and as much as 70 percent of the annual flow is treated during the spring.

Waste rock flows range from 37 to 2,000 cubic meters per day.

Waste rock drainage pH ranges from 3 to 8.

Metal concentrations vary by up to three orders of magnitude.

metal	high (mg/L)	low (mg/L)
copper	28	0.028
iron	1080	0.97
manganese	120	0.45
zinc	239	0.43

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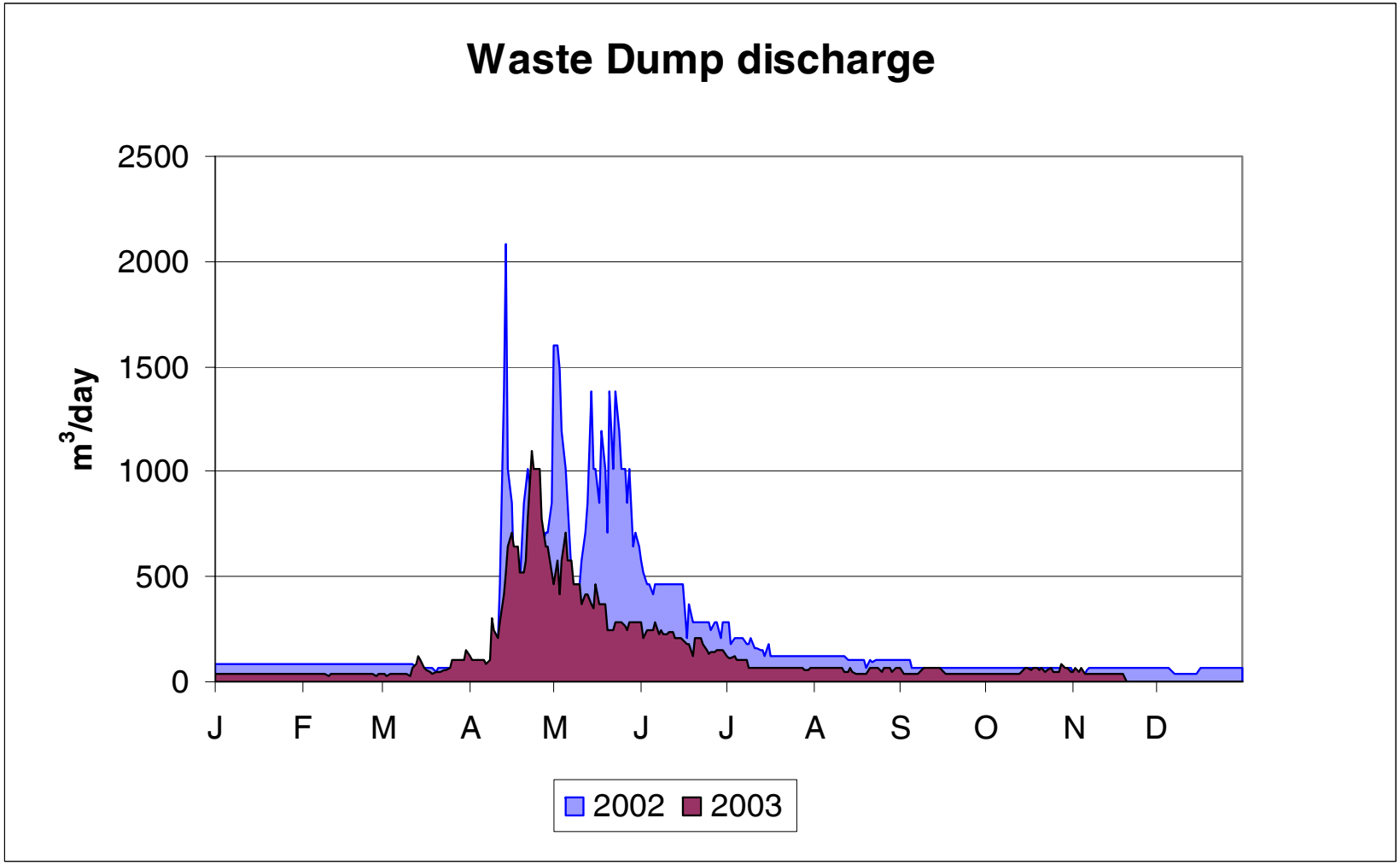
managing waste rock drainage



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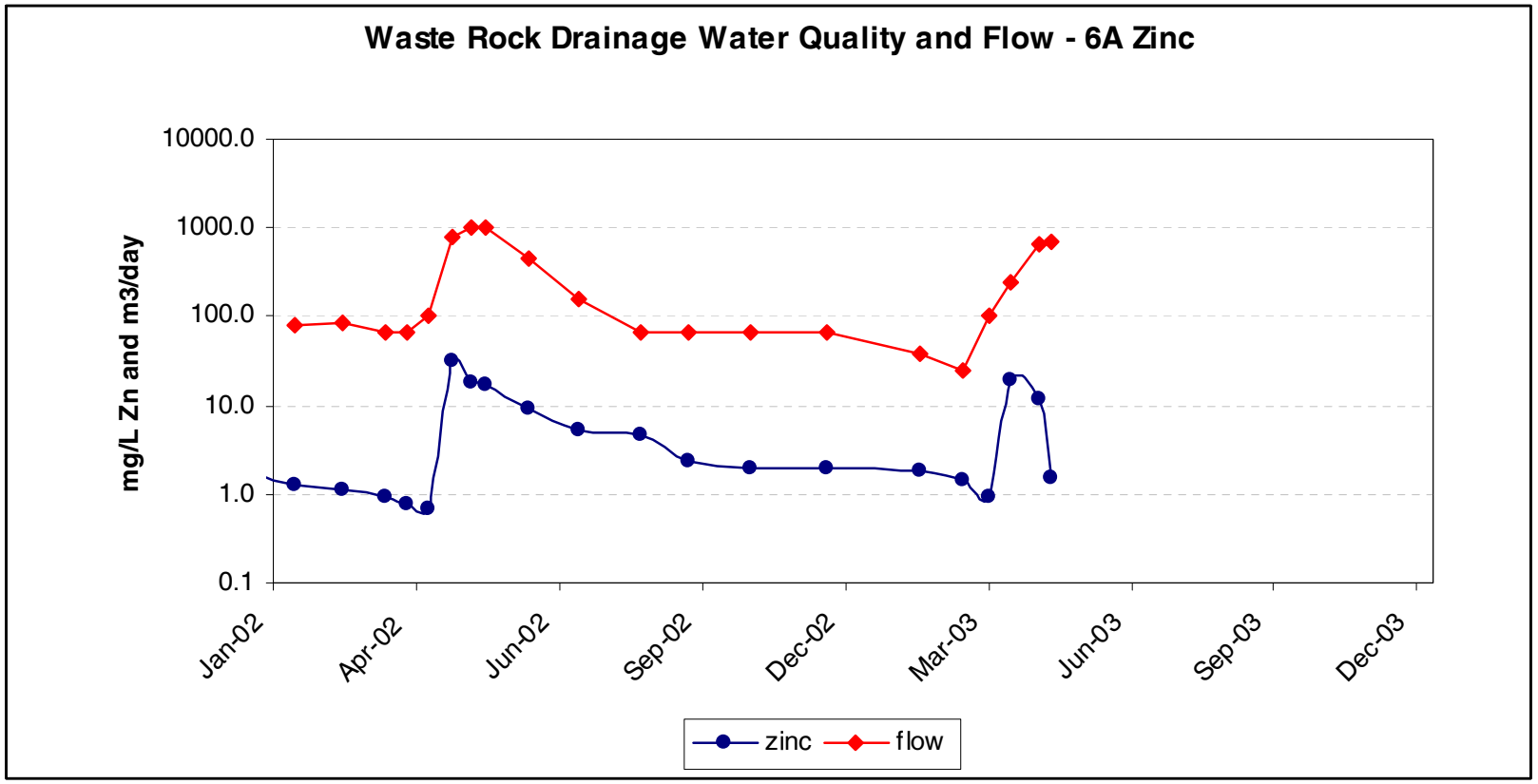
managing waste rock drainage



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managing waste rock drainage - aeration controls Mn

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managing waste rock drainage

Plant performance depends on balancing the open pit and waste rock drainage; when treating waste rock drainage, plant performance:

- improves with the use of water from the open pit, and
- is dependent on dissolved solids concentration

Sludge recycle ratios are higher than design

- likely due to relatively low iron, and
- are further increased to improve plant performance during winter

Sludge production has decreased over the past three years due to:

- improved sludge management
- stable water quality from open pit and waste rock

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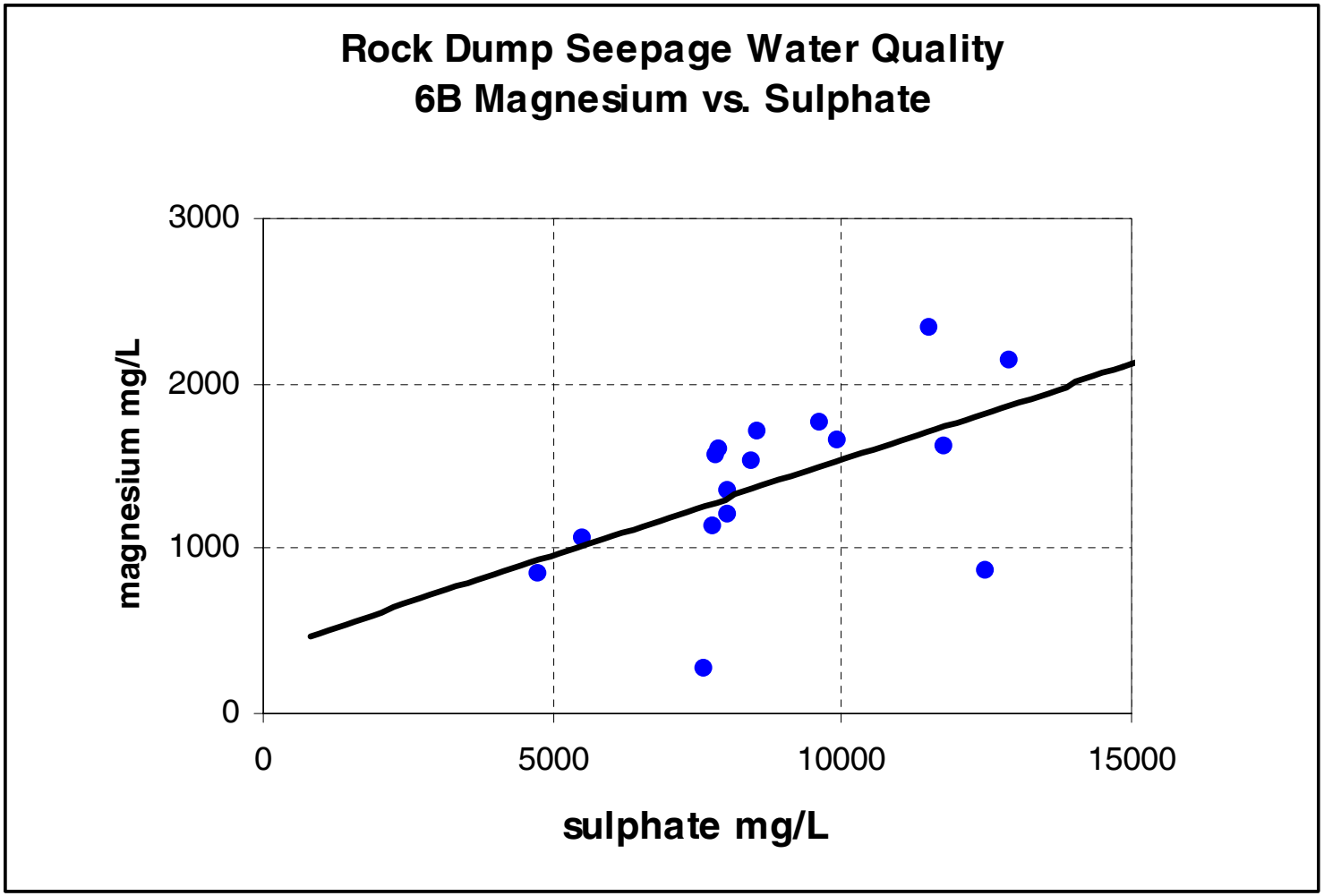
sulphate and Mg



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treatment sludge

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treatment sludge

- **Sludge is comprised of gypsum, epsomite, and dolomite**
- **The sludge contains the following elements:**

magnesium	12.5 percent
iron	10.0 percent
calcium	10.0 percent
sulphur	7.0 percent
zinc	3.5 percent
manganese	1.5 percent
carbon	1.0 percent
aluminum	0.8 percent
copper	0.3 percent

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summary and conclusions

Inmet places high priority on compliance with all applicable legislation at all of its sites.

Samatosum has made considerable progress rehabilitating the site, with dramatic improvements in water quality.

Water quality impacts have been minimized by monitoring the performance of rehabilitation systems and mitigating problems as they arise.

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summary and conclusions

Water quality at Sam will continue to change slowly over time.

Open pit water quality is likely stable

- **pH, sulphate and acidity have stabilized, and**
- **alkalinity appears to have been consumed**
- **open pit metals also appear to have stabilized**

Waste rock water quality appears stable at this time

- **pH sulphate acidity appear stable, however**
- **alkalinity is still available to neutralize acid**
- **metals appear stable at this time, however alkalinity consumption will likely be associated with lower pH and may increase copper concentration**

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summary and conclusions

Water quality monitoring at the pit and waste rock locations will continue in order to ensure that evolving acidic and metal-bearing drainage can be managed effectively.

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the neighbours -anglers and Rainbow trout

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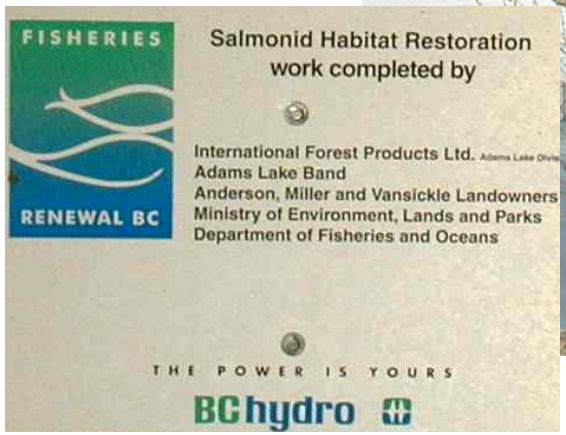
the neighbours
ranchers, loggers, residents, salmon



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closing comments

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Operational challenges and capital project assessment, associated with variable flow and water quality, are managed with the help of monitoring programs.

The current relative stability of the site's drainage chemistry is being managed with the help of a regularly reviewed management system.