



# ASSESSING THE CONSTRUCTABILITY OF REMEDIATION PROJECTS IN THE NORTH

REMTECH 2009 – BANFF, Alberta

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***Part 1:***

***Constructability of Remedial Action Plans in the North***

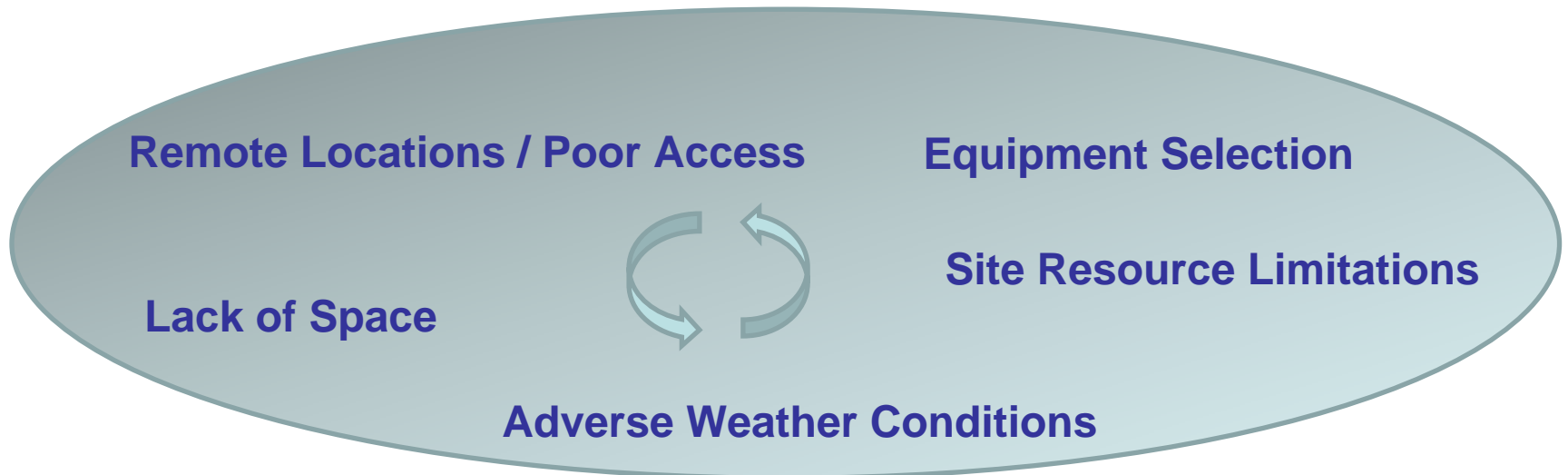
***Part 2:***

***Reliability of Field Data to Properly Develop a Remedial Action Plan***

*Jk link ...north*

# Part 1

- **Constructability** is one of the most important factors when designing a Remedial Action Plan (RAP) for a contaminated sites in the north.
- Number of obvious and not so obvious considerations in comparison to southern projects.
- Overview of challenges and solutions.





## REMOTE LOCATIONS / POOR SITE ACCESS



# Remote Locations / Poor Access



Large distances from major centers, requiring a Variety of Aircraft Types and or Marine Vessels



# Remote Locations / Poor Access

## UNDERSTAND SEASONAL CONDITIONS

- When is site ice free / snow free / spring freshet,
- What are ground conditions like to support aircraft, equipment etc.

### Client Schedules Versus Mother Nature!

- Design, if possible for alternate transportation means
- Build in back-up/redundancy of materials/equipment
- Robust and simple designs are a MUST



# Remote Locations / Poor Access

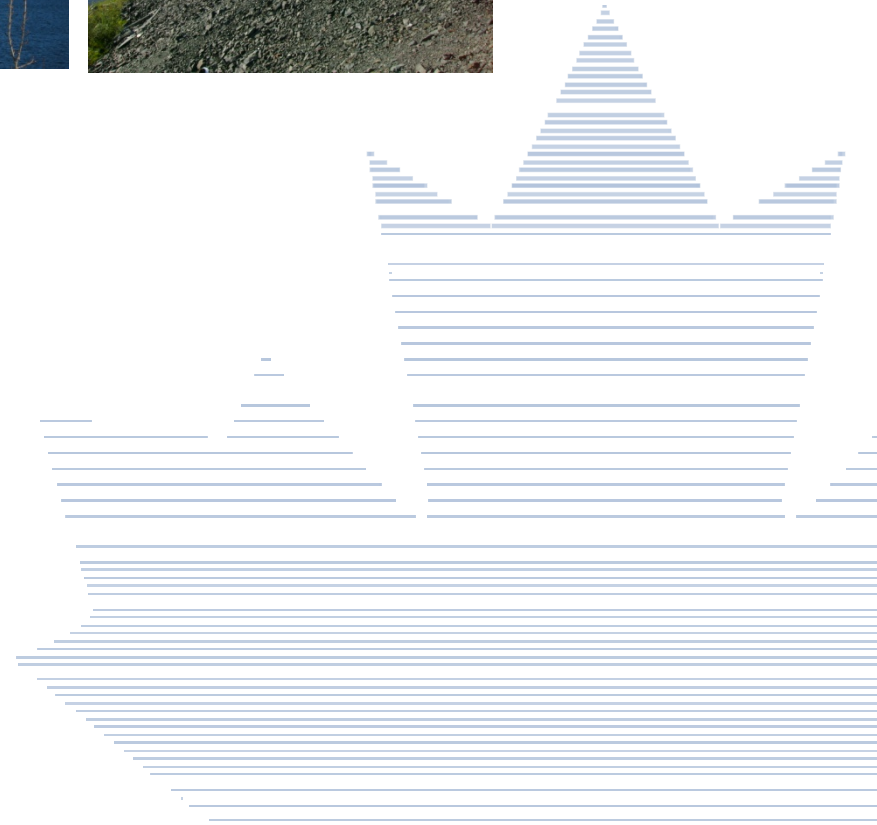
- Optimize timing around mobilization and demobilization (i.e. large aircraft, winter road mobilization or marine barging) limited window

**AVOID SMALL AIRCRAFT IF POSSIBLE**





LACK OF SPACE





# Lack of Space

Rigorous assessment  
at front end to plan for  
site constraints.

Important for ENTIRE Team  
to conduct Pre-Remedial Site Visits.

***“It never is what they say it is!”***



# Lack of Space

Work may require challenging conditions for skilled labor force

Skilled operators and multiple operators on site.



# Lack of Space

Work may require for example, staging operations which requiring good on-site logistics, communications and planning.



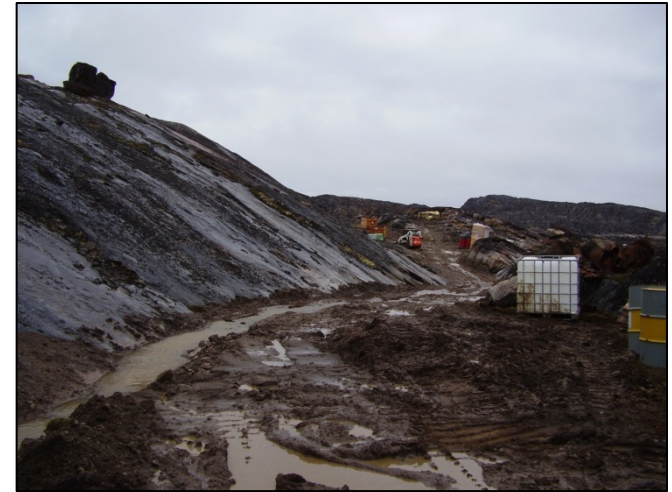


# ADVERSE WEATHER CONDITIONS

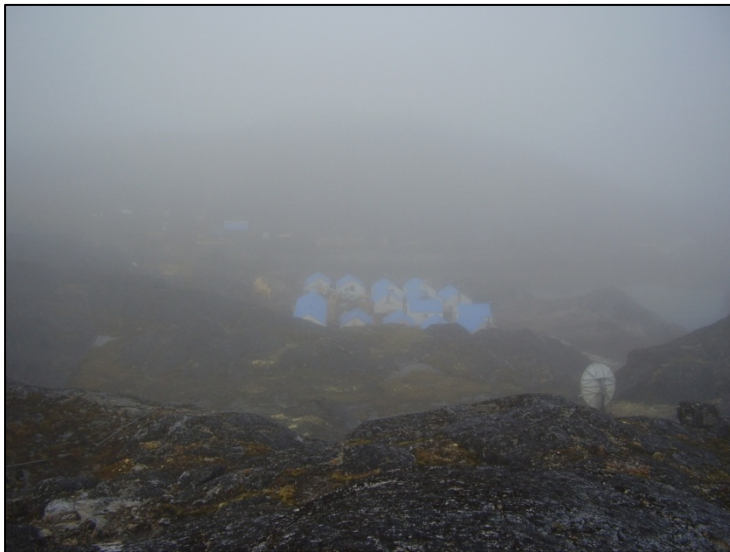


# Adverse Weather Conditions

- Build in schedule contingency.
- Provide contractor specification to reflect downtime potential (define 'adverse' weather).



**RAIN / WET CONDITIONS**



**FOG**



**HIGH WINDS**



# EQUIPEMENT SELECTION



# Equipment Selection

- Contractor must understand limitations associated with site and the remedial tasks.
- Appropriate equipment must be selected.
- Equipment O&M Considerations



# Selection of Appropriate Equipment



Equipment may need to be portable for mobilization.





# RESOURCE SITE LIMITATIONS



# Resource Site Limitations

Cover Materials Limited.  
(i.e.. Sands, gavel, low k fines)



Resources may be restricted for use.

**Engineer Solutions KEY**

# Resource Site Limitations

Extreme cases, barging of soils for landfill covers is possible however expensive.

## Other Engineering Solutions:

- geomembrane liners
- frozen liners (using passive heat siphons)



# Resource Site Limitations

**Use on-site solutions if possible.**

On-Site Treatment of Contaminated Water  
Portable Water Treatment Plant



# Resource Site Limitations

## Hazardous Wastes



# Take Home Message

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- Requirement for remediation team (consultant/contractor) to have a thorough understanding of site constraints in order to properly select equipment, resources, develop appropriate supply chains, logistics, etc.  
**This may take months or years. Be creative. Think outside the box.**
- Important to clearly layout the procedures to fully execute the work (i.e. often spec needs to include logistics etc.).
- Understand weather conditions and don't underestimate it's effects. Build contingency into schedules and define downtime in contracts.
- Be prepared to handle and address unforeseen events (i.e. changes in weather, environmental issues, labor issues, breaks in the supply chain etc.).

## Part 2 – Linkage to Overview

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**Conventional Groundwater Site  
Characterization in Frost Prone  
Regions of Northern Canada  
- Lessons Learned**

# Introduction

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- This work was completed by Martin Guilbeault, M.Sc., P.Eng
- For the purposes of the presentation the site will be anonymous.
- This is the first time this work has been publically presented.  
*(Intention is to publish).*
- In the interest of time, brief overview only.

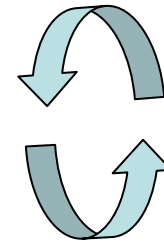


# Talk Overview

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- The development of the **Conceptual Model** (Introduce the Issue)
- Typical Groundwater Site **Characterization** Methods/Techniques
- Assessment of Field Data

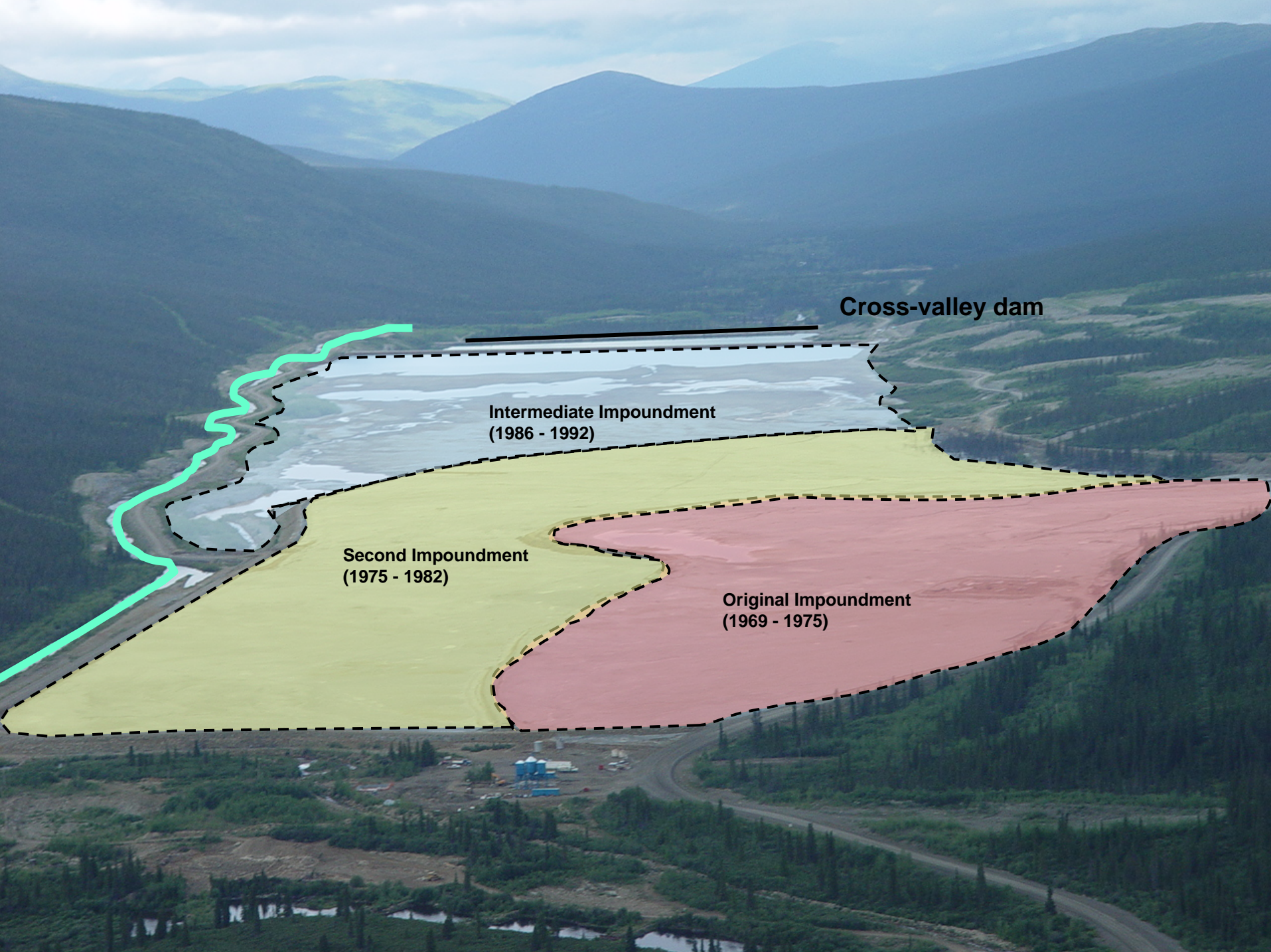
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- Revise the Conceptual Model with Revised Site Characterization Method

# Conceptual Model

*(Typical of Abandoned Mines Across Canada)*



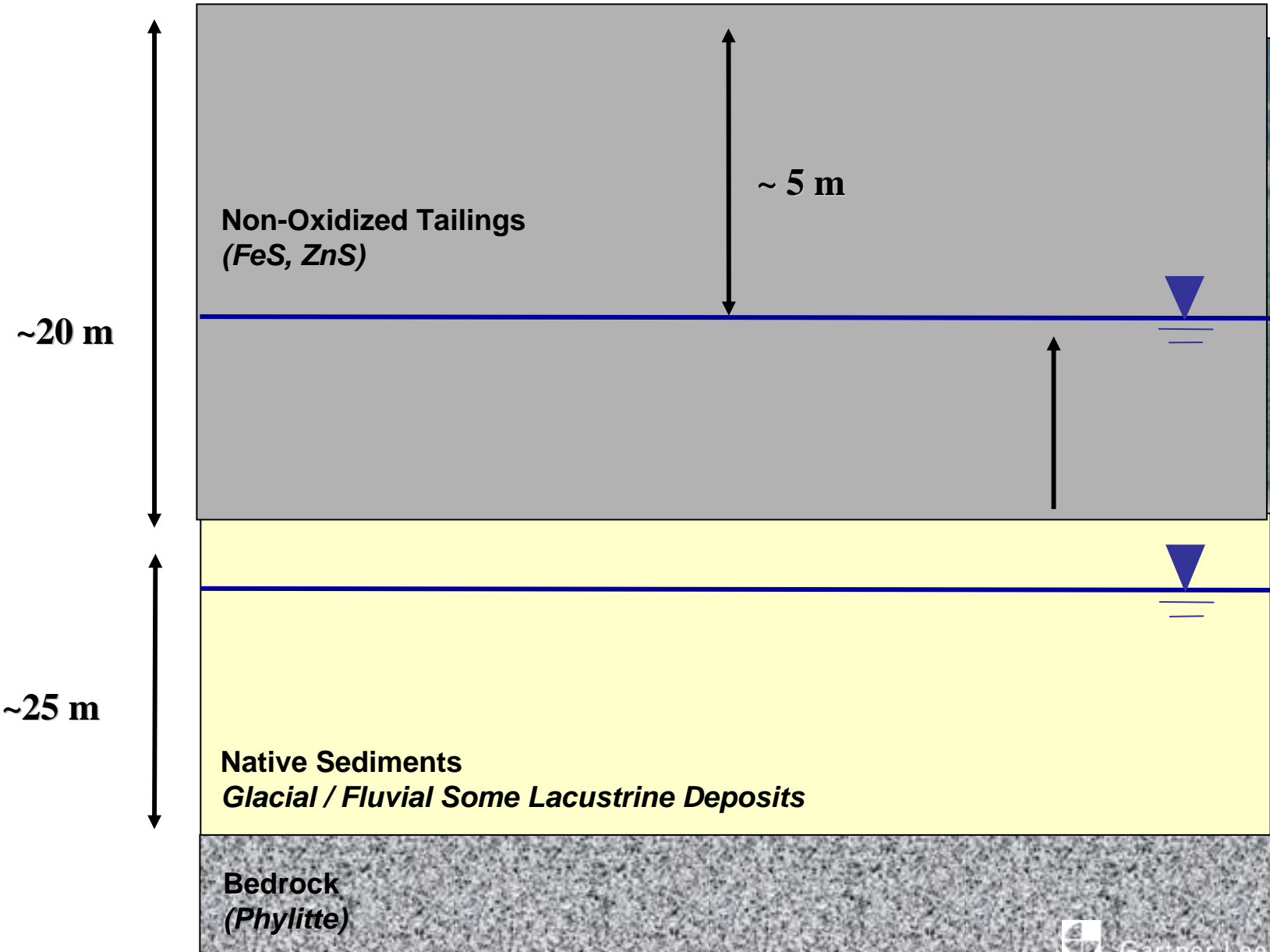
**Cross-valley dam**

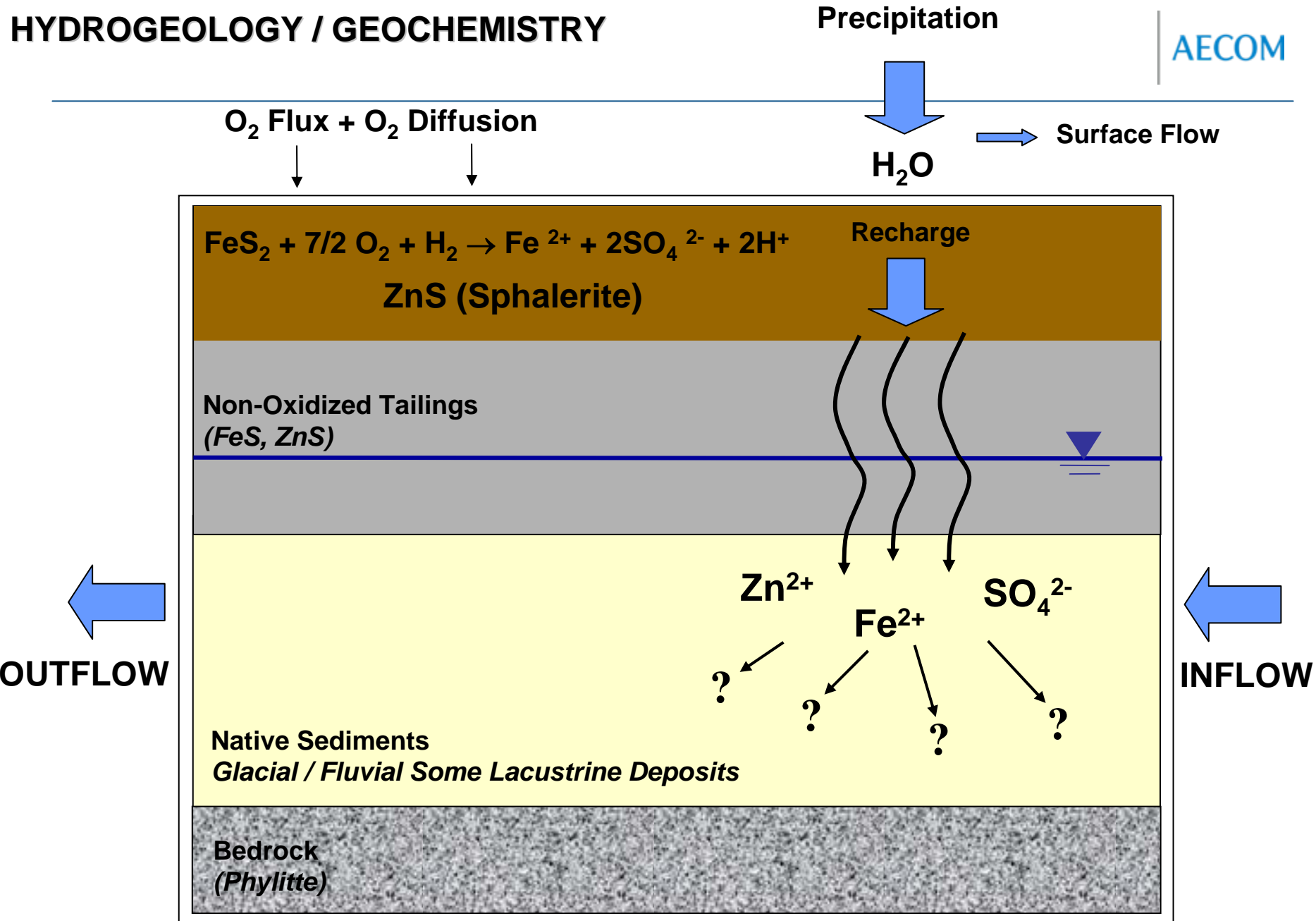
**Intermediate Impoundment  
(1986 - 1992)**

**Second Impoundment  
(1975 - 1982)**

**Original Impoundment  
(1969 - 1975)**

# GEOLOGY OF TAILINGS IMPOUNDMENT

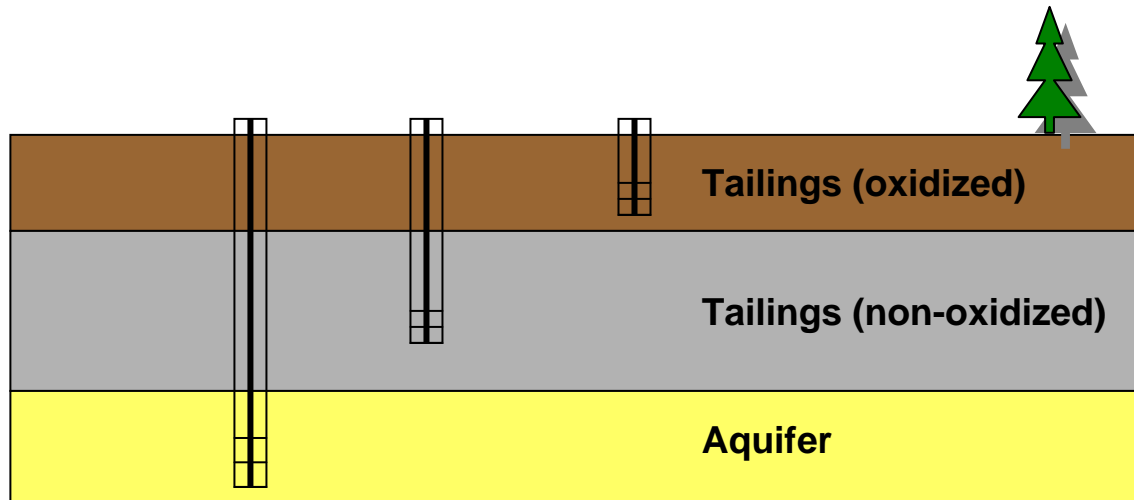




Developed by R. V. Nicholson et al.

# Conventional Site Characterization

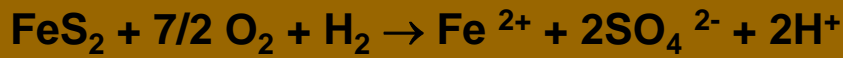
- The site has a long history of groundwater studies.
- 2 –inch conventional wells were the standard along with protective casings.
- Various drilling techniques allowed for a variety of interpretations of geological conditions including the presence of frost/ice.



**Results Indicated a problem with the Conceptual Model!**

# Recall The Conceptual Model

O<sub>2</sub> Flux + O<sub>2</sub> Diffusion

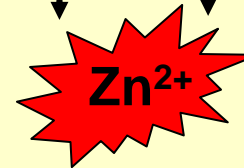
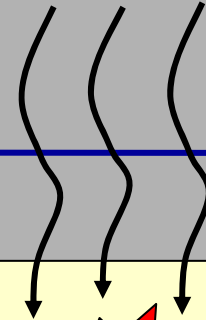


ZnS (Sphalerite)

Recharge

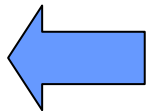


Non-Oxidized Tailings  
(FeS, ZnS)

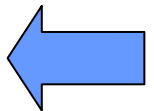


Native Sediments  
*Glacial / Fluvial Some Lacustrine Deposits*

Bedrock  
(Phyllite)



OUTFLOW



INFLOW

Developed by R. V. Nicholson et al.

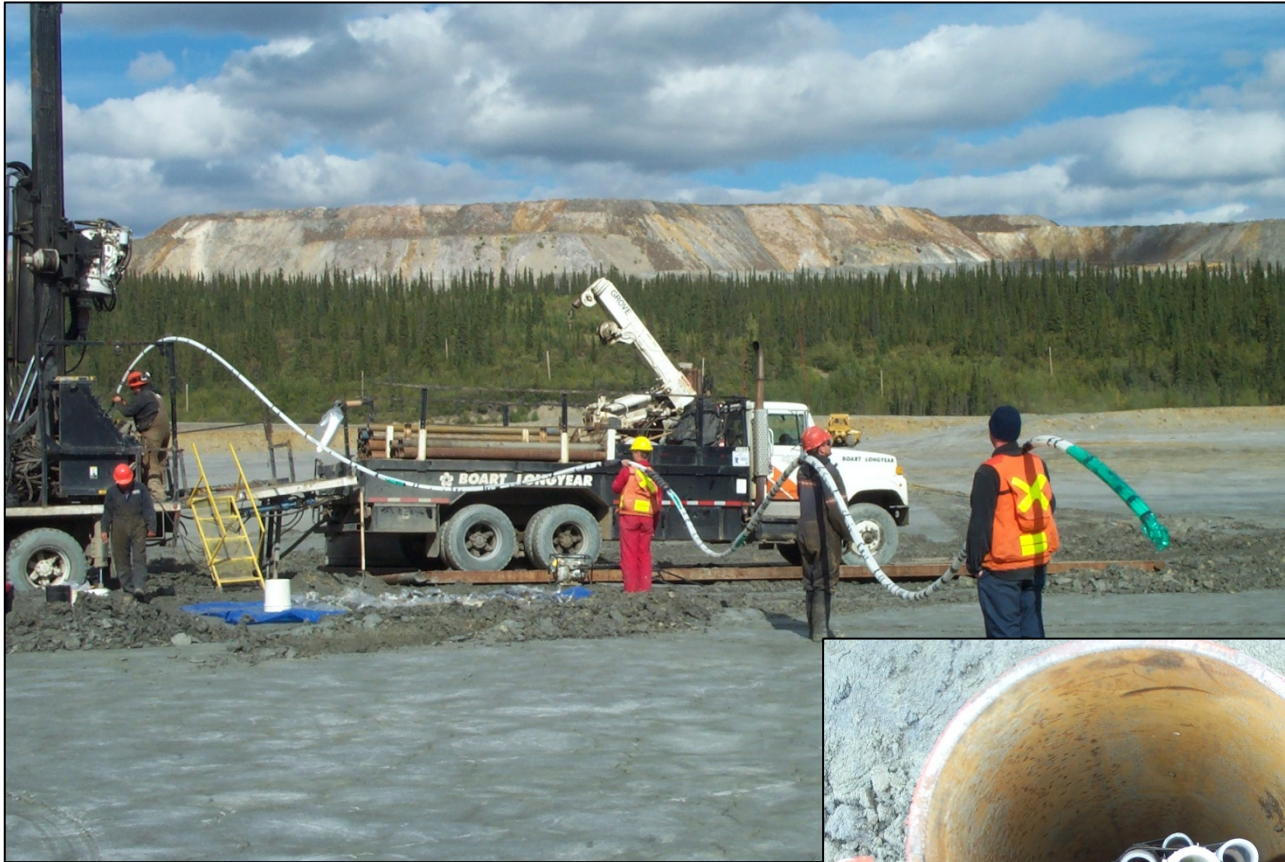
# Non Conventional Site Characterization



screen

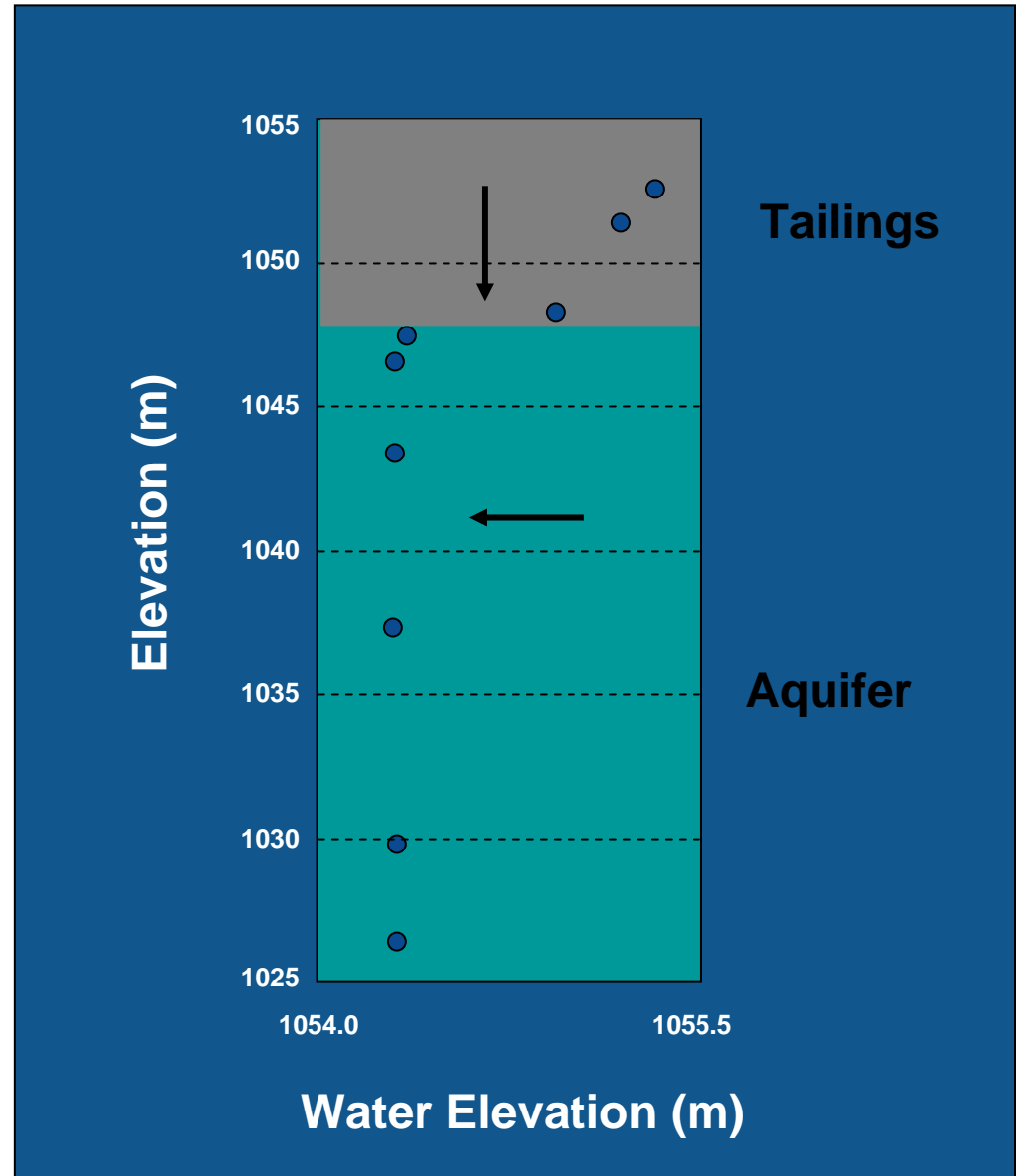


# Non Conventional Site Characterization



- Vertical Gradient in Tailings
- No Vertical Gradient in Aquifer
- Low zinc concentrations in non oxidized deep tailings (front not arrived).
- No Zinc in Aquifer
- **Conceptual Model Looks Good**

?



**? Issues with conventional wells ?**

**? Issues with data Integrity ?**

**1. Visual Observations**

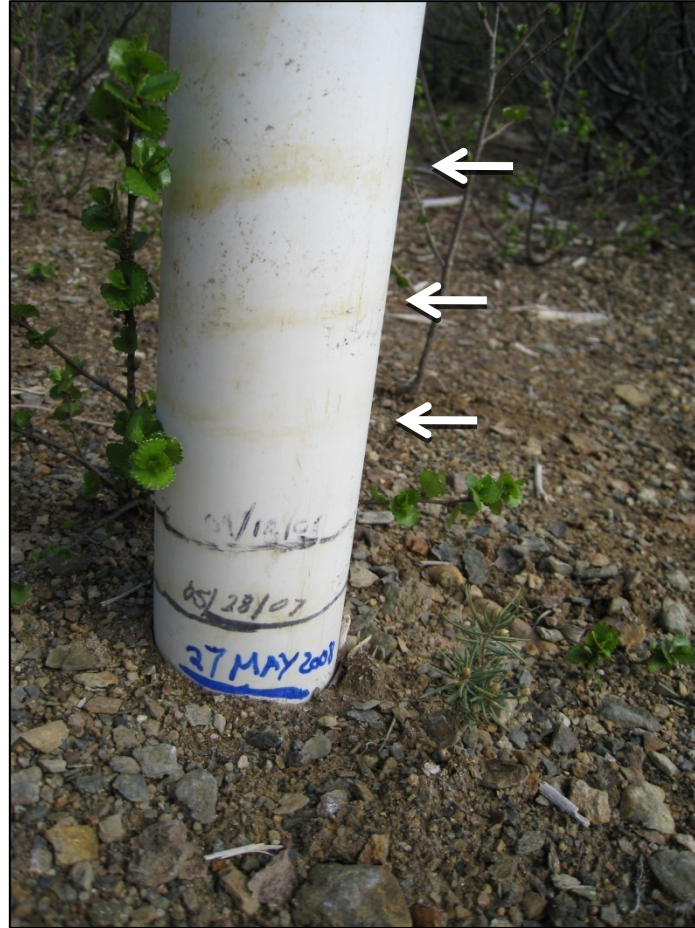
**2. Packer Testing / Water Quality Testing**

**3. Downhole Camera Inspections**

# Visual Observations of Casing at Surface



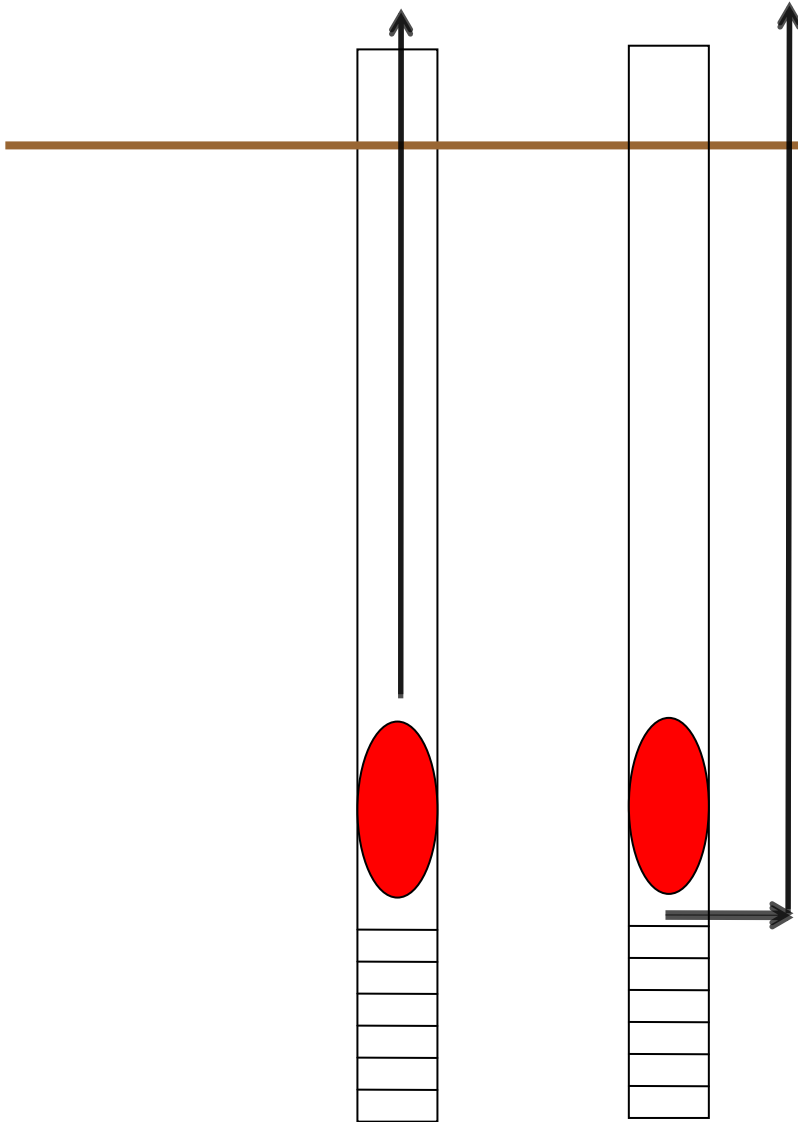
Protective Casing Jack  
(note PVC elevation)



## Evidence of Frost Jacking

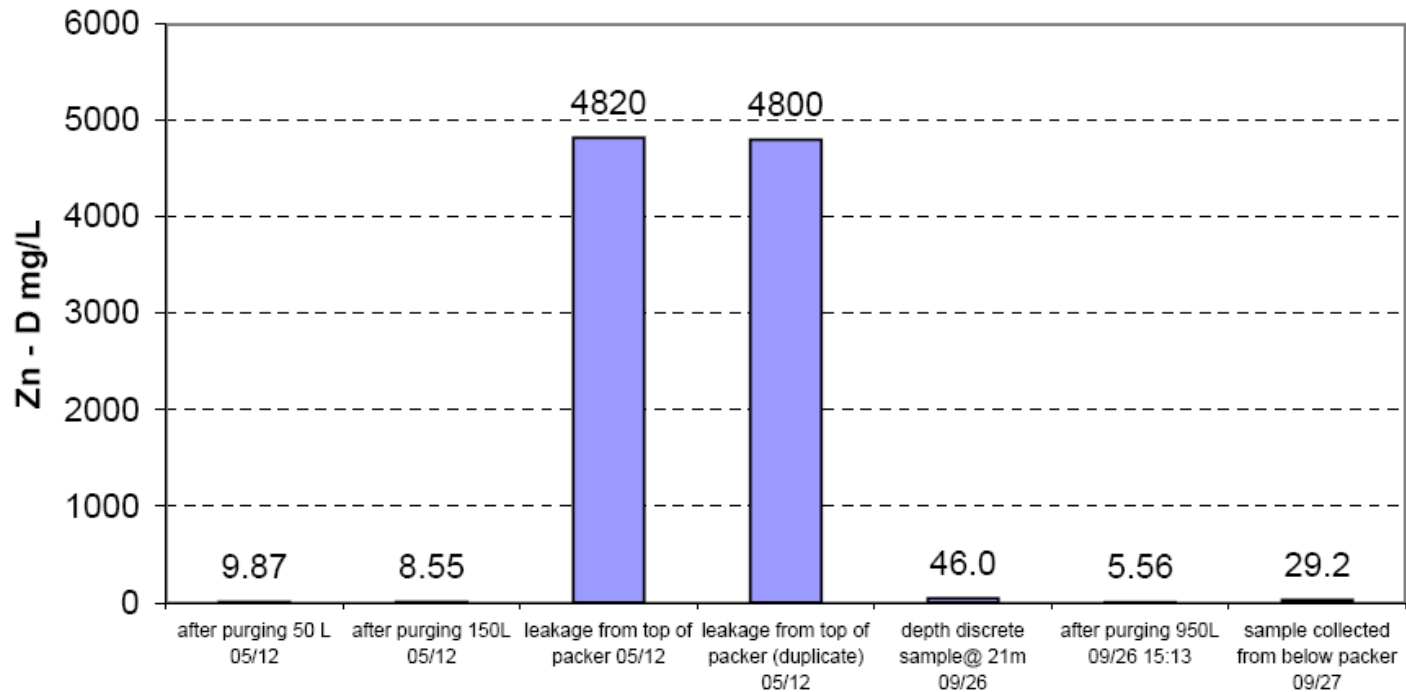
(jk explain process and implications)

# Packer Testing / Water Quality Testing



# Results – Packer Testing Water Quality Testing

## Packer Testing Results (Zinc - Dissolved)



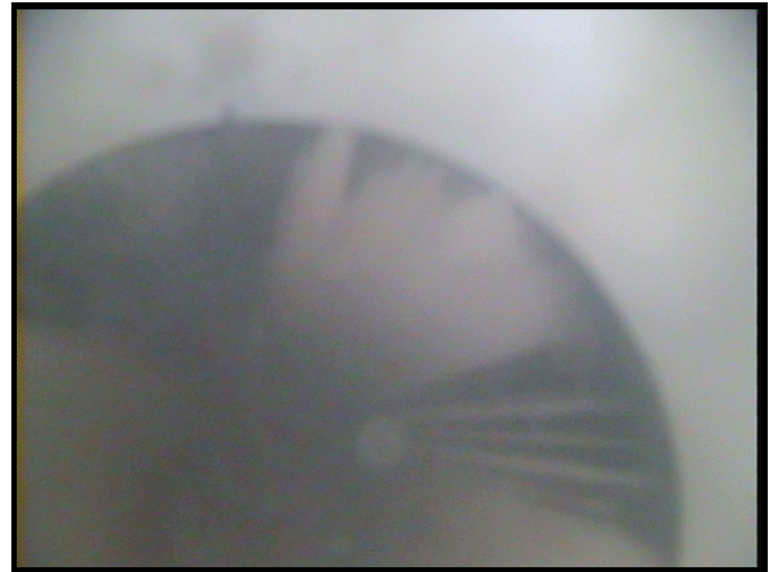
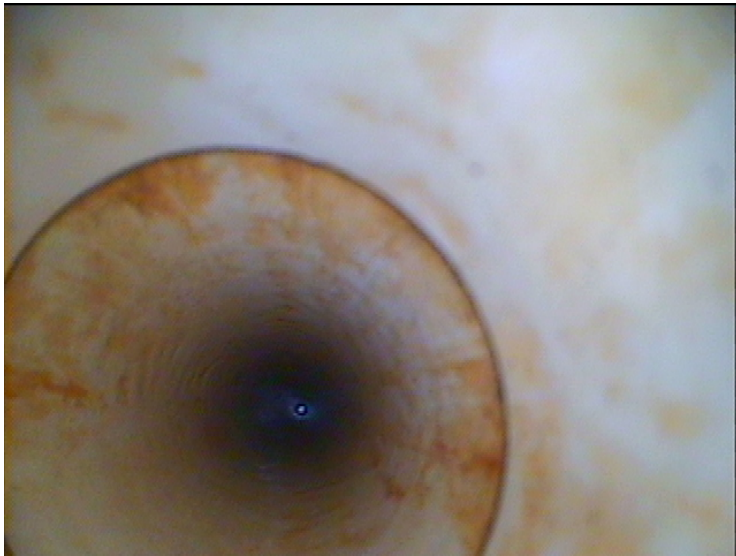
### METHOD (MAY)

purged well for 3 well volumes and collected sample.  
Placed packer down well and removed any water above packer  
Left packer in well >12 hrs. (depending on well)  
Collected sample from leakage water that collected on top of packer

### METHOD (SEPTEMBER)

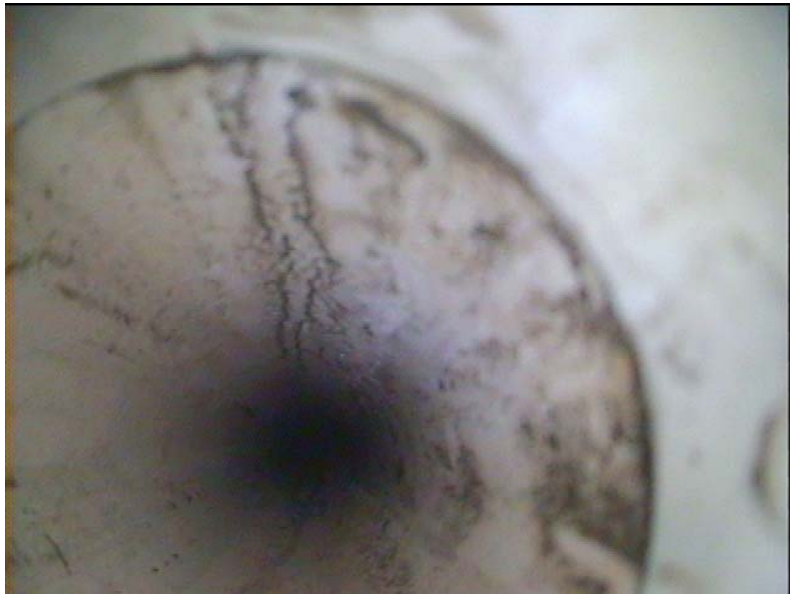
took a depth discrete sample above and at well screen  
purged 950L volumes and collected sample  
placed packer down well and purged  
collected sample from below back with packer in place,  
sample tube was at top of packer

# Results – Downhole Camera Inspections



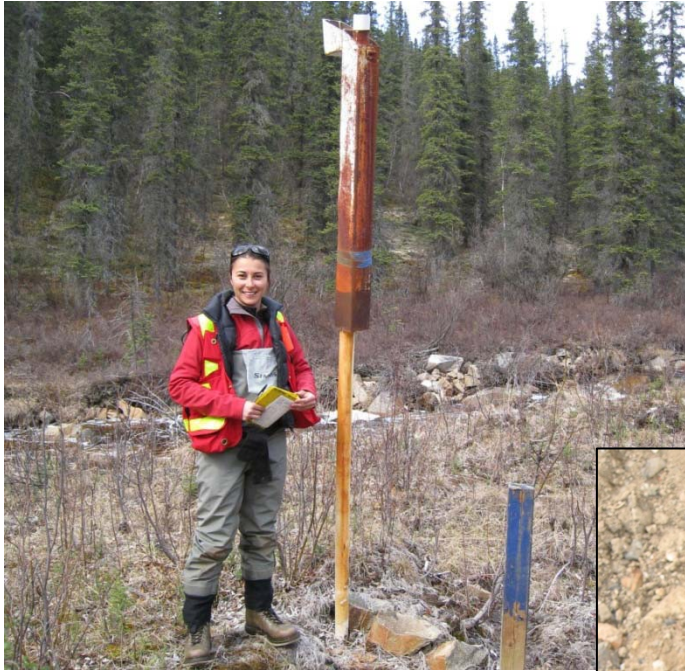
Joint staining on downward side of joint.

# Results – Downhole Camera Inspections





# Other Examples of Monitoring Well Frost Jacking



Protective casing, concrete/sand against PVC appears to exasperated the problem!

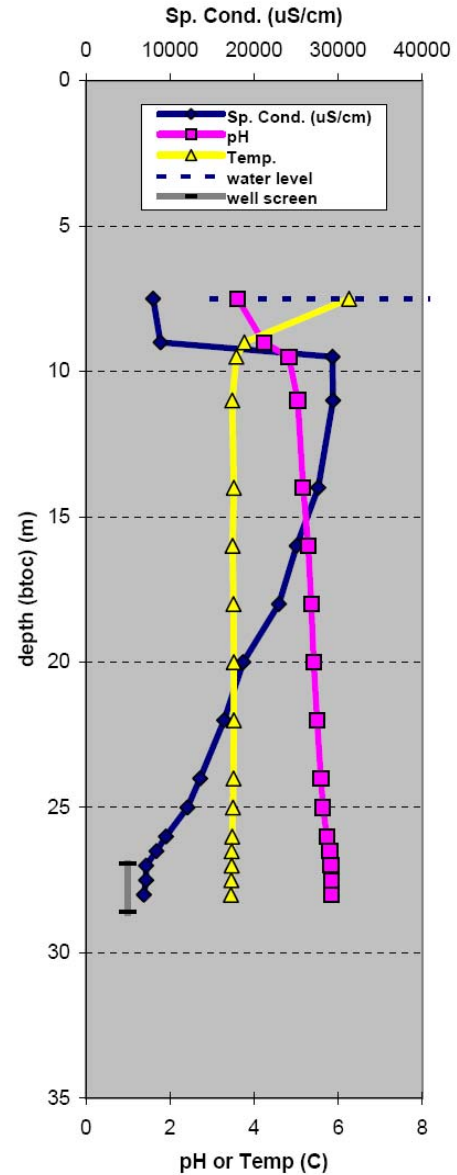
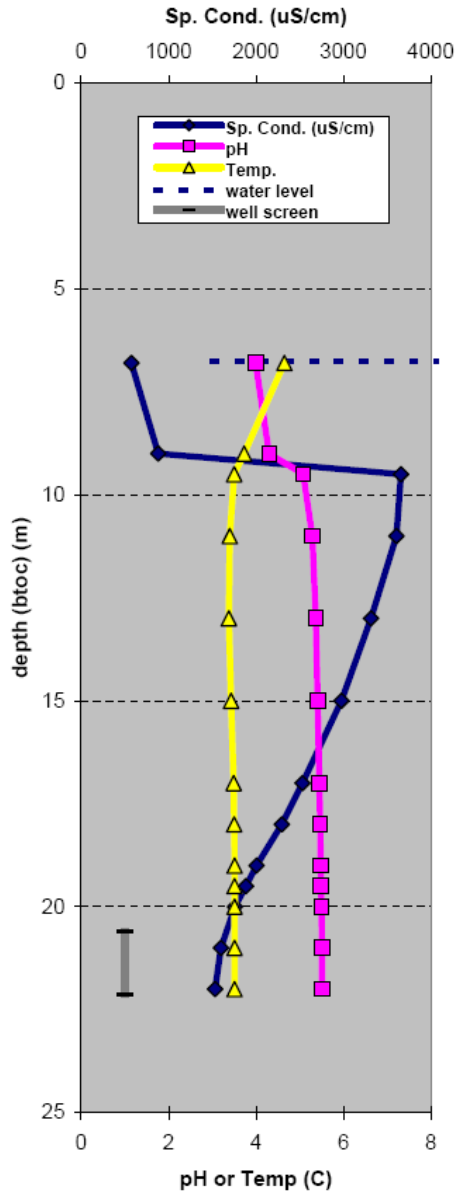
# Take Home Message

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- Don't allow trust your field data....ask questions!
- Monitoring wells should not be used indefinitely!
- Careful QA/QC programs should be conducted to ensure data integrity.
- Data from wells that exhibit frost jacking wells should be suspect.
- Careful consideration should be made when construction monitoring wells in areas which may be prone to frost jacking.

(I.e. protective casings, concrete, annual space materials etc.)

**END**



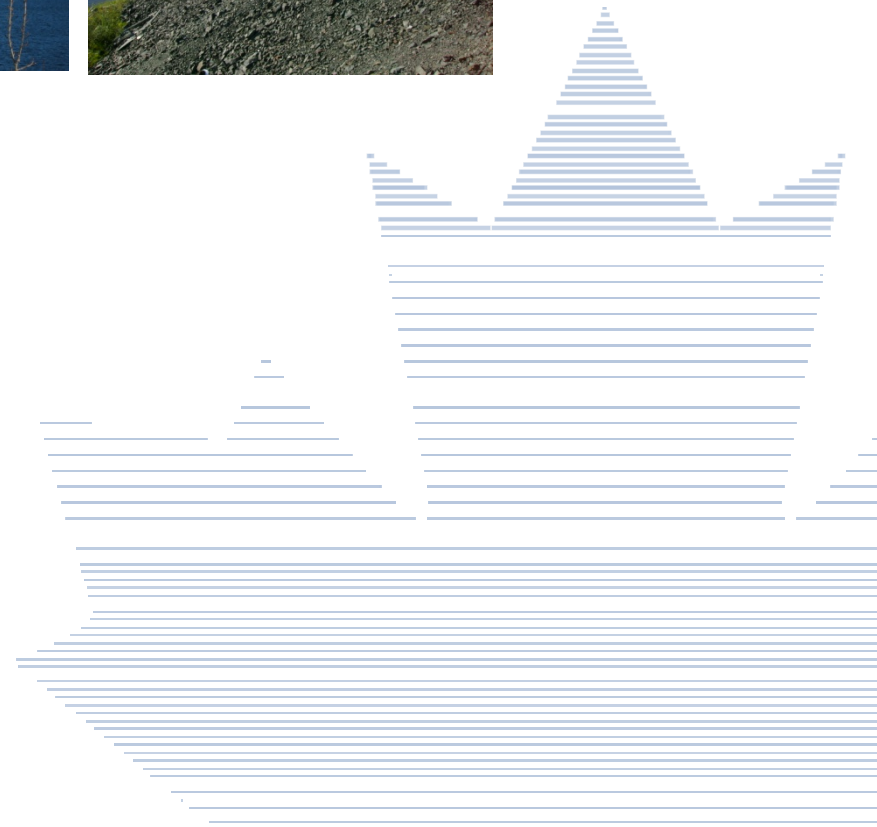


End of Part 1





# WILDLIFE CONTROL





Bear Fence around Camp





# WHAT DO YOU DO WITH HAZARDOUS AND NON-HAZARDOUS WASTE?





# Handling Hazardous and Non-Hazardous Waste



**Scrap Metal**



**Hazardous Wastes  
(i.e. Spent Batteries)**

# Handling Hazardous and Non-Hazardous Waste



**C & D Wastes**





Need to stay somewhat true to the abstract/outline but I like building in your story line on the wells. Below are some thoughts on text bullets to add around the approaches/methods issues/themes in the current presentation: (don't need to use all but work in as helps)

#### Remote Locations/Poor Site Access:

- scheduling to optimize productivity while on site
- optimization of mobilization and demobilization
- plan for marine/air lifted resources, materials, equipment
- design for alternate transportation means
- built in back-up/redundancy on materials/equipment on site
- low maintenance methods, materials
- robust and simple designs
- flexibility of means & methods in tender specifications

#### Lack of Space:

- rigorous assessment and plan for site constraints
- specification of materials/equipment for small/flexible footprints
- use of multi-task materials/equipment
- minimizations of disposables/consumables

#### Adverse Weather Conditions:

- seasonal project planning/scheduling
- design for seasonal factors
- build in schedule contingency
- contractor specification to reflect downtime potential

#### Equipment Selection:

- design and specify equipment for simplicity, durability, ease of maintenance/replacement
- procurement to match seasonal mobilization windows
- performance in cold climate/snow

#### Site Limitations:

- plan, specify to apply available local resources, materials (e.g. FN resources)
- plan and specify and build contingency for unique site conditions (e.g. bears, access, seasonality, space)
- allow for means & methods/flexibility in specifications to adapt to site conditions

Regards

David