

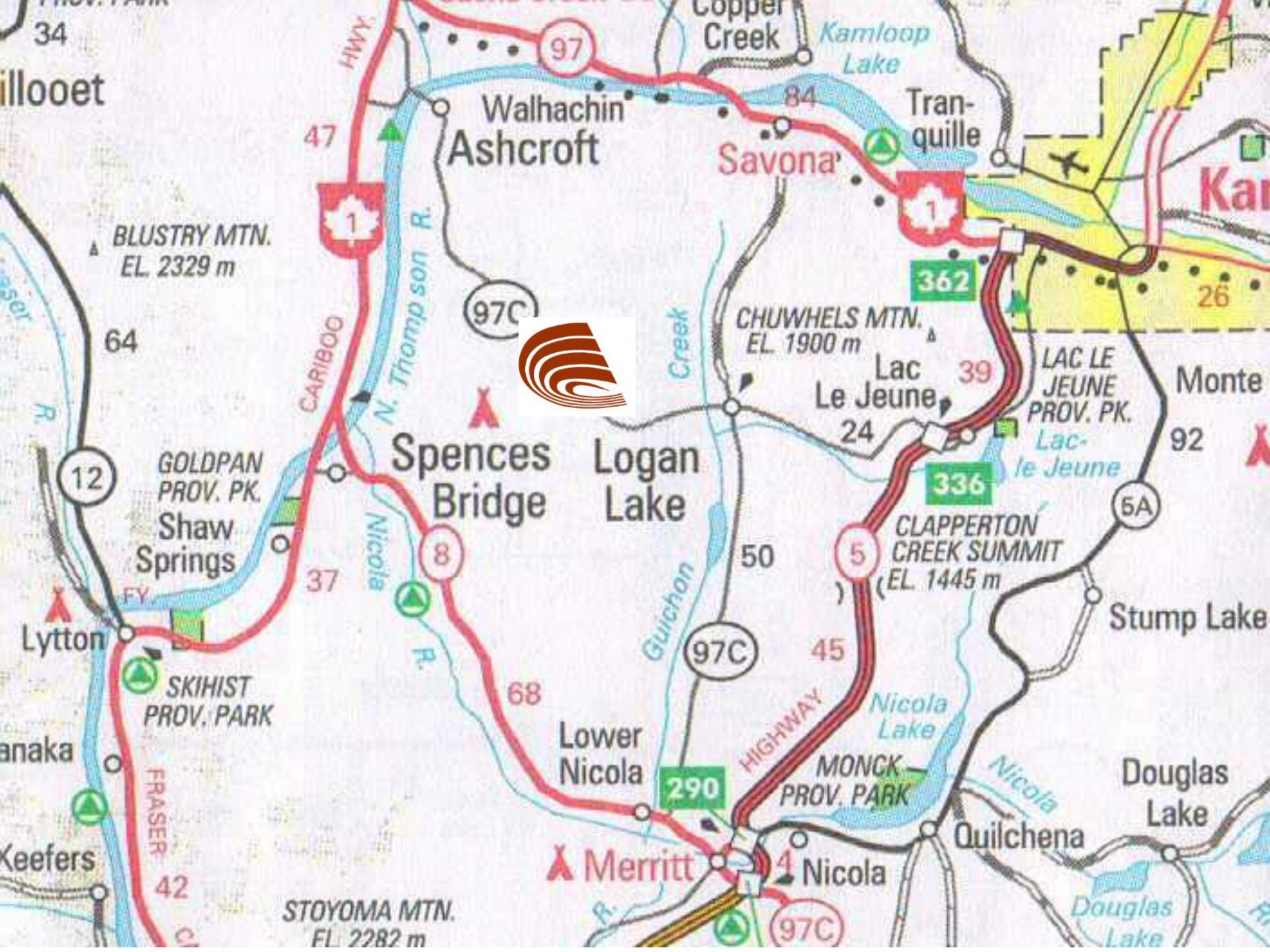
# Molybdenum Removal In Constructed Anerobic Wetlands



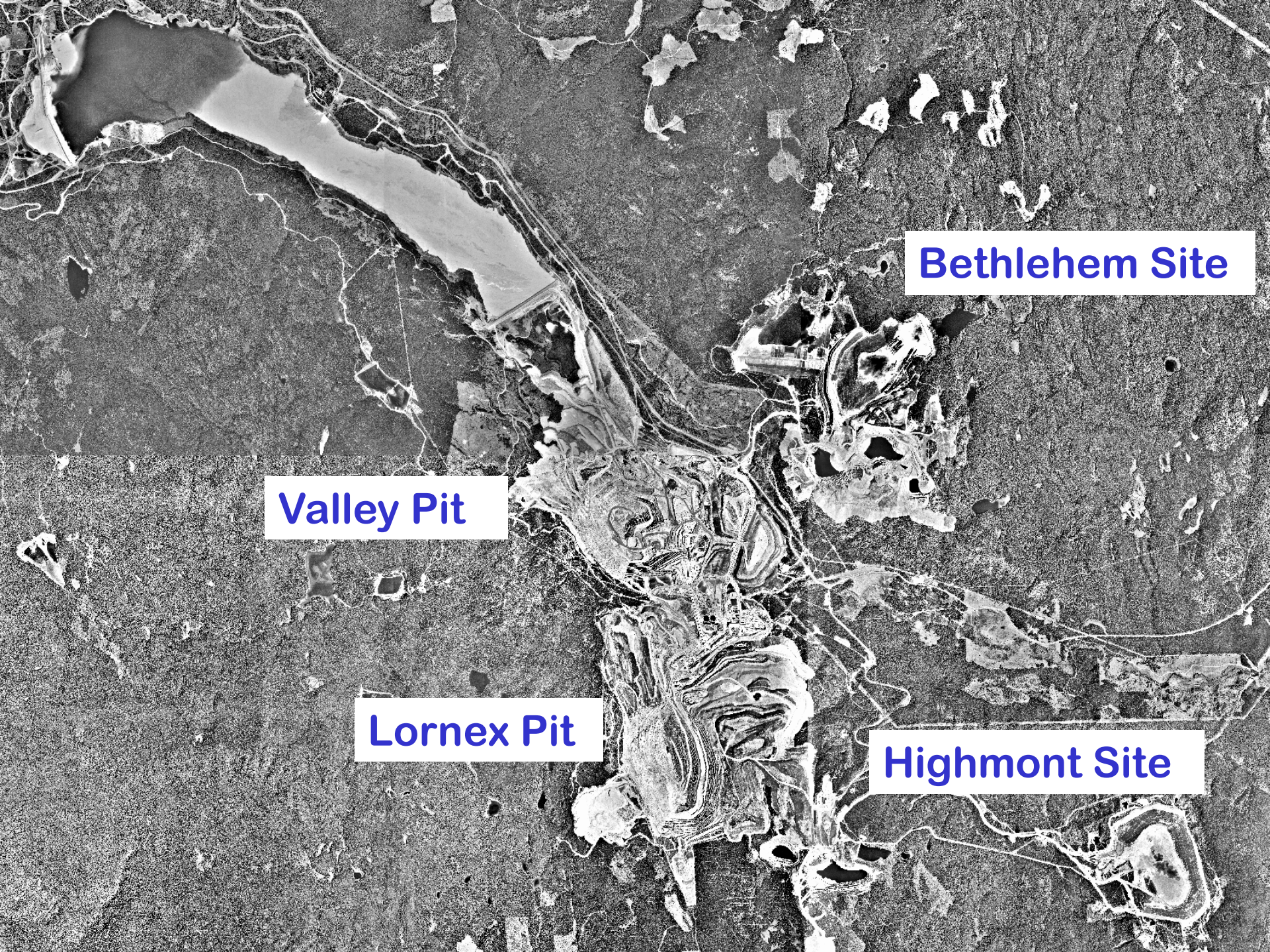
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**Mark Freberg**  
**Highland Valley Copper**









**Bethlehem Site**

**Valley Pit**

**Lornex Pit**

**Highmont Site**



# Highmont Tailings Pond





# Highmont Tailings Seepage Chemistry

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■ pH	7.2 to 8.6
■ Molybdenum	2.5 to 9.9 mg/l
■ Copper	0.002 to 0.007 mg/l
■ Sulphate	330 to 560 mg/l
■ Manganese	0.01 to 0.36 mg/l
■ Alkalinity	220 to 250





# History of Passive Treatment

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- 1994 to 1996 Pilot Test Tank
- 1998 Full Scale Installation at S5 Pond
- 2002 Full Scale Installation at S8 Pond



# Tank Scale Testwork



- Operated between 1994 and 1996.
- Both internal and external nutrient sources tested.







# Tank Scale Testwork

- Molybdenum removals as high as 99% obtained but system was very temperature sensitive.



- Internal nutrient source gave the best overall results.



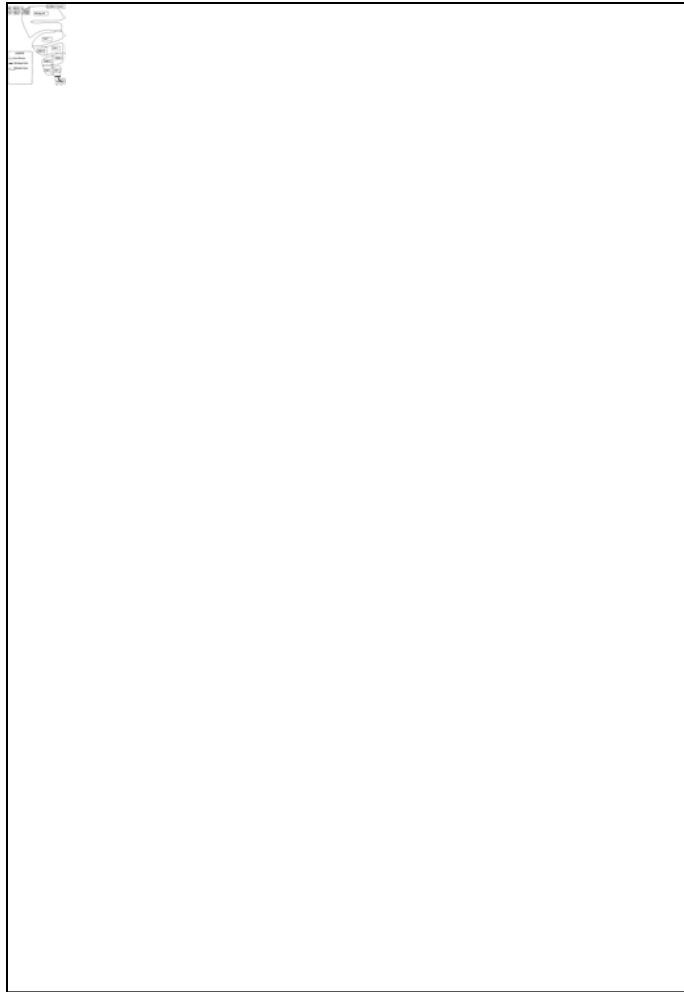
# S5 Installation - 1998





# S5 Installation - 1998

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# S5 Installation

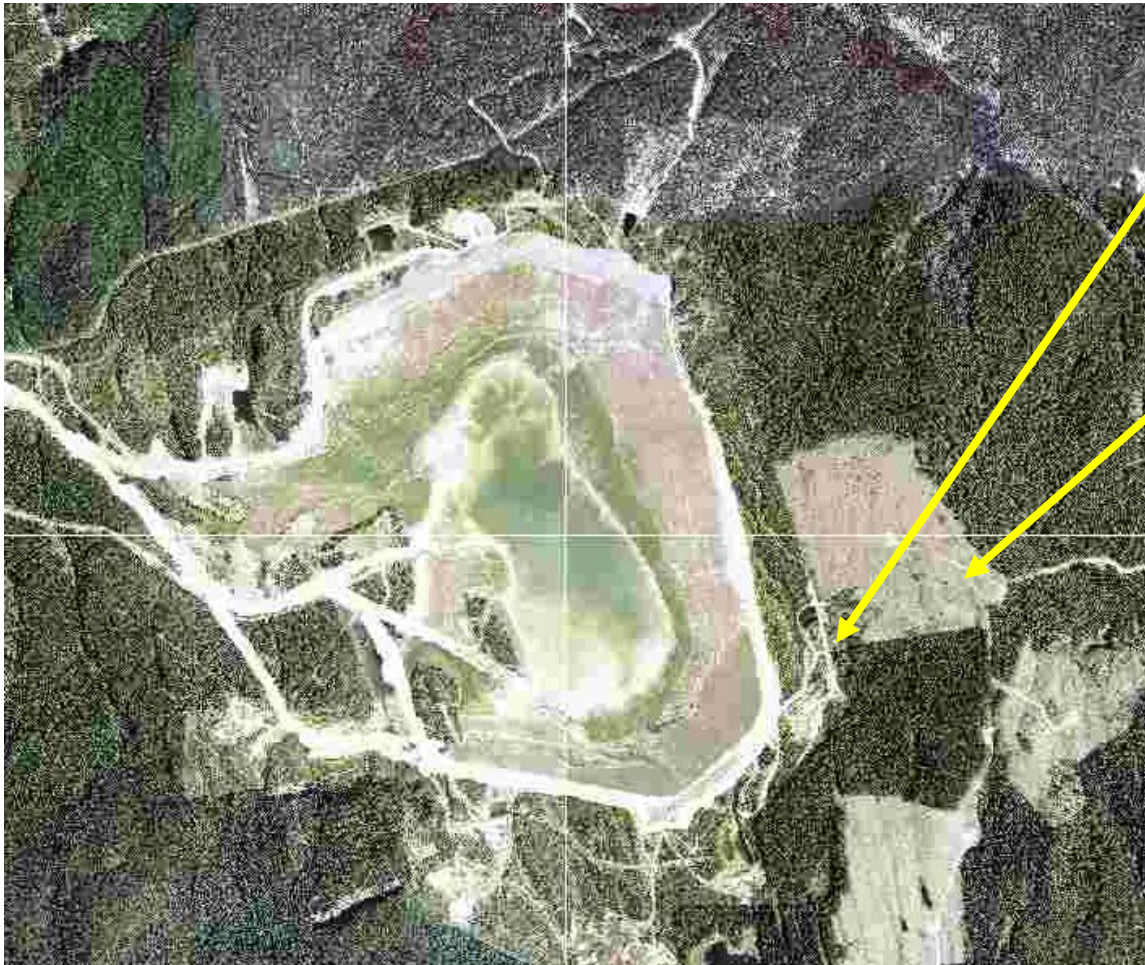


# Collection of Bacterial Innoculant





# S5 Final Discharge Point



S5 Pond

Final  
Discharge  
at Culvert





# S5 Flow Rates

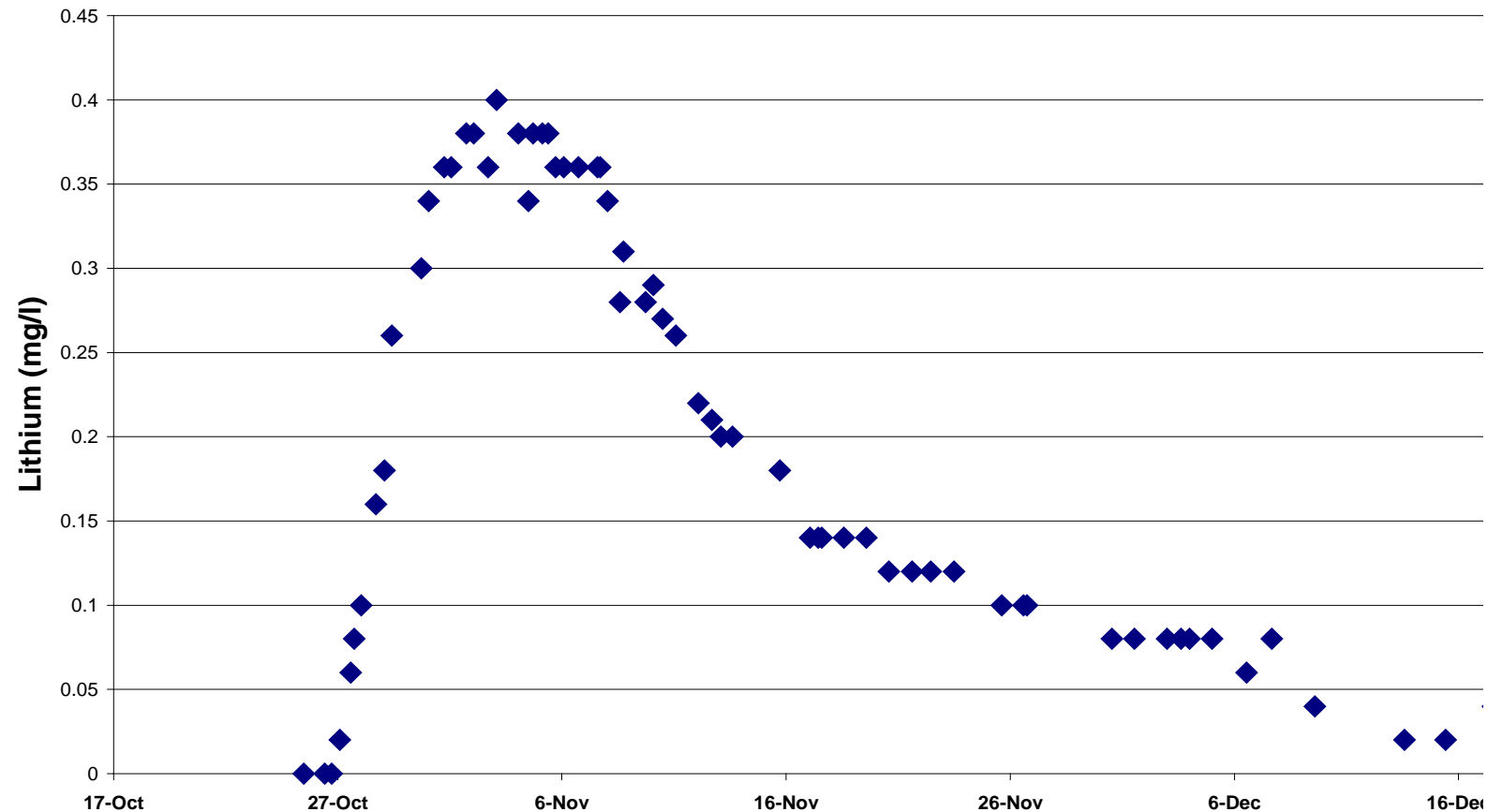
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- Flows range between 60 and 80 litres/min. for most of the year.
- During freshet flow rates can exceed 500 litres/min.



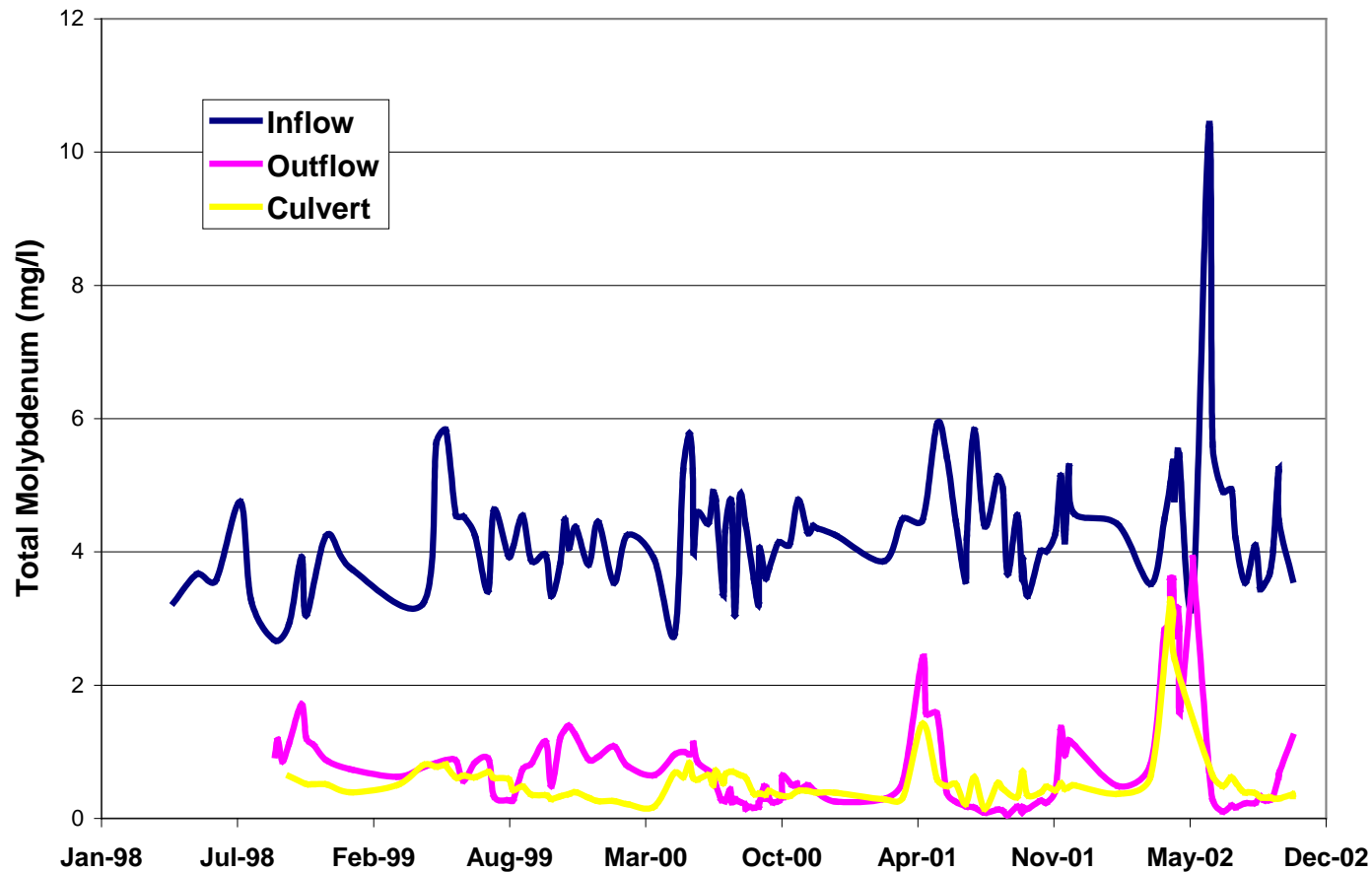


# S5 Residence Time



# S5 Performance To Date

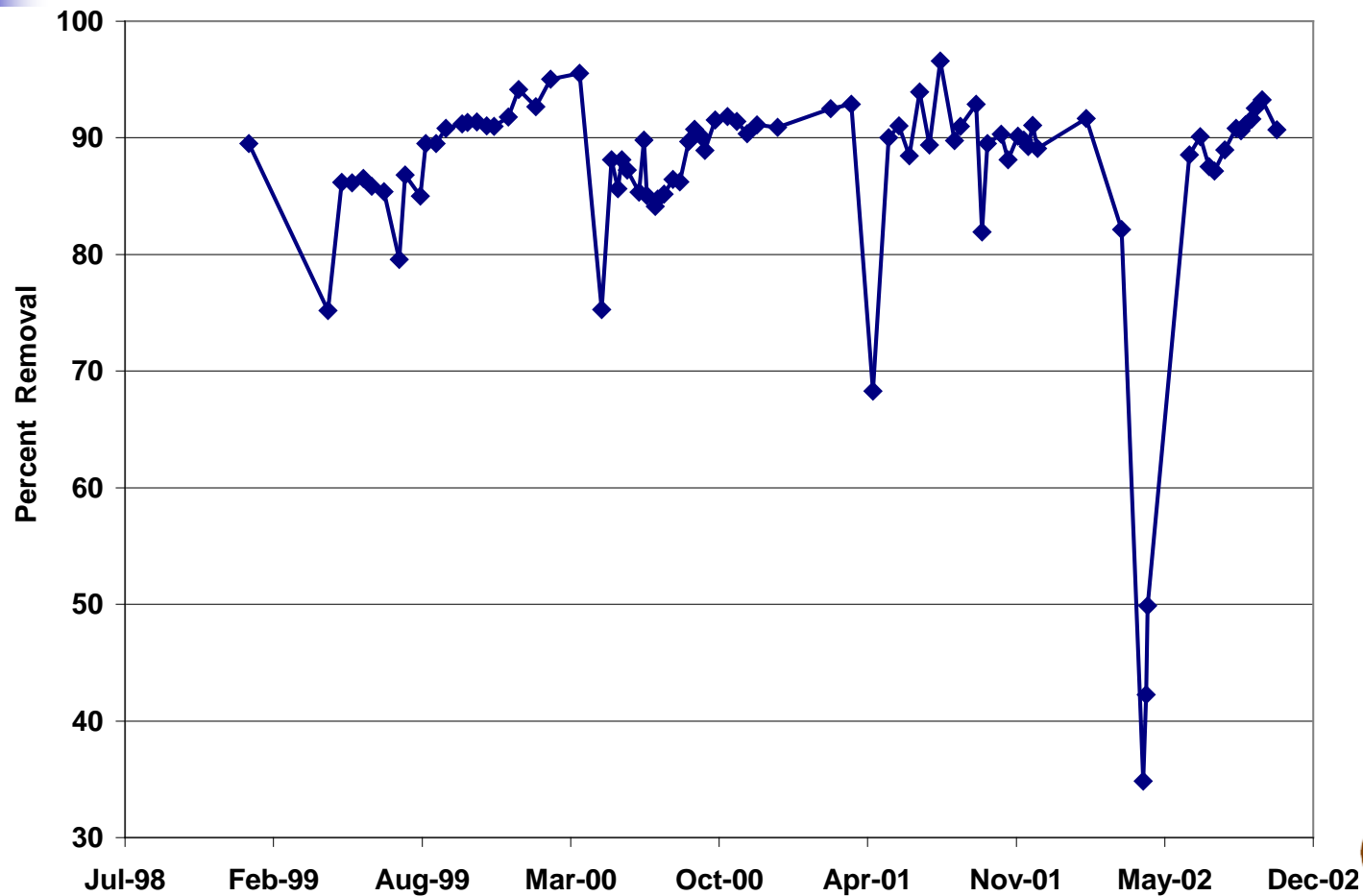
## Molybdenum





# S5 Performance To Date

## Molybdenum Removal





## S5 Performance

# 2001 Average Results

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(mg/l)	Seepage	Discharge	Culvert
Molybdenum	4.56	0.58	0.48
Copper	0.0033	0.0029	0.0026
Iron	0.052	0.267	0.057
Sulphate	291	173	116





## S5 Performance

# 2001 Average Results

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(mg/l)	Seepage	Discharge	Culvert
Total Nitrogen	0.24	1.32	0.43
Ammonia	0.015	0.627	0.027
Total Phosphate	0.023	1.09	0.158
Manganese	0.14	0.55	0.12



## S5 Performance

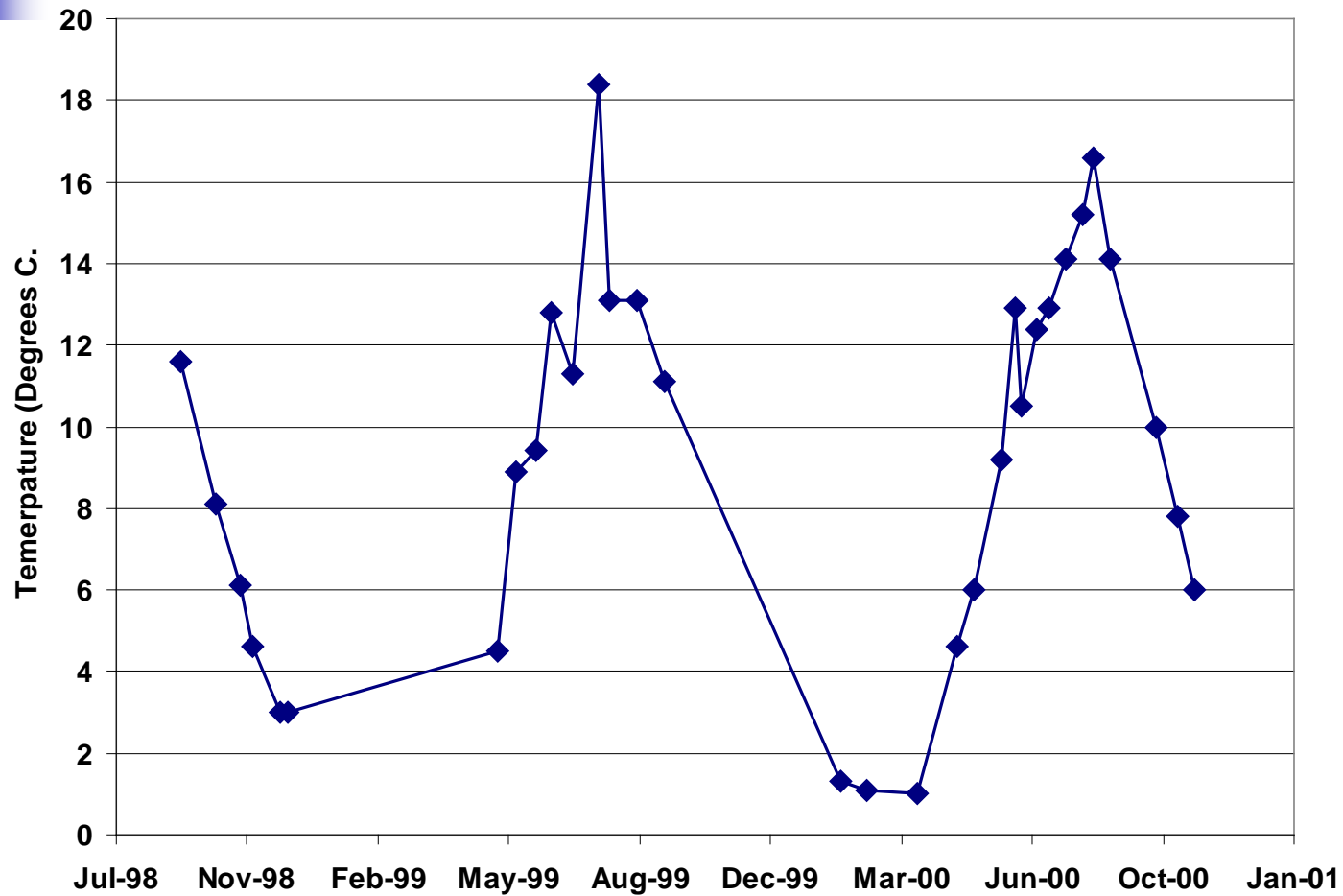
# 2001 Average Results

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	Range	Average
Redox (mv)		
Seepage	+60 to +165	+131
Discharge	-530 to -555	-546
pH		
Seepage	7.28 to 8.42	8.04
Discharge	7.28 to 8.25	7.76

# S5 Performance To Date

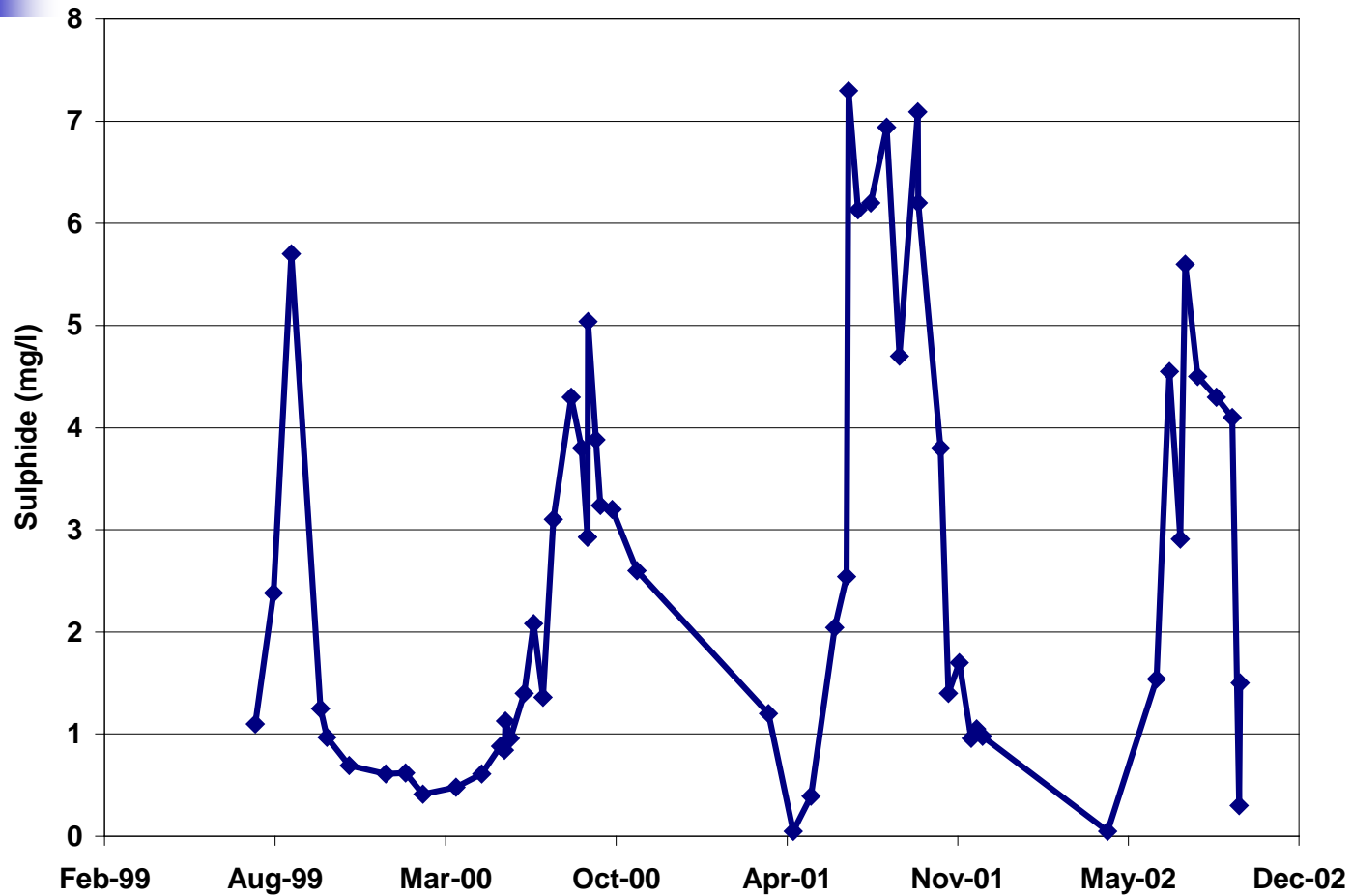
## Temperature





# S5 Performance To Date

## Sulphide





# S5 Performance To Date

## Limiting Factors

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- **Molybdenum Removal**
  - Low water temperature
  - Availability of simple carbon
- **Volumetric Throughput**
  - Bed permeability

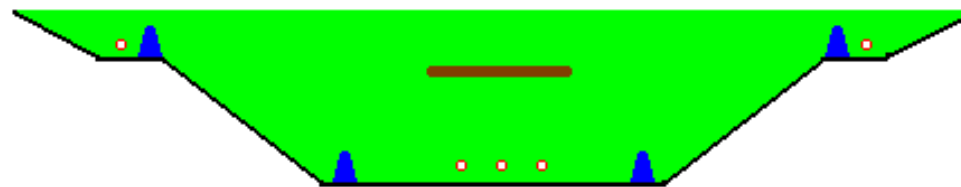


# Highmont Tailings Pond





# S8 Installation








S8 North/South cross-section



S8 East/West cross-section  
containing all planes of reference

## LEGEND

-  SHORT CIRCUIT PREVENTION PLYWOOD
-  SHORT CIRCUIT PREVENTION CURBS
-  GEOTEXTILE AND PVC LINER
-  PERFORATED PIPE
-  FILTER MEDIA

Drawn By: Rudolf Zdravljje

Date: Aug 10th, 2002

Scale: N.T.S.

# S8 Installation





# S8 Pond Installation





# S8 Pond Installation



# S8 Pond Installation





# Acknowledgement

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**Heather Larratt  
H. M. Larratt Aquatic Consulting  
Kelowna, BC**

