

# 2008 Annual Reports

## Tailings



June 2, 2009

# Presentation Outline

- Placement data
- Stability
  - Compaction
  - Inspections
- Water level data
- Precipitation and flow data
- Water quality at internal monitoring sites
- Snow sample results
- Sulfate Reduction Monitoring Program (SRMP) update
- ABA data
- General site management and co-disposal

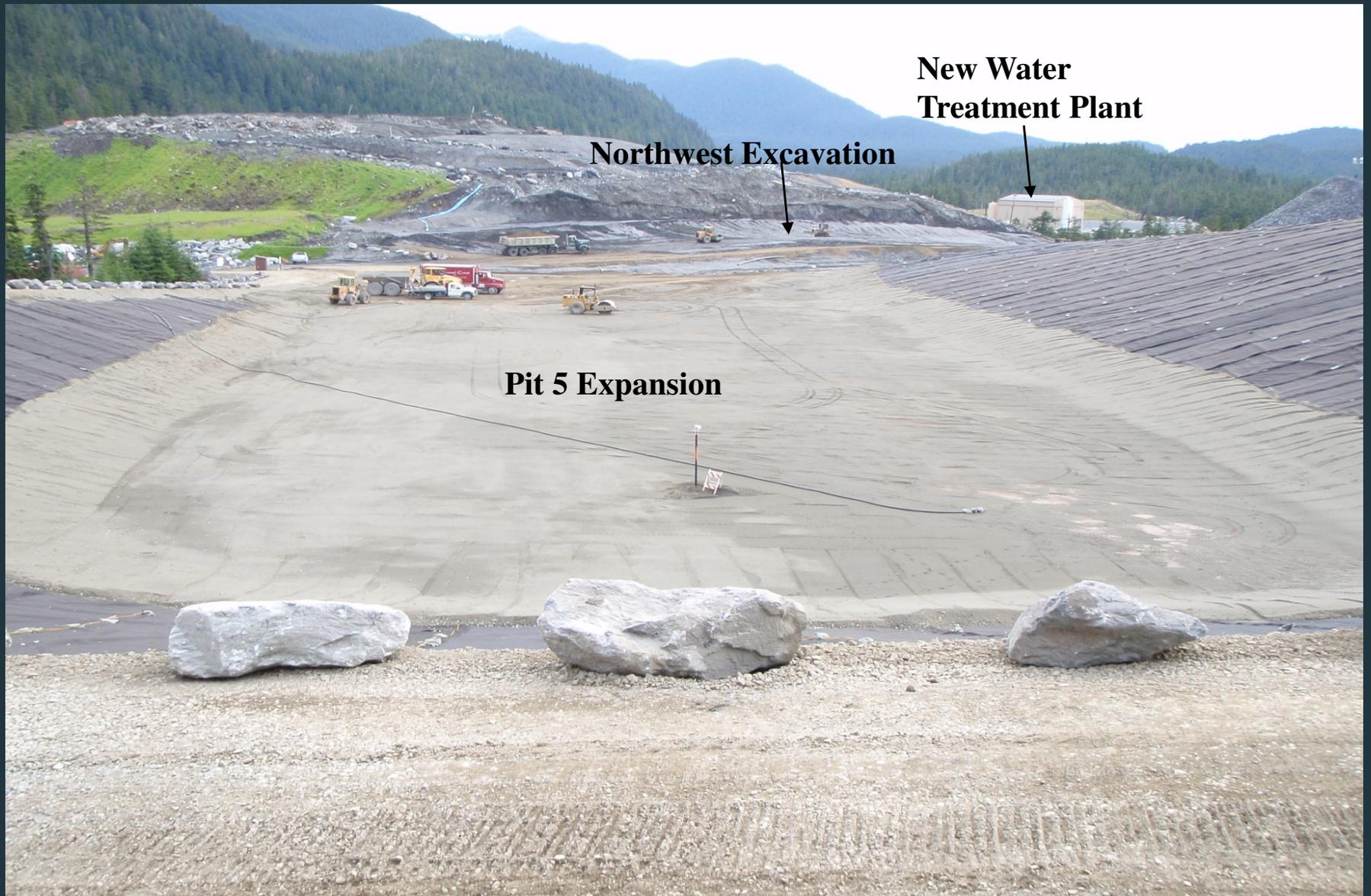
# Tailings Facility Sept. 2007

**Hecla**  
MINING COMPANY



# 2008 Pit 5 Looking South

**Hecla**  
MINING COMPANY



# Table 2.1 Tailings Placement Data



	All Materials Annual	All Materials Cumulative	All Materials Annual	All Materials Cumulative	Prod Rock from Site 23	Other Materials	Tailings
	yd <sup>3</sup>	yd <sup>3</sup>	Tons	Tons	Tons	Tons	Tons
	<i>Survey</i>	<i>Survey</i>	<i>Calculated</i>	<i>Calculated</i>	<i>Truck Count</i>	<i>Truck Count</i>	<i>Calculated</i>
<b>Totals</b>							
<b>2007</b>	215,575	2,648,842	390,557	4,798,255	39,425	16,285	334,847
<b>Totals</b>							
<b>2008</b>	201,658	2,850,140	365,344	5,163,598	25,679	62,395	277,270

Tons calculated at 134.2 pounds per cubic foot for tailings.

Remaining capacity approx 4.4M tons

# Tailings Facility Stability Compaction

- High degree of achieving >90% compaction
- Average dry density: 138 pcf
- Average Standard Proctor dry density: 143 pcf
- Average optimum percent moisture: 12.5%
- HGCMC on-site lab 1-point Proctors
  - Average dry density: 147 pcf
  - Average percent moisture: 12.5%

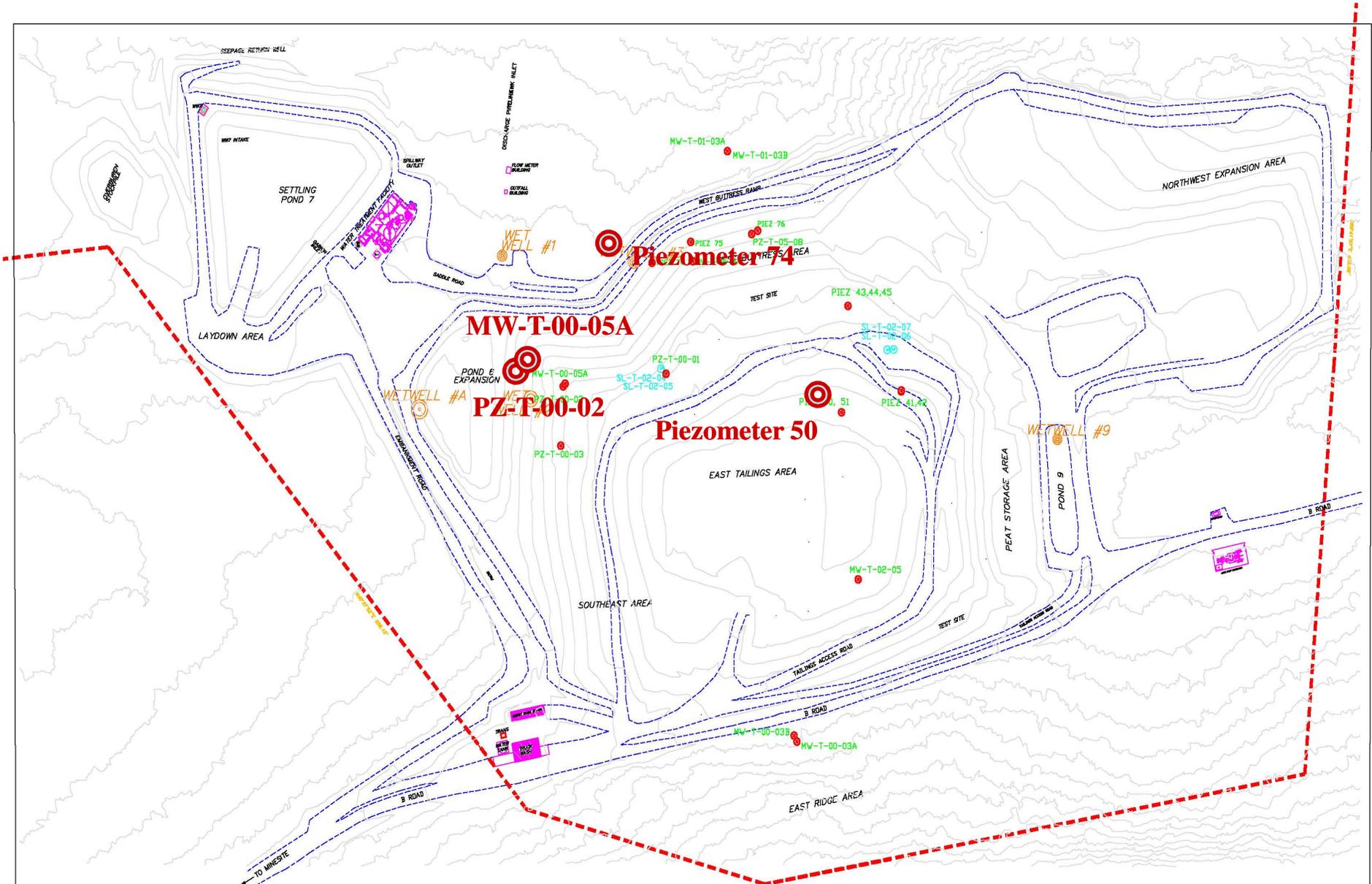
# Tailings Facility Stability - Inspections

- Results of operator, engineering, environmental department and regulatory inspections revealed no signs of instability
- 2008 WMP Audit by SRK
- Agency Inspections
  - USFS - 21
  - ADEC - 4
  - DNR - 2

# Tailings Facility Monitoring Well and Piezometer Water Level Data

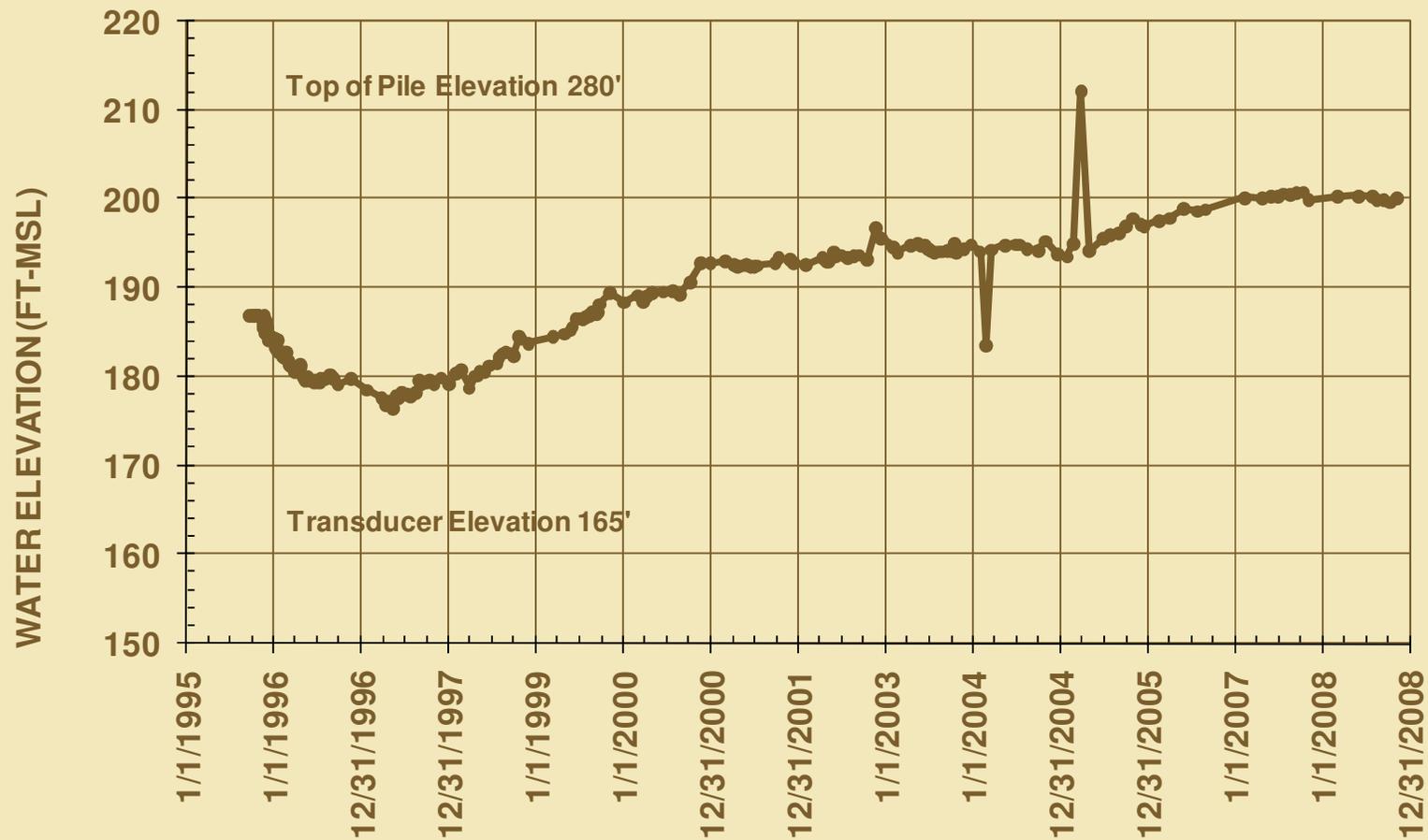


- Maximum saturated thickness 35 feet
- Toe foundations are well drained
- Water perches approximately 12 feet above the unsaturated underdrains

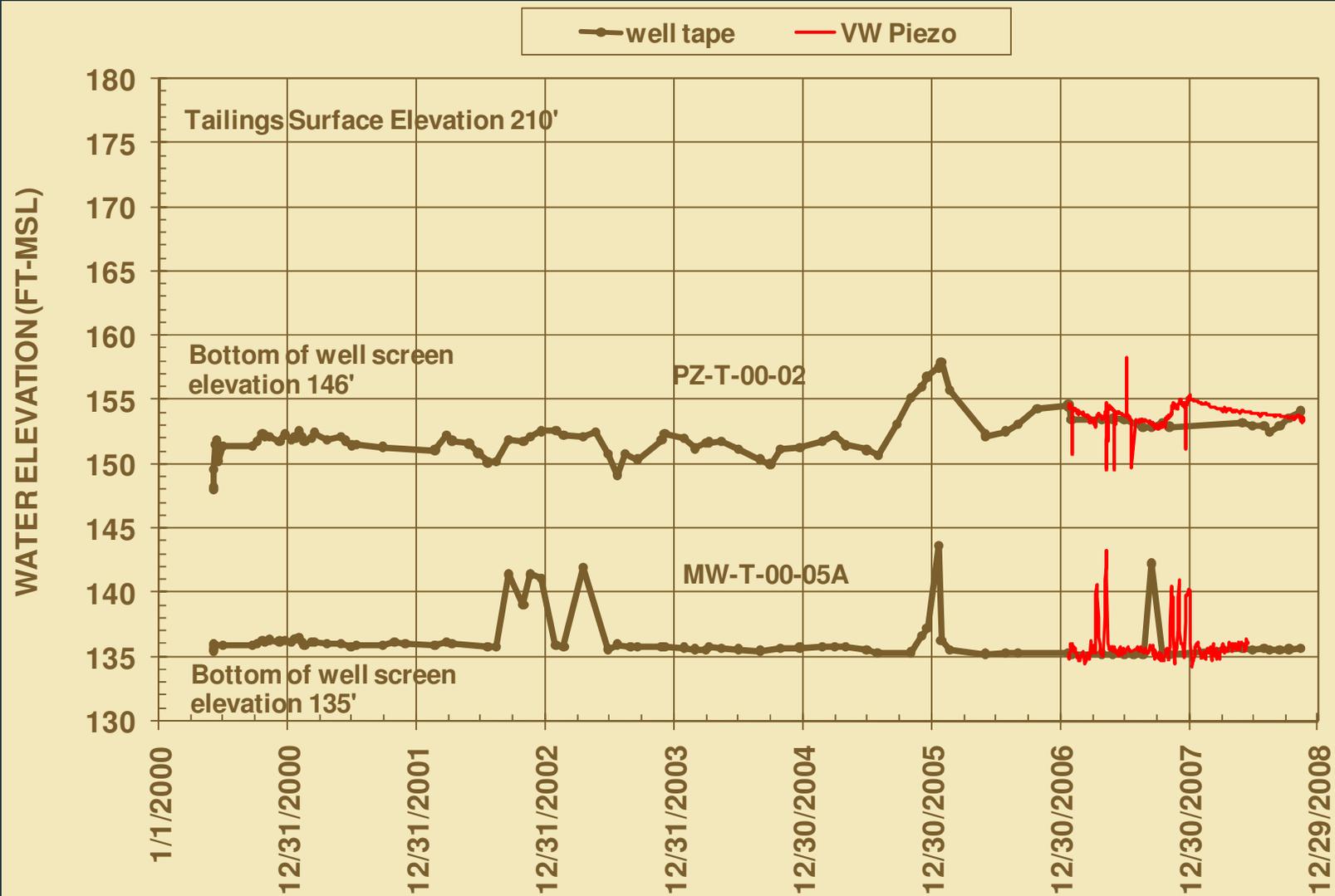


	<b>LEGEND:</b> ROADS/DITCHES: ——— WATER UTILS: - - - - - BOUNDARY: - - - - - MONITORING WELL: ● PIEZOMETER: ○ WET WELL: ⊙	<b>HECLA GREENS CREEK MINING CO.</b> P.O. BOX 32199 JUNEAU, ALASKA 99803 PHONE: (907)790-8441 FAX: (907)790-8448
	DATE: 11-31-08 DRAWING BY: Shelby Edwards DESIGN BY: _____ REVIEWED BY: _____ PROJ OR REF: _____	<b>TITLE:</b> Tailings Asbuilt Annual Report Instruments
		SHEET: 1 OF 1

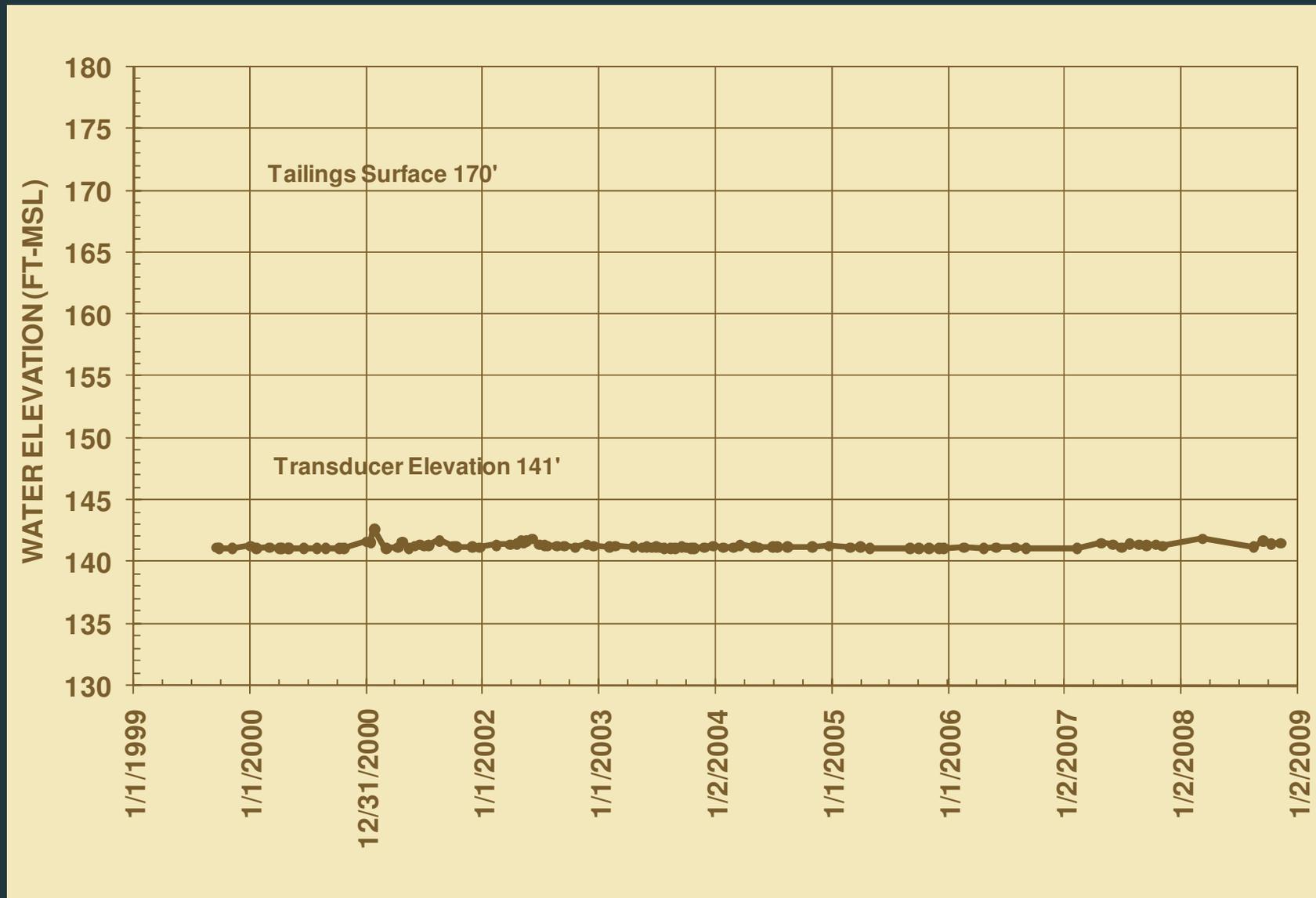
# Figure 2.6 Water Level Data for Piezometer 50



# PZ-T-00-02 and MW-T-00-05A Data Figures 2.12 and 2.14



# Figure 2.8 Water Level Data for Piezometer 74



# Table 2.4 Monthly Summary of Tailings Area Climate Data

Month	Avg Temp ( °C )	Precipitation (in)
January	-2.6	4.7
February	-2.3	4.9
March	1.7	3.9
April	3.3	4.6
May	7.9	3.2
June	9.7	2.8
July	11.6	5.9
August	12.0	3.8
September	9.8	8.2
October	5.1	9.9
November	2.5	5.0
December	-3.3	3.6
2008	4.6	60.5

# Tailings Facility Internal Monitoring Sites: Water Quality Data



- Internal site waters captured, treated and discharged per NPDES permit
- pH between 6.0 and 8.5: Alkalinity 250 to 600 mg/L
- Conductivity in wet wells and tailings completion wells ranged from 1400 to 3700 umho/cm
- Conductivity in suction lysimeters ranged from 1400 to 6600 umho/cm
- Sulfate and hardness correlate with conductivity

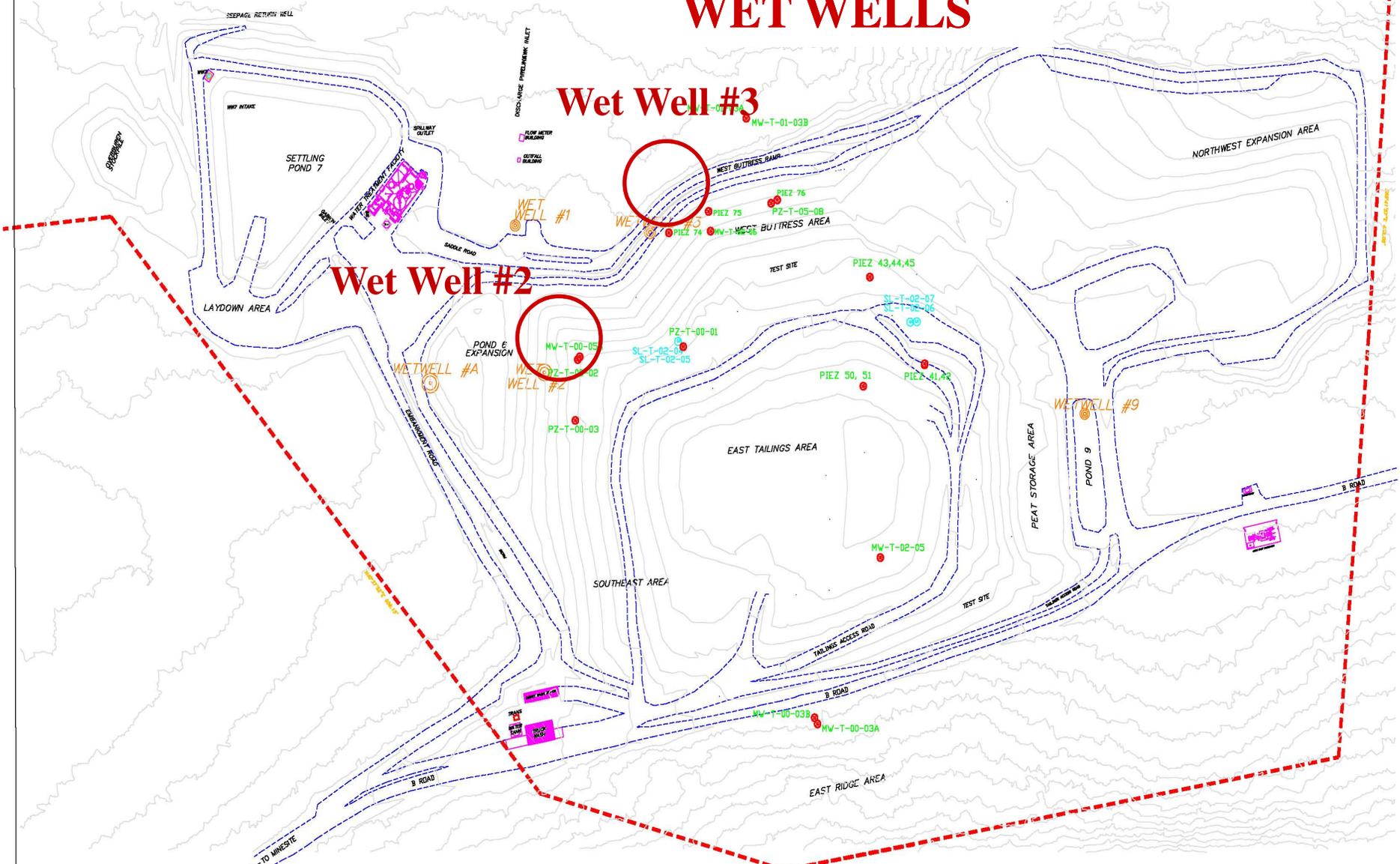
# Tailings Facility Internal Monitoring

## Sites: Water Quality Data



- Fluctuations in saturated zone thickness and associated redox conditions influence arsenic and iron concentrations
- Zinc is considerably more mobile than other metals
- Microbial sulfate reduction and base metal sulfide precipitation produces low metal concentrations in most saturated zone wells
- Shallow unsaturated zone and WW3 have higher metal concentrations
- Iron and manganese concentrations are elevated in wet wells, groundwater, and most of the suction lysimeters due to oxidation/reduction and buffering reactions

# WET WELLS



**Wet Well #3**

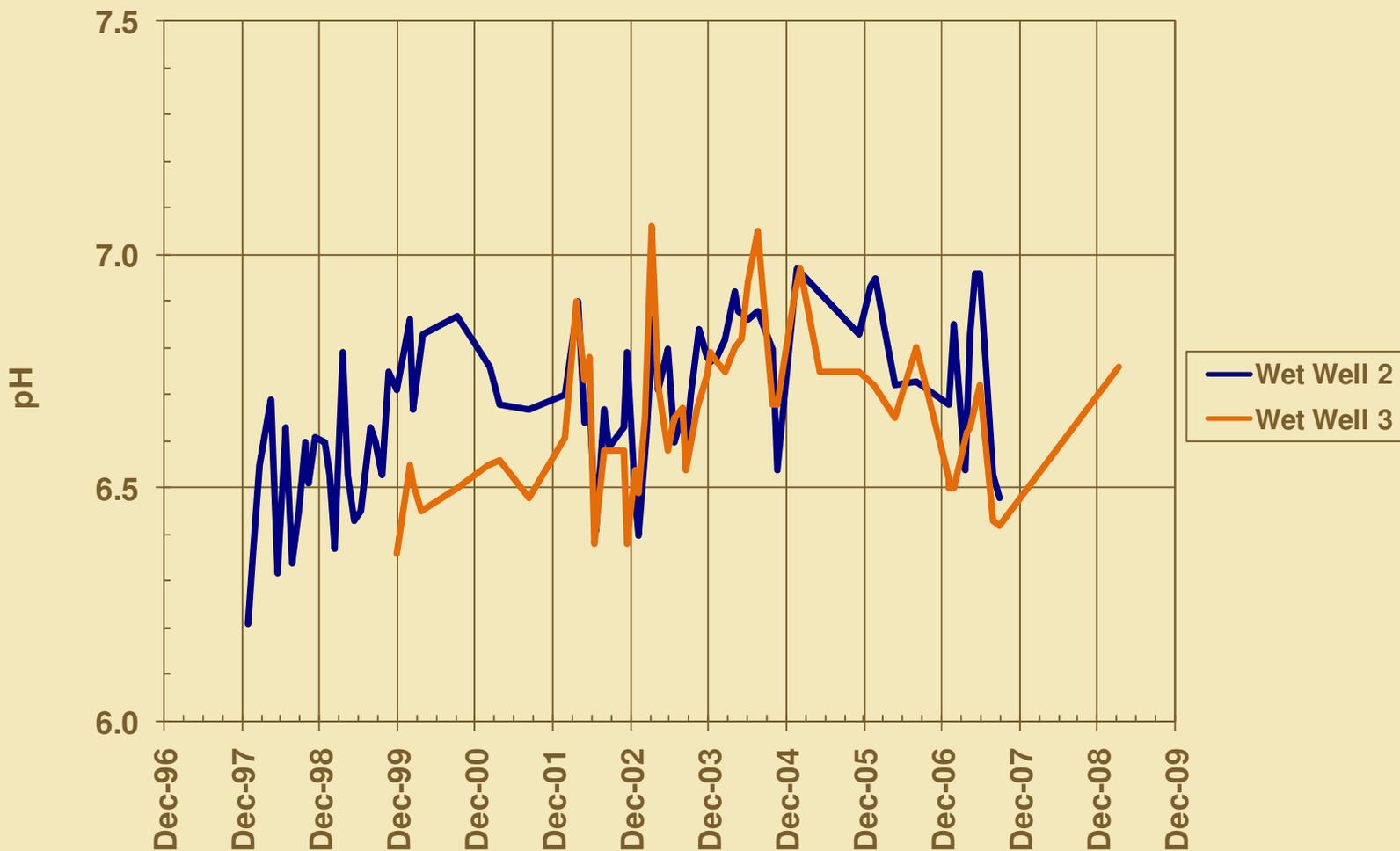
**Wet Well #2**

LEGEND:	
ROADS/DITCHES	
WATER UTILS	
BOUNDARY	
MONITORING WELL	
PIEZOMETER	
WET WELL	

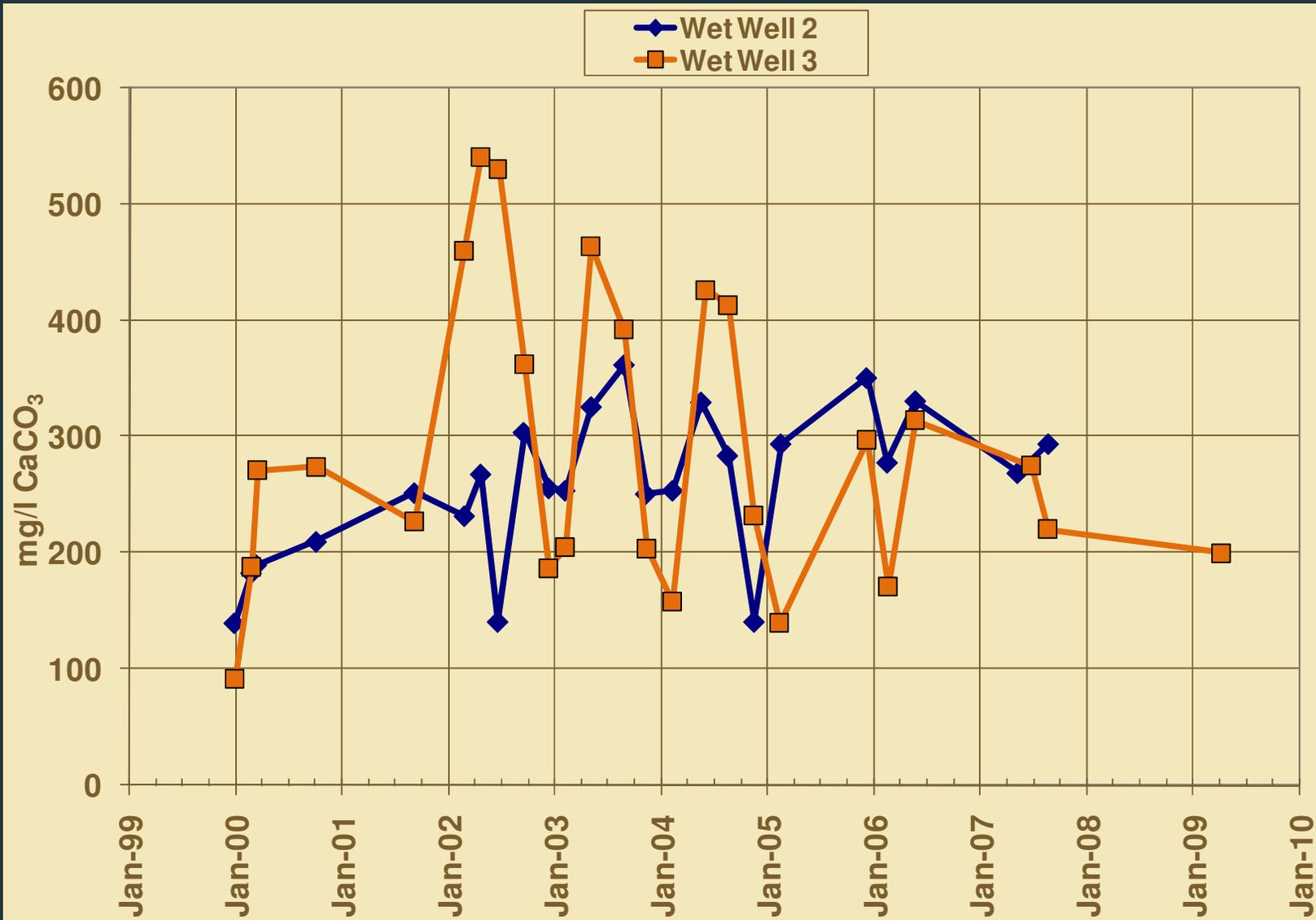
DATE:	11-31-08
DRAWING BY:	Shelby Edwards
DESIGN BY:	
REVIEWED BY:	
PROJ OR REF:	

HECLA GREENS CREEK MINING CO. P.O. BOX 32199 JUNEAU, ALASKA 99803 PHONE: (907)790-8441 FAX: (907)790-8448	
TITLE: Tailings Asbuilt Annual Report Instruments	
GRAPHIC SCALE: 1" = 50'	SHEET: 1 OF 1

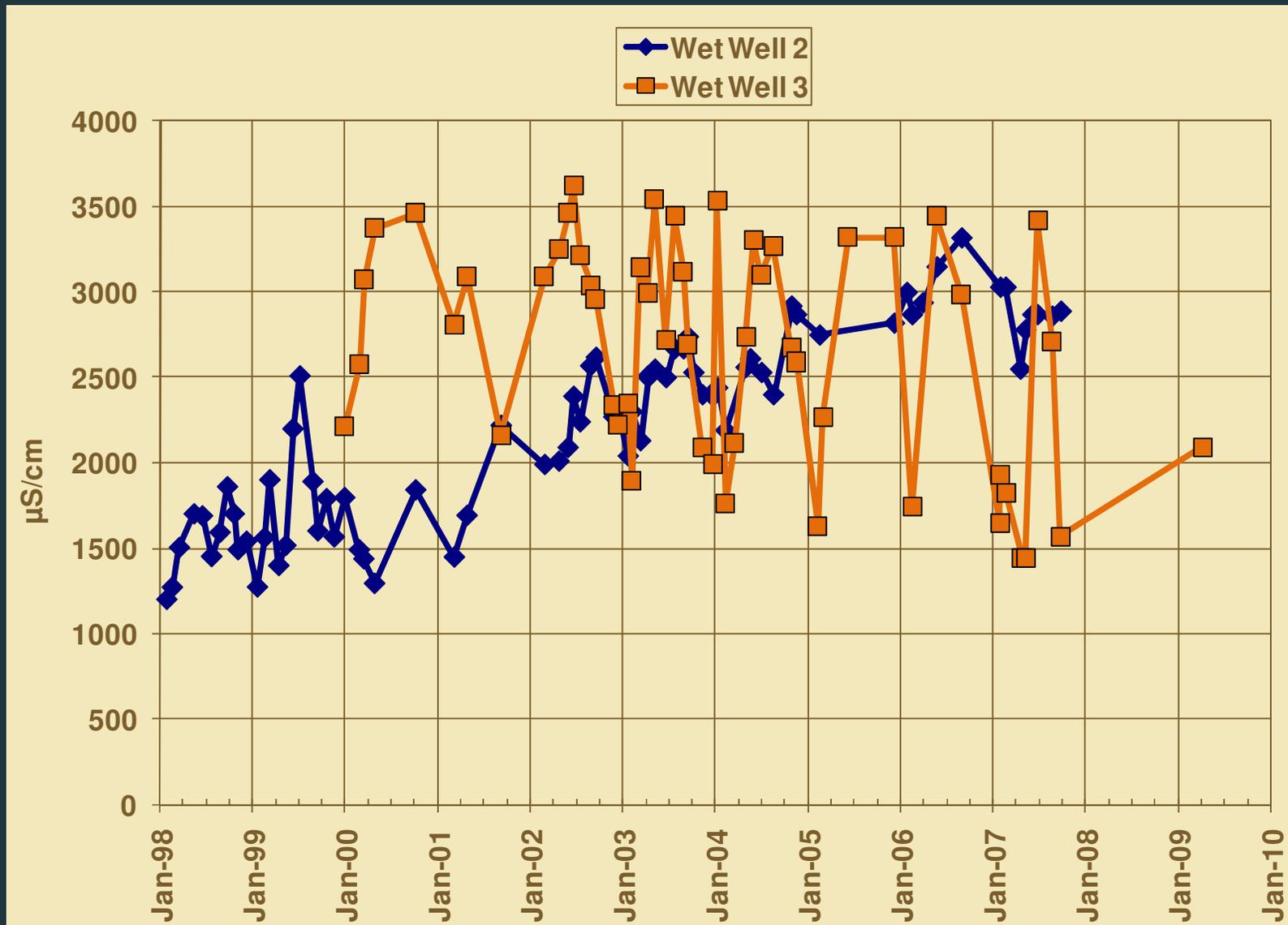
# Tailings Area Internal Sites pH - Figure 2.20a



# Tailings Area Internal Sites Alkalinity - Figure 2.21a



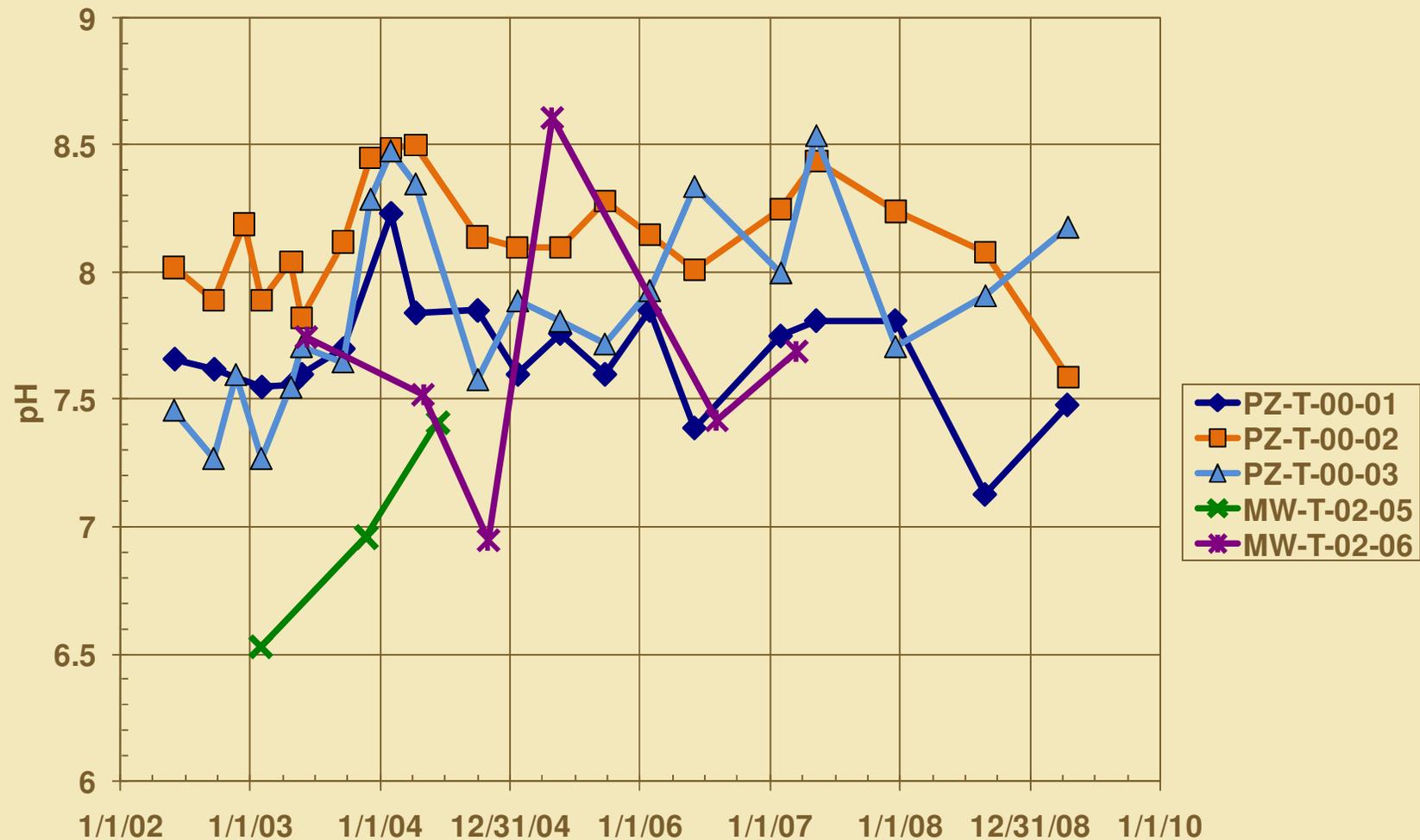
# Tailings Area Internal Sites Conductivity - Figure 2.22a



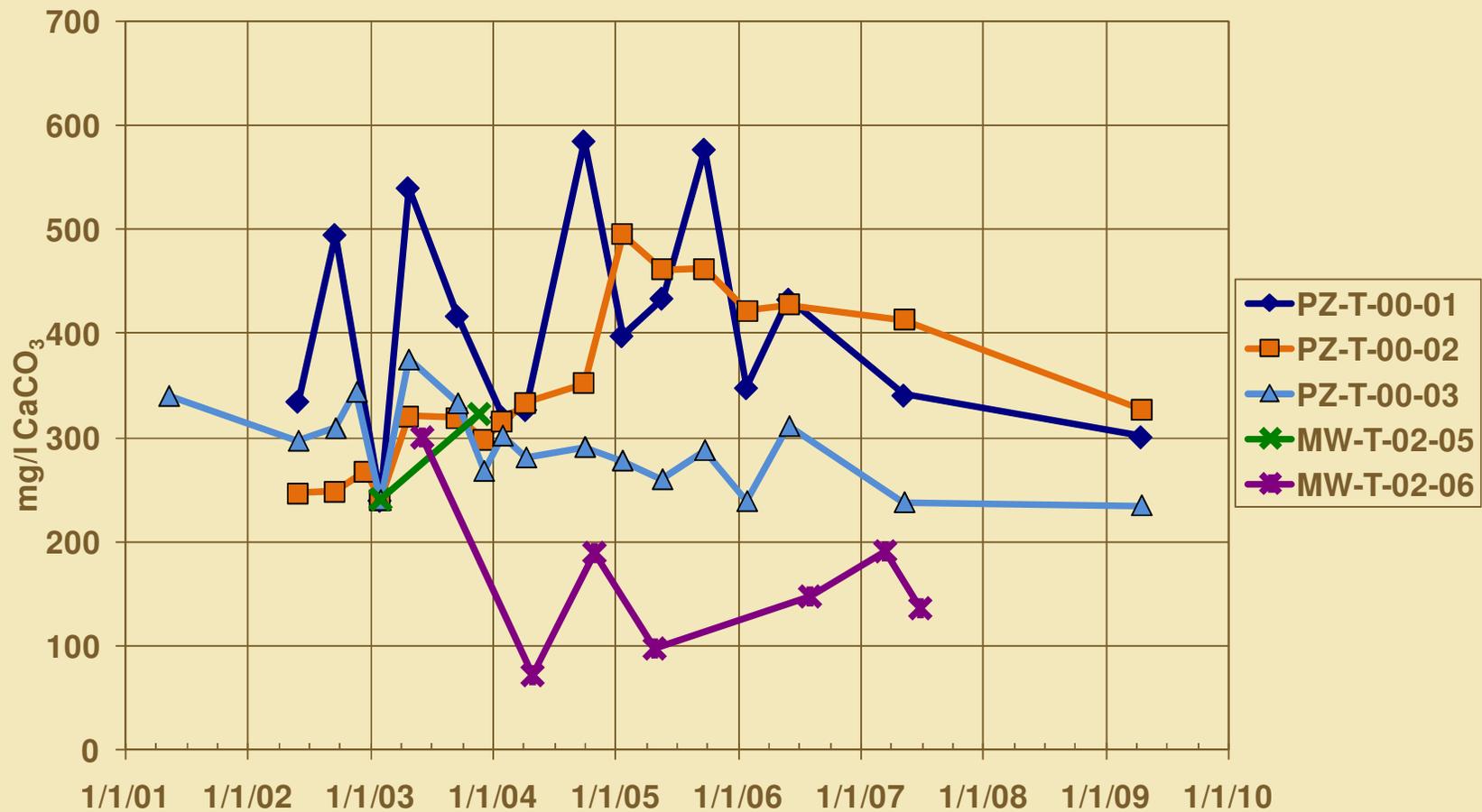




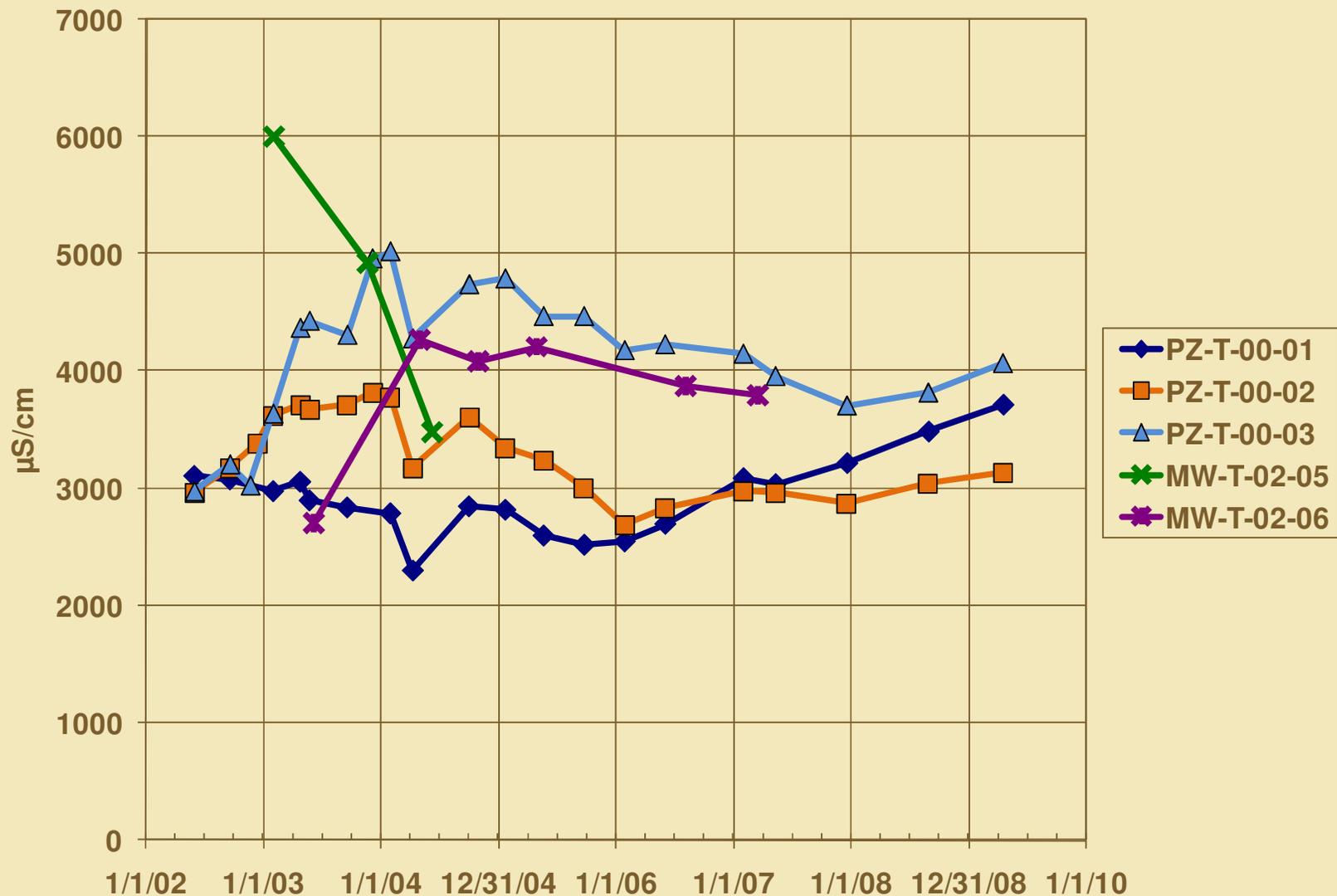
# Tailings Area Internal Sites pH Figure 2.20b



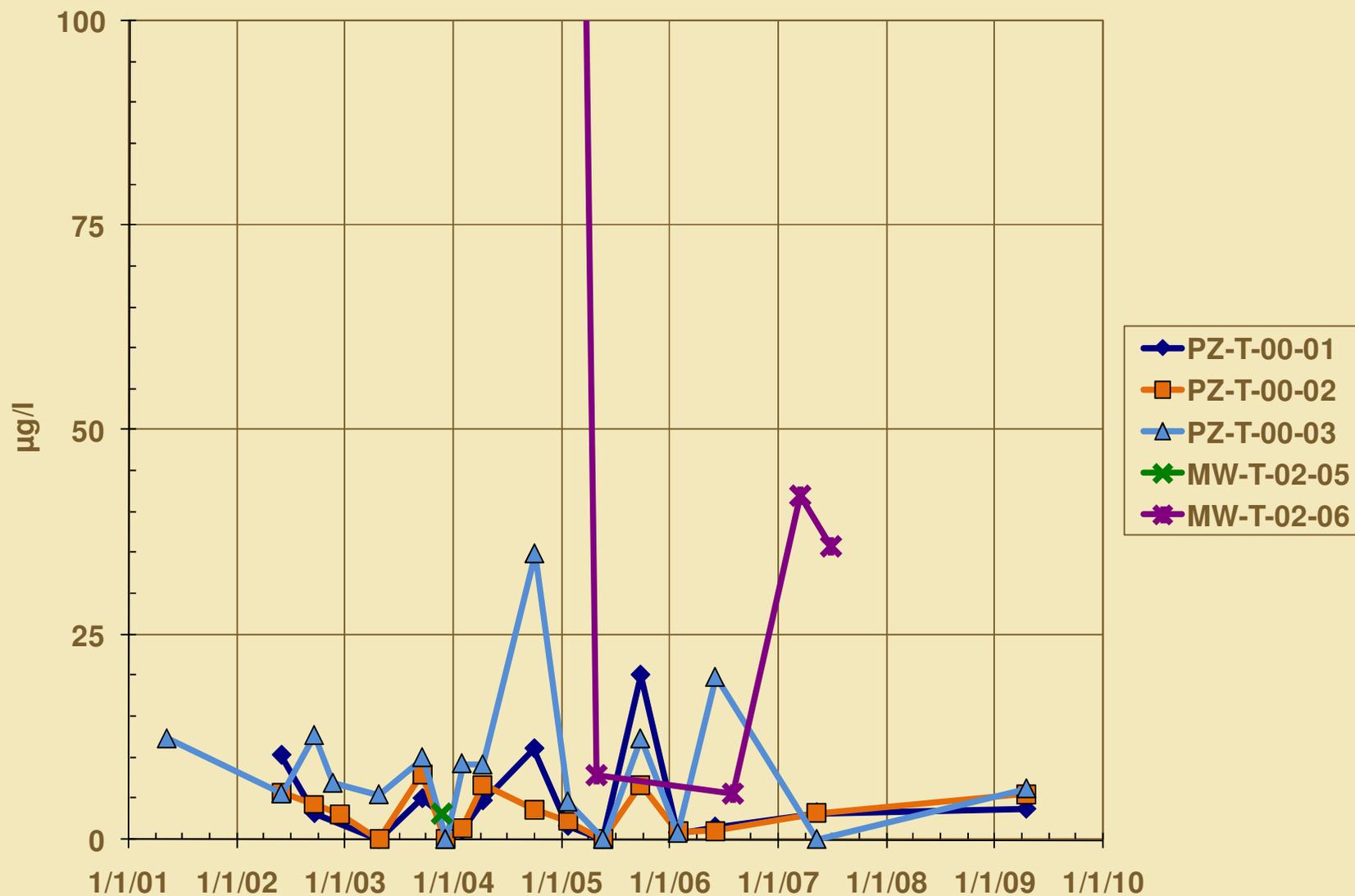
# Tailings Area Internal Sites Alkalinity - Figure 2.21b



# Tailings Area Internal Sites Conductivity - Figure 2.22b

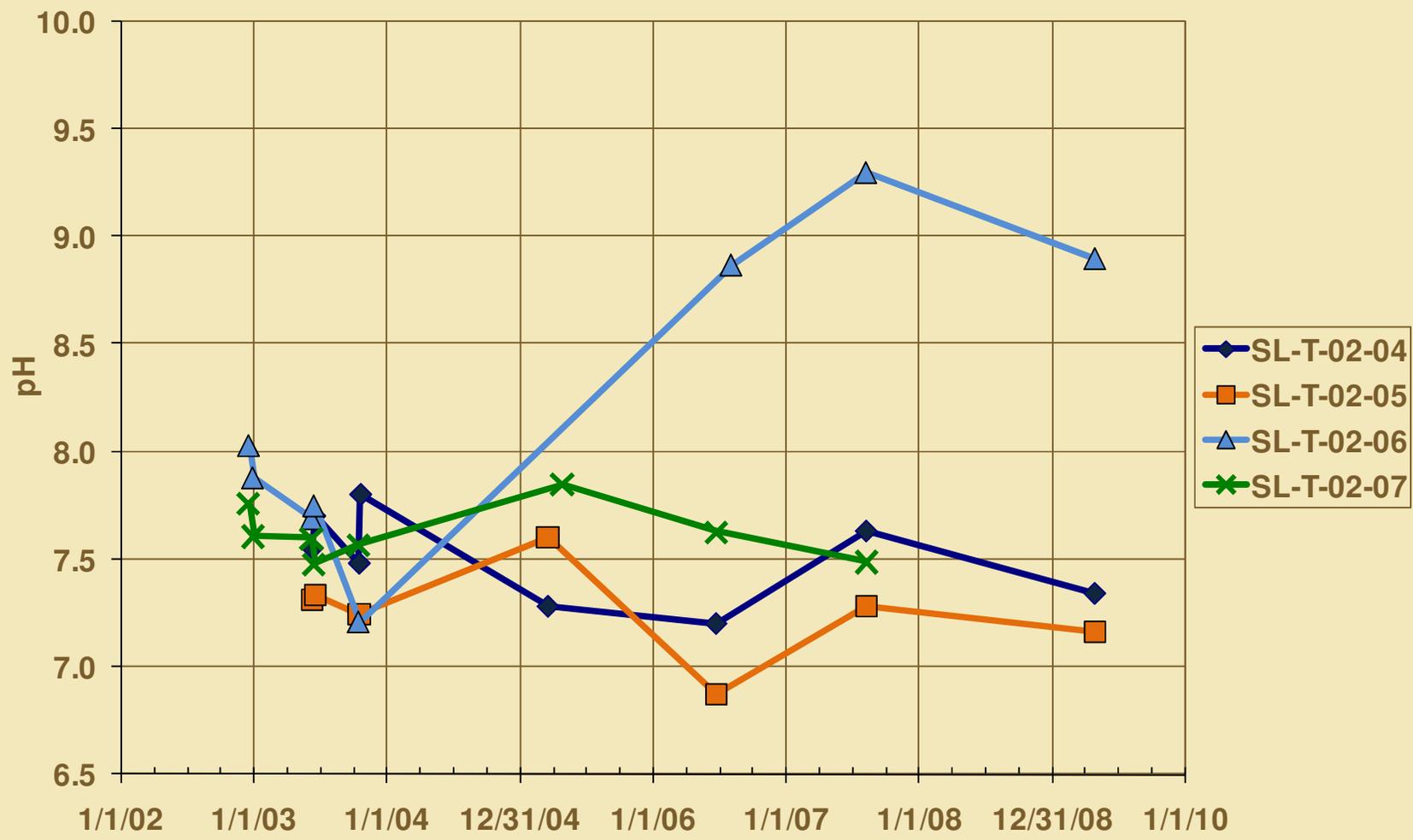


# Tailings Area Internal Sites Zinc - Figure 2.26b

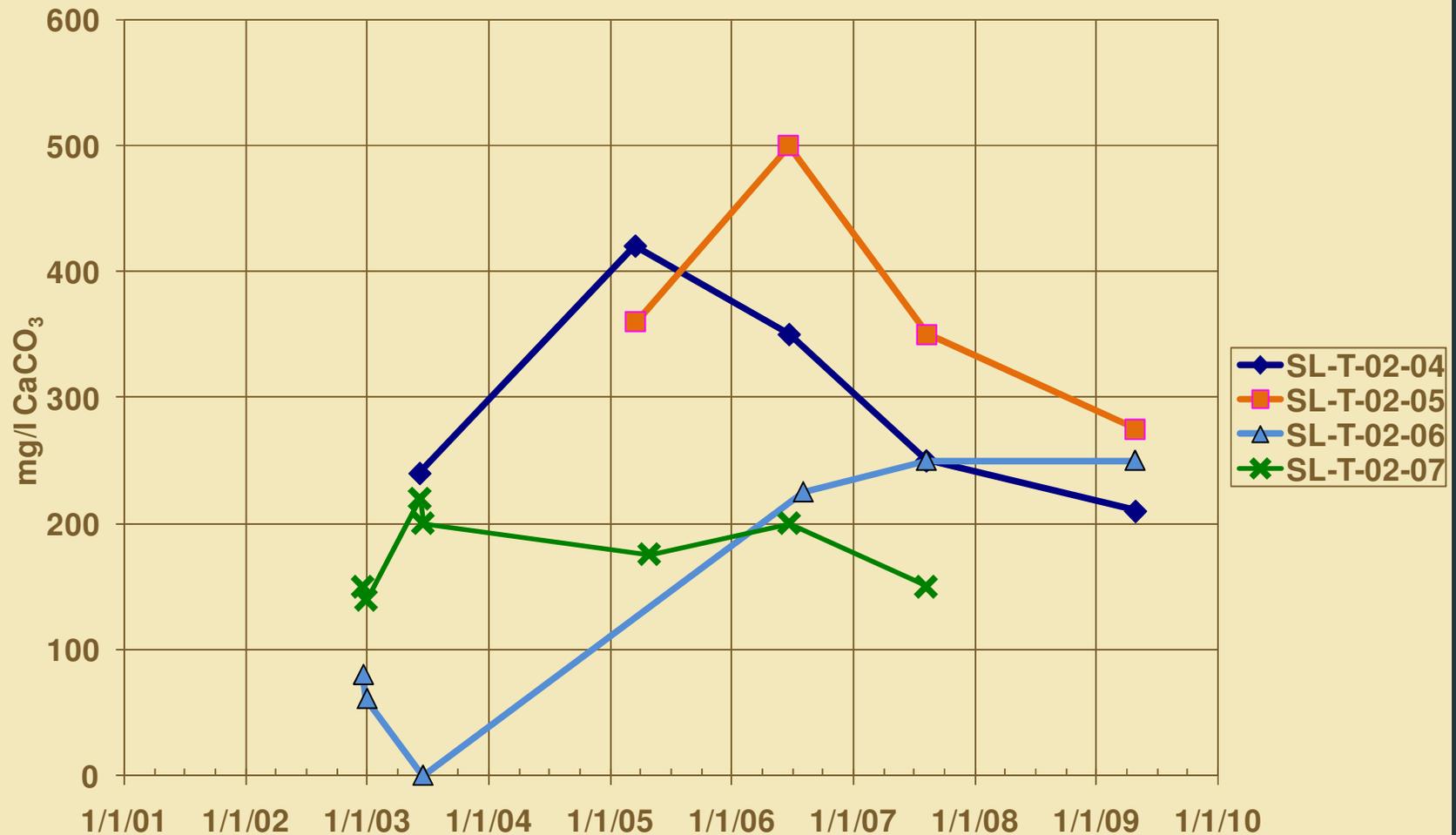




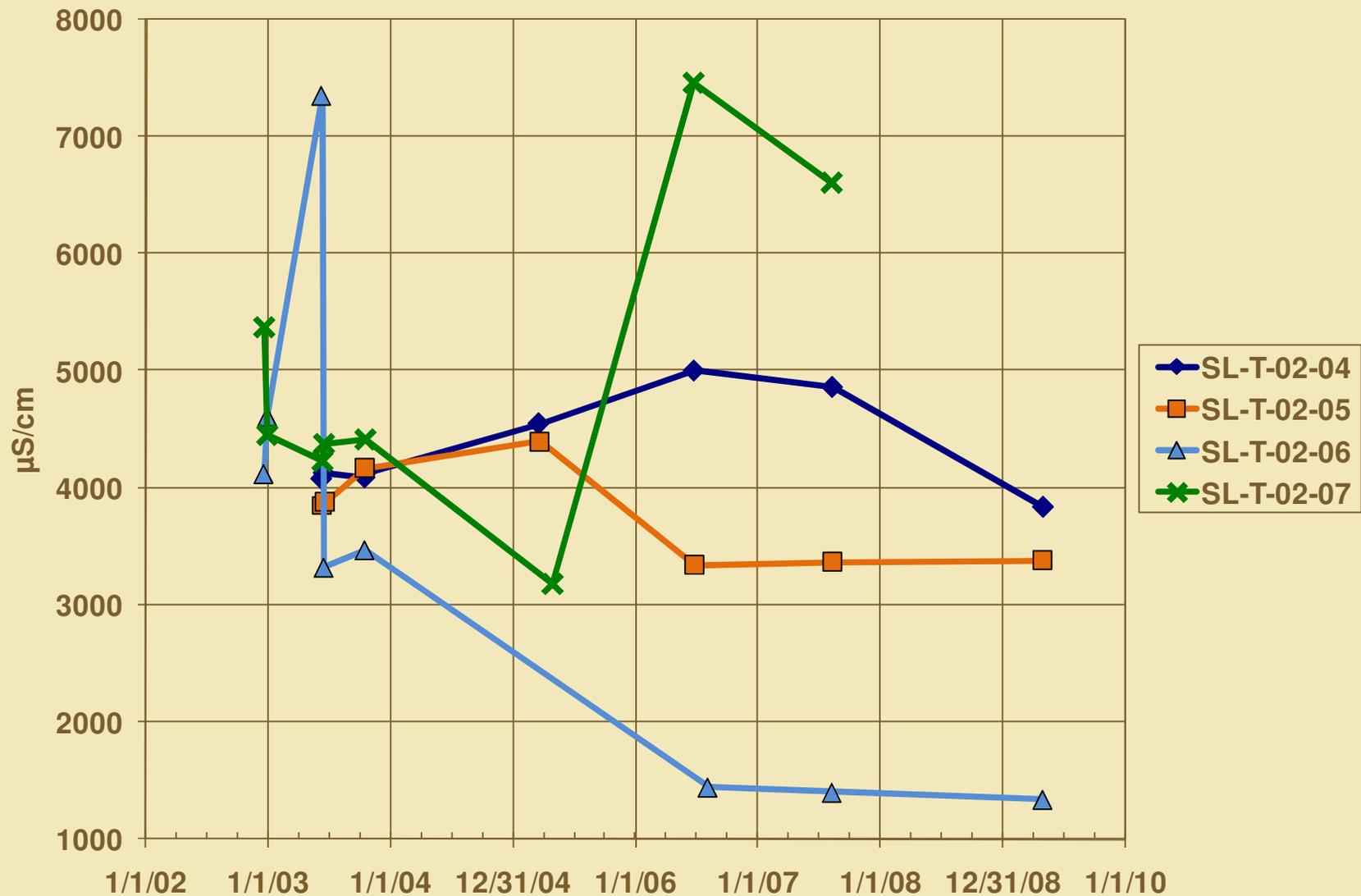
# Tailings Area Internal Sites pH - Figure 2.20c



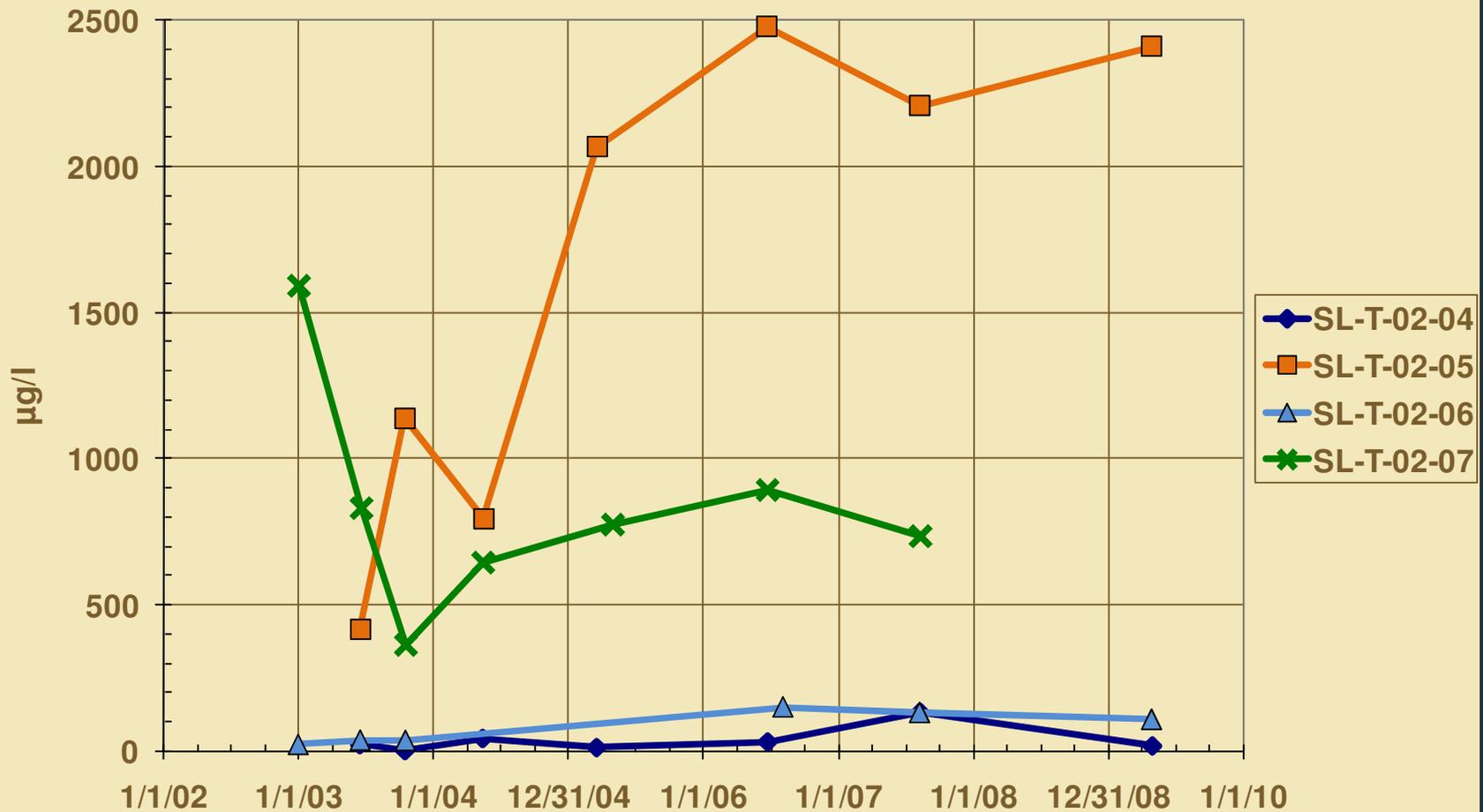
# Tailings Area Internal Sites Alkalinity - Figure 2.21c



# Tailings Area Internal Sites Conductivity - Figure 2.22c



# Tailings Area Internal Sites Zinc - Figure 2.26c



# Tailings Facility Additional Monitoring

- Perimeter wells exhibit chemistry comparable to background waters
- Pyritic rock used locally for access roads produced acidic drainage in two areas (The pyritic rock was removed from both locations)
  - Water quality shows improvement in response to remediation efforts
- Residual sulfate and metal concentrations are very low relative to contact waters but higher than background levels in localized areas
- Continued monitoring will determine the effects of other efforts to minimize loading (e.g. lined bedrock areas, improved truck wash, covering exposed slopes with rock and ditch sediments)

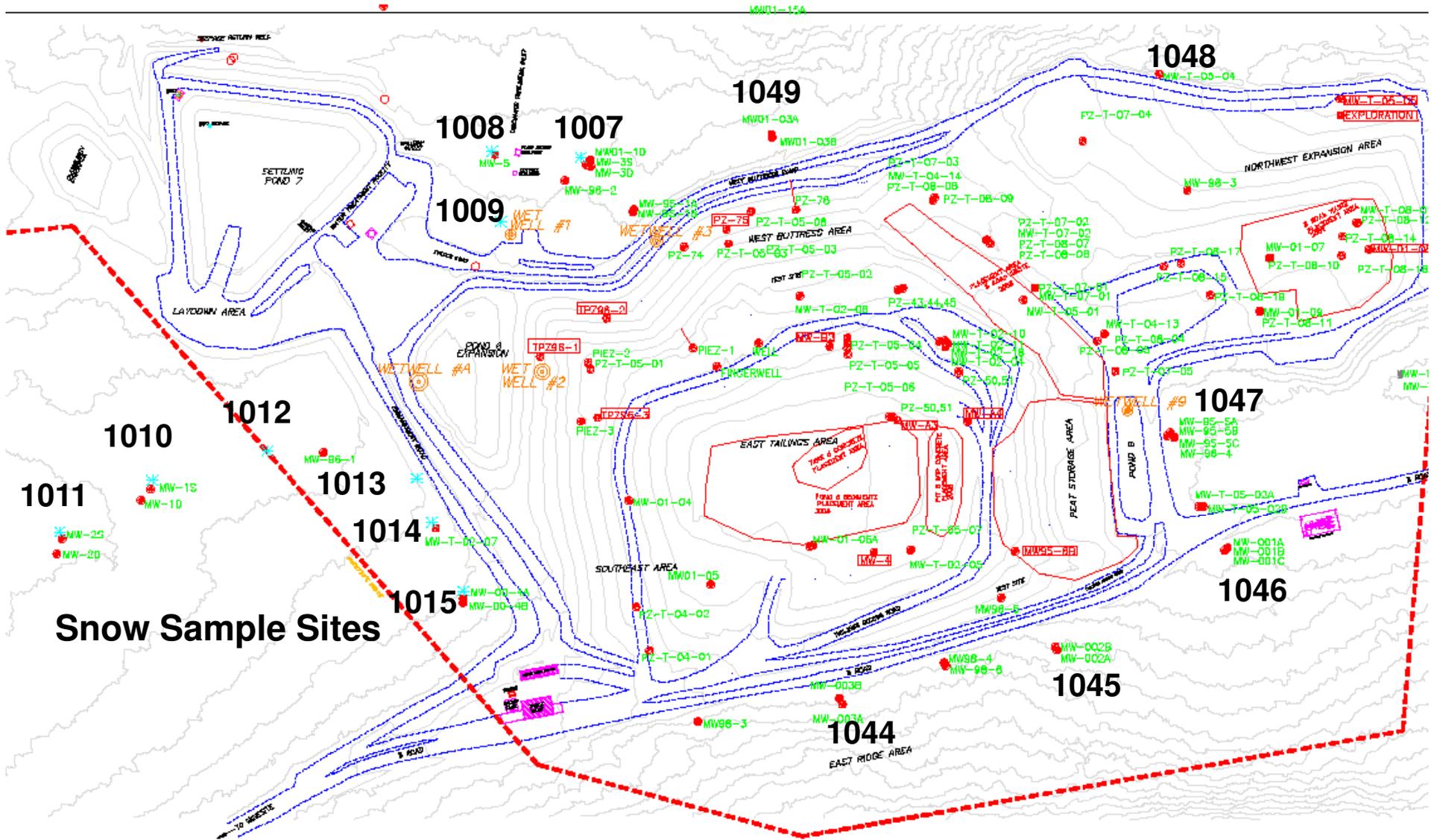
# Tails Snow Dust Sampling

**Hecla**  
MINING COMPANY



# Tails Snow Dust Sampling

- Mitigation
  - Snow Fences
  - Eco Blocks
  - Snow removal only in active placement area
- Lead levels in water do not directly correlate to lead loading values
- Observable up to approximately 1700 feet away
- Significant decrease in lead load over the past three years



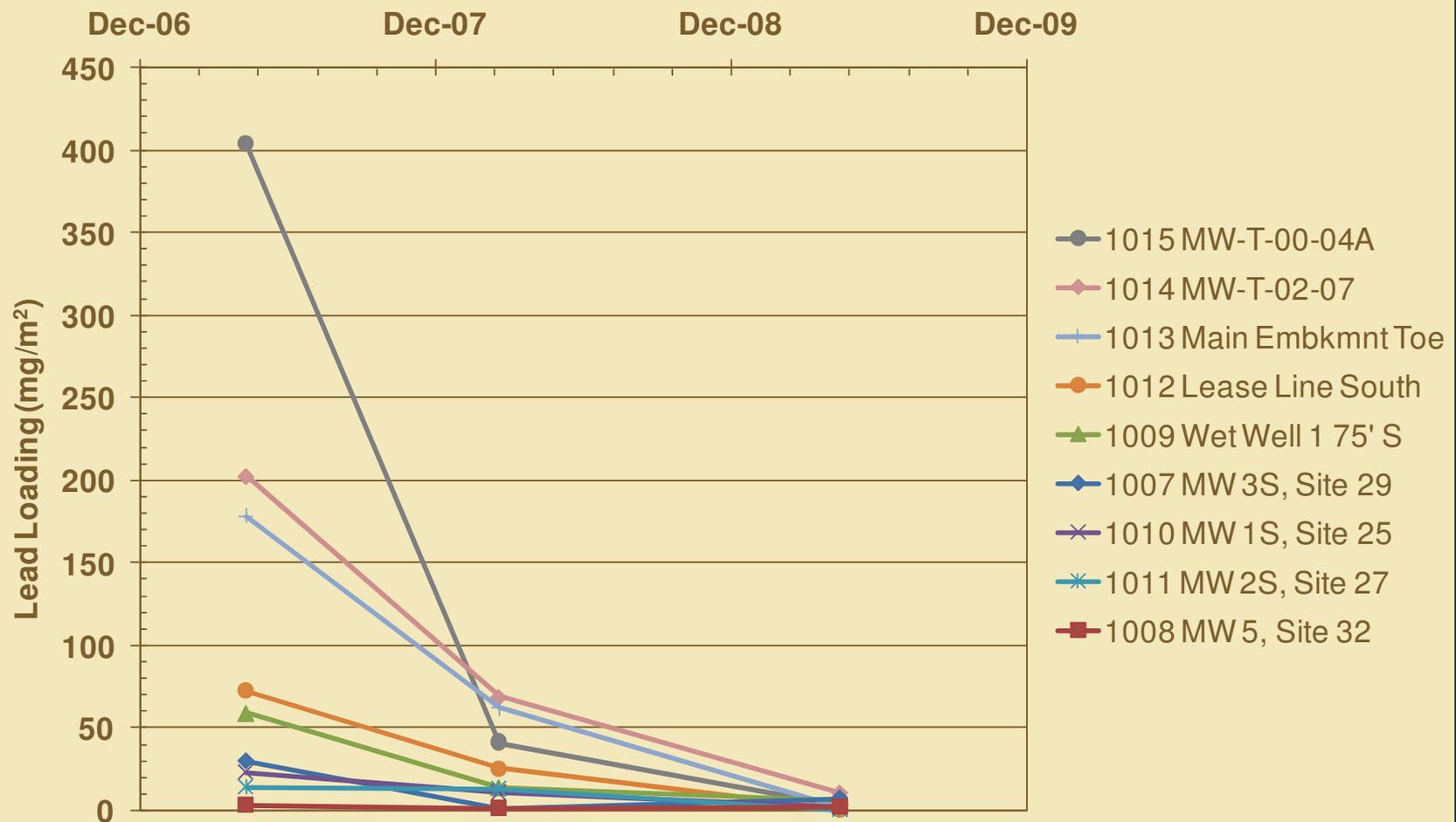
**Snow Sample Sites**

LEGEND:	
	ROADS/DITCHES
	WATER UTILITY
	BOUNDARY
	WATERING WELL
	PIEZOMETER
	WET WELL
	EXPLORATION
	SNOW SAMPLE LOCATION

DATE:	11-21-08
DRAWING BY:	Chadly Edwards
DESIGN BY:	
REVIEWED BY:	
PRINT OR REF:	

HECLA GREENS CREEK MINING CO. P.O. BOX 32190 JUNEAU, ALASKA 99903 PHONE: (907)790-8441 FAX: (907)790-8441	
TTC Tailings Asbuilt Wells and Piezometers	
GRAPHIC SCALE	
SHEET: 1 OF 5	

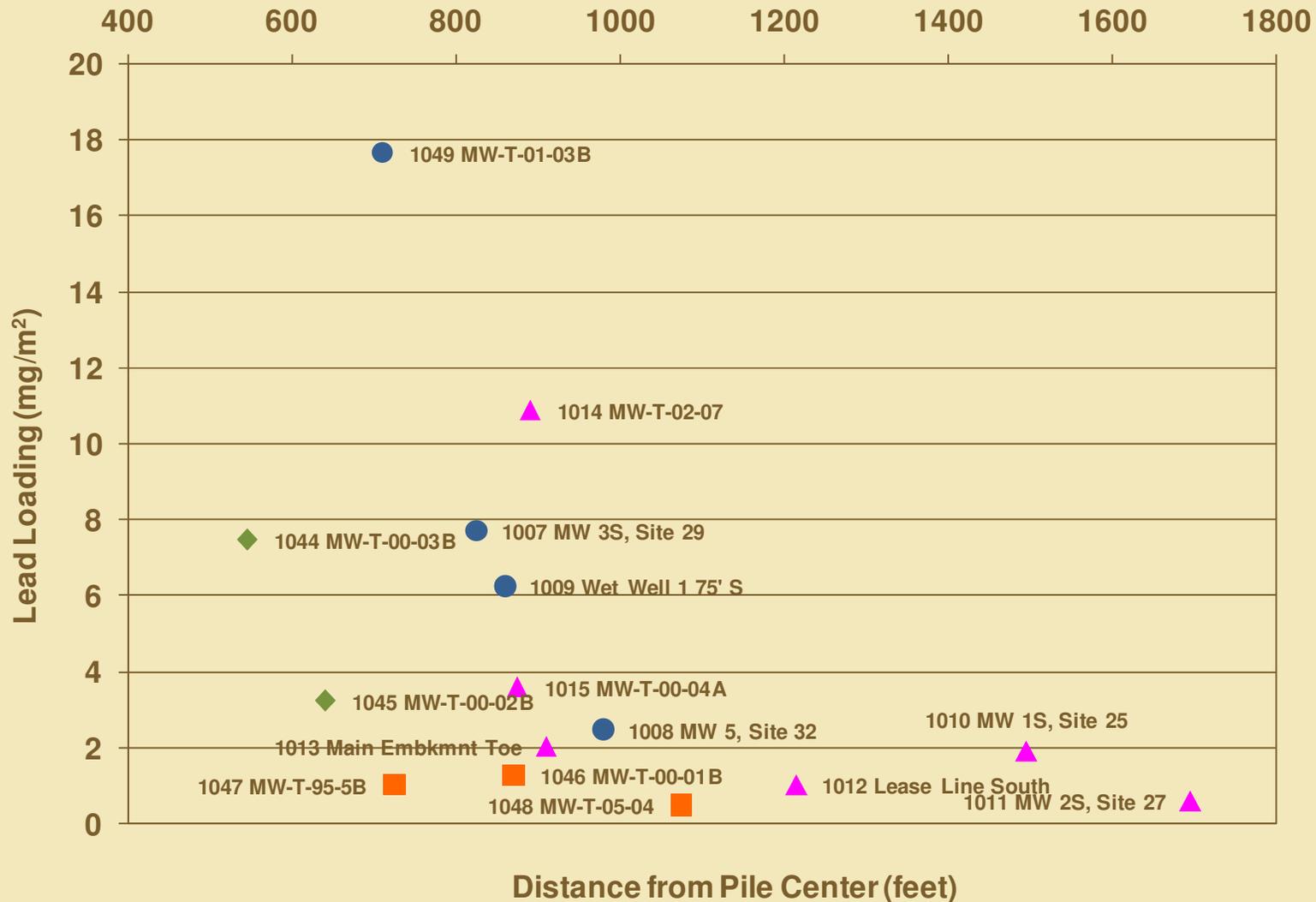
# Figure 2.35 Snow Survey Analysis



# Figure 2.35 Snow Survey Analysis



# Figure 2.35 Snow Survey Analysis



# Sulfate Reduction Monitoring Program (SRMP) Update

- Tailings Expansion EIS ROD required a study to determine if long term sulfate reduction is achievable and will meet closure needs; evaluate existing and additional carbon sources and application methods
- SRMP objectives and action plan developed and implemented: Project team includes GCMC, University of Waterloo, Environmental Design Engineering, Whitlock and Associates
- Seven field test plots (5 carbon amendments; 2 controls) constructed, instrumented (suction lysimeters, tensiometers, moisture access probes) and sampled

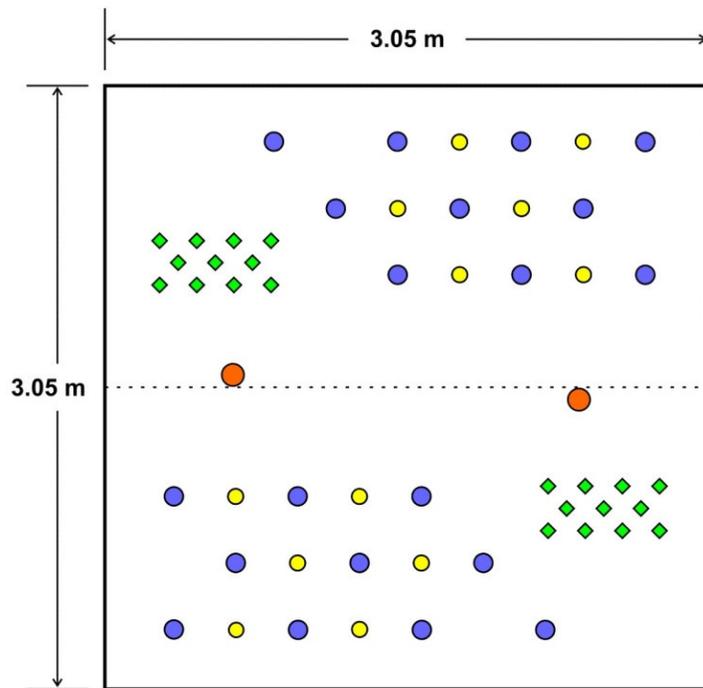
# Sulfate Reduction Monitoring Program



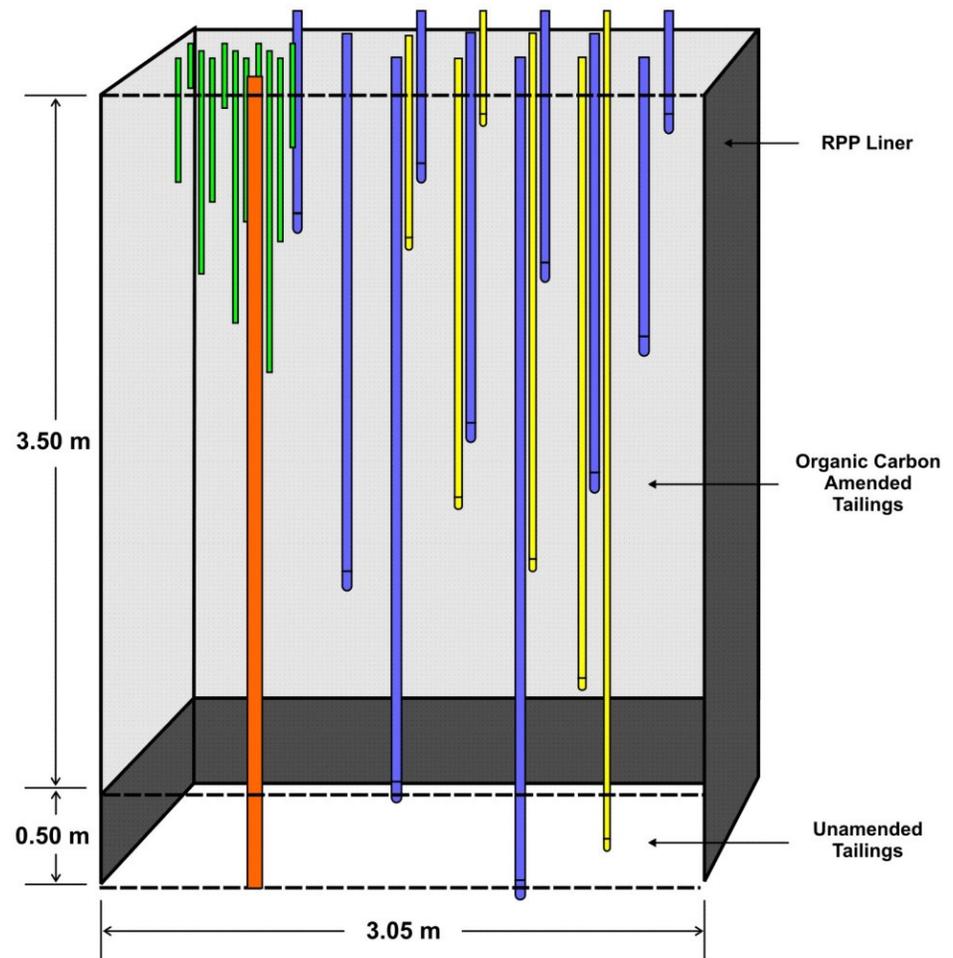
## Field Test Cell Amendment Mixtures

	<b>Tailings</b> (vol %)	<b>Peat</b> (vol %)	<b>Brewery</b> <b>Grain</b> (vol %)	<b>Bio-</b> <b>Solids</b> (vol %)	
<b>Cell 1</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>Unexcavated</b>
<b>Cell 2</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>Excavated</b>
<b>Cell 3</b>	<b>95</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>Amended</b>
<b>Cell 4</b>	<b>95</b>	<b>2.5</b>	<b>2.5</b>	<b>0</b>	<b>Amended</b>
<b>Cell 5</b>	<b>95</b>	<b>2.5</b>	<b>0</b>	<b>2.5</b>	<b>Amended</b>
<b>Cell 6</b>	<b>95</b>	<b>2.5</b>	<b>1.25</b>	<b>1.25</b>	<b>Amended</b>
<b>Cell 7</b>	<b>90</b>	<b>5</b>	<b>2.5</b>	<b>2.5</b>	<b>Amended</b>

# Sulfate Reduction Monitoring Program



- Lysimeter
- Moisture Probe Access
- Tensiometer
- ◆ Pore Gas Tube



# Sulfate Reduction Monitoring Program (SRMP) Update

- Performance as of spring 2009
  - Microbially mediated sulfate reduction in cells 4-7
    - Lower sulfate: higher alkalinity, depletion of  $^{13}\text{C}$  in dissolved inorganic carbon, and enrichment of  $^{34}\text{S}$  in pore water sulfate
  - No evidence of significant sulfate reduction in control cells or peat-amended cell
  - Precipitation of metal sulfides contributes to a decrease in sulfate and metal concentrations
  - Increase in iron reducers, elevated dissolved Fe and As
  - Sulfate reduction and calcite/metal-sulfide precipitation control compositions in Cells 4-7
  - Sulfide oxidation, carbonate dissolution and sulfate precipitation control compositions in Cells 1-3
  - Organic carbon from biosolids is rapidly consumed. Cells containing spent brewing grain show best performance
  - Laboratory batch and column test results support field results

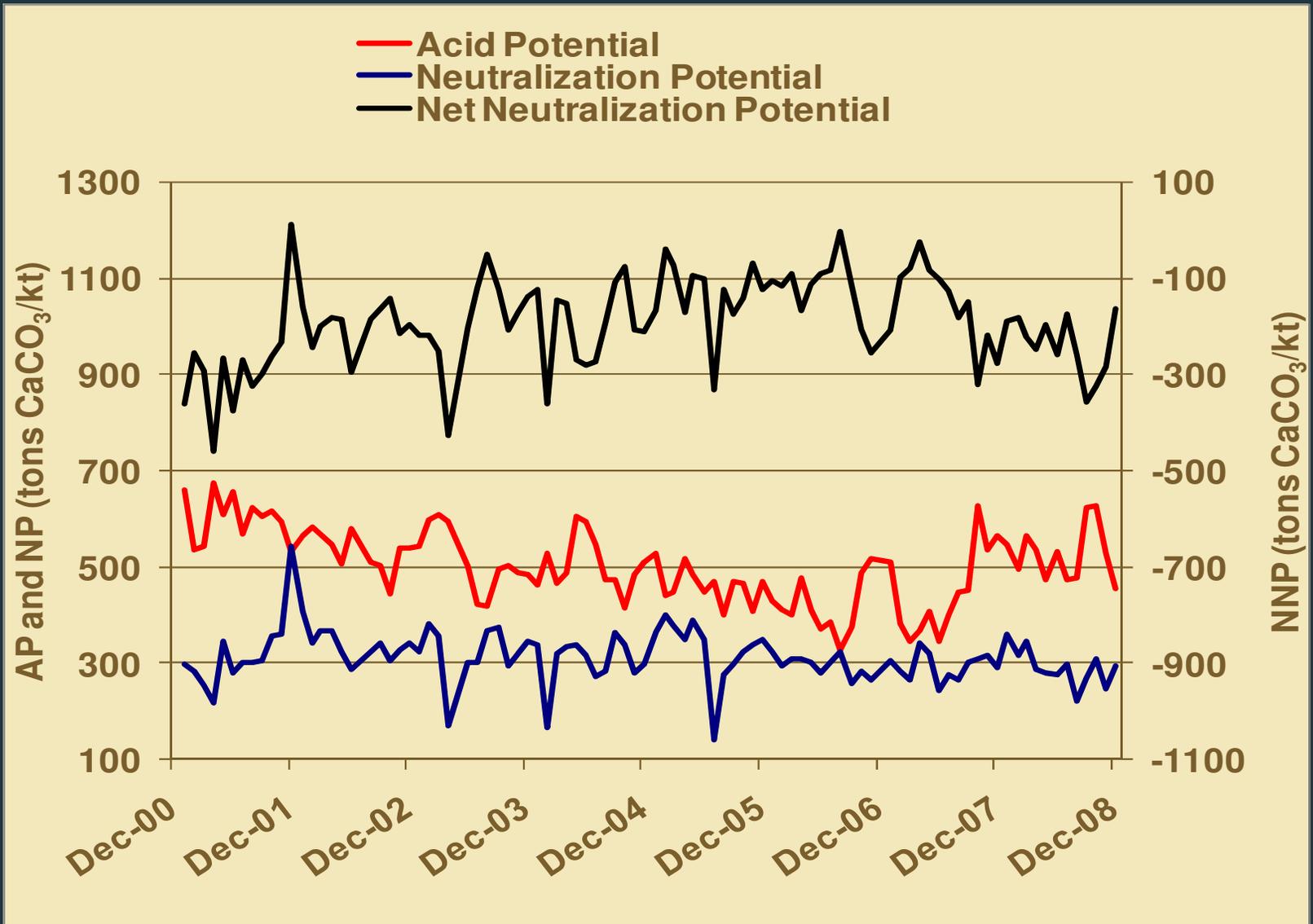
# Sulfate Reduction Monitoring Program (SRMP) Update

- Future work planned
  - Ongoing performance sampling
  - Final report from University of Waterloo
  - Geotechnical evaluation
  - Logistical considerations
  - Program completion and final report

# Tailings Facility Acid Base Accounting Analyses

- Tailings have the potential to generate acidic drainage if the buffering capacity of the tailings is consumed
- High carbonate content supports a long lag time for depletion of buffering capacity
- Long lag time (decades) allows time for construction and closure of the facility, including construction of an oxygen-inhibiting composite soil cover

# Figure 2.32 Monthly Tailings Acid Base Accounting Data



# Tailings Facility General Site Management



- Operations per GPO Appendix 3 and Waste Disposal Permit
- Most placement occurred in northwest expansion area
- Tailings facility activities in 2008
  - Completion of Pit 5 area
  - Relocation of Pond 6 sediments
  - Installation of Wet Well A
  - Placement of B Road pipeline excavation material

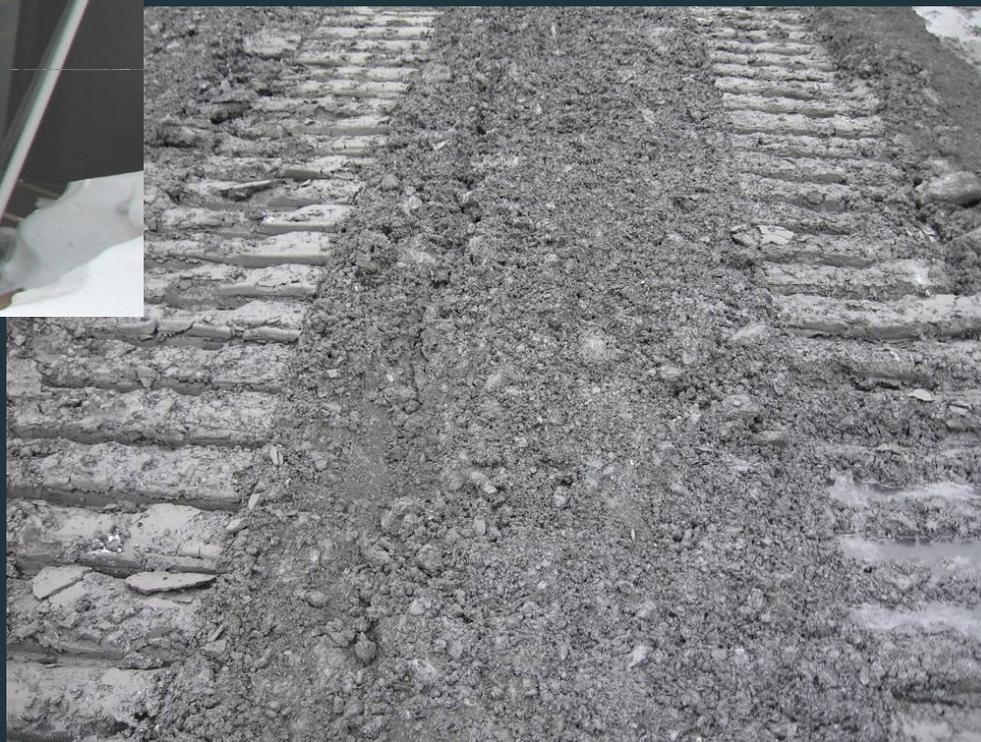
# Tailings Facility General Site Management



- 2009 Planned Tailings Activities
  - Instrumentation at Pond 6 and Pit 5 area
  - Construction of degrit basin
  - Continued work at Pond 6
  - Begin test pits on East Ridge
  - Commence Site E removal and co-disposal

# Co-Disposal Testing

**Hecla**  
MINING COMPANY



# Tailings Facility General Site Management

- Tailings and production rock co-disposal geotechnical and geochemical studies complete
  - A 3:2 (production rock:tailings) ratio is recommended
  - Site E Drainage will improve following relocation
  - Lower acid generation potential (higher NNP) than tailings alone, improved stability, decreased permeability
  - Decreased oxidation and improved pore water compositions
  - Lower metal content than tailings

# Co-Disposal Testing

