




GOLDER

# Closure Activities – Progress over the last 10 years, Britannia Mine

BC MEND ML/ARD Workshop  
28 November 2018





**Golder was contracted by the Crown  
Contaminated Sites Program of the Government  
of British Columbia, Ministry of Forests, Lands,  
Natural Resource Operations and Rural  
Development, for this work**





# Presentation Overview

Mine history **01**

Remediation/Risk Assessment **02**

Operation & Maintenance Challenges **03**







# Britannia Mine - History



- Mine operated from 1904 to 1974
- Largest producing copper mine in Canada in the 1920s
- Closed in 1974 after owners ordered to collect/treat ARD discharge
- Mining methods: open pit, gloryhole, open stoping
- Length of underground workings: >80km



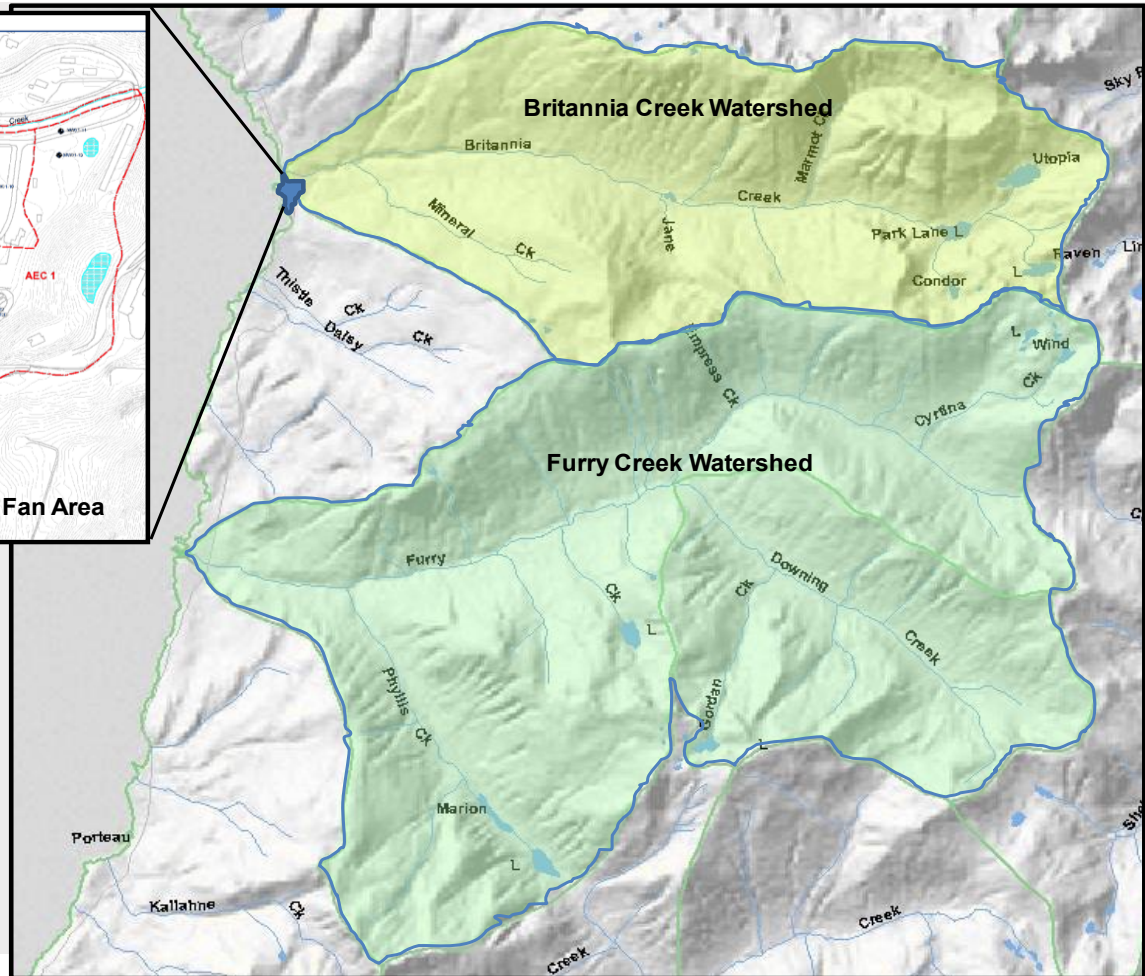
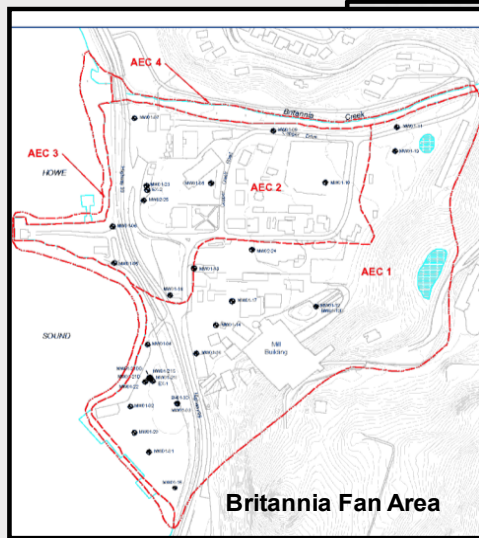
# Britannia Mine

## REMEDIATION APPROACH

- Phase 1 (2001 to 2009)
  - Identify and address high priority issues
  - Reduce loadings to Howe Sound
  - Investigate/monitor lower priority issues
- Phase 2 (2010 to current)
  - addressed the lower priority issues from original phase
  - used a risk based approach to achieve closure
  - includes site safety and operation & maintenance



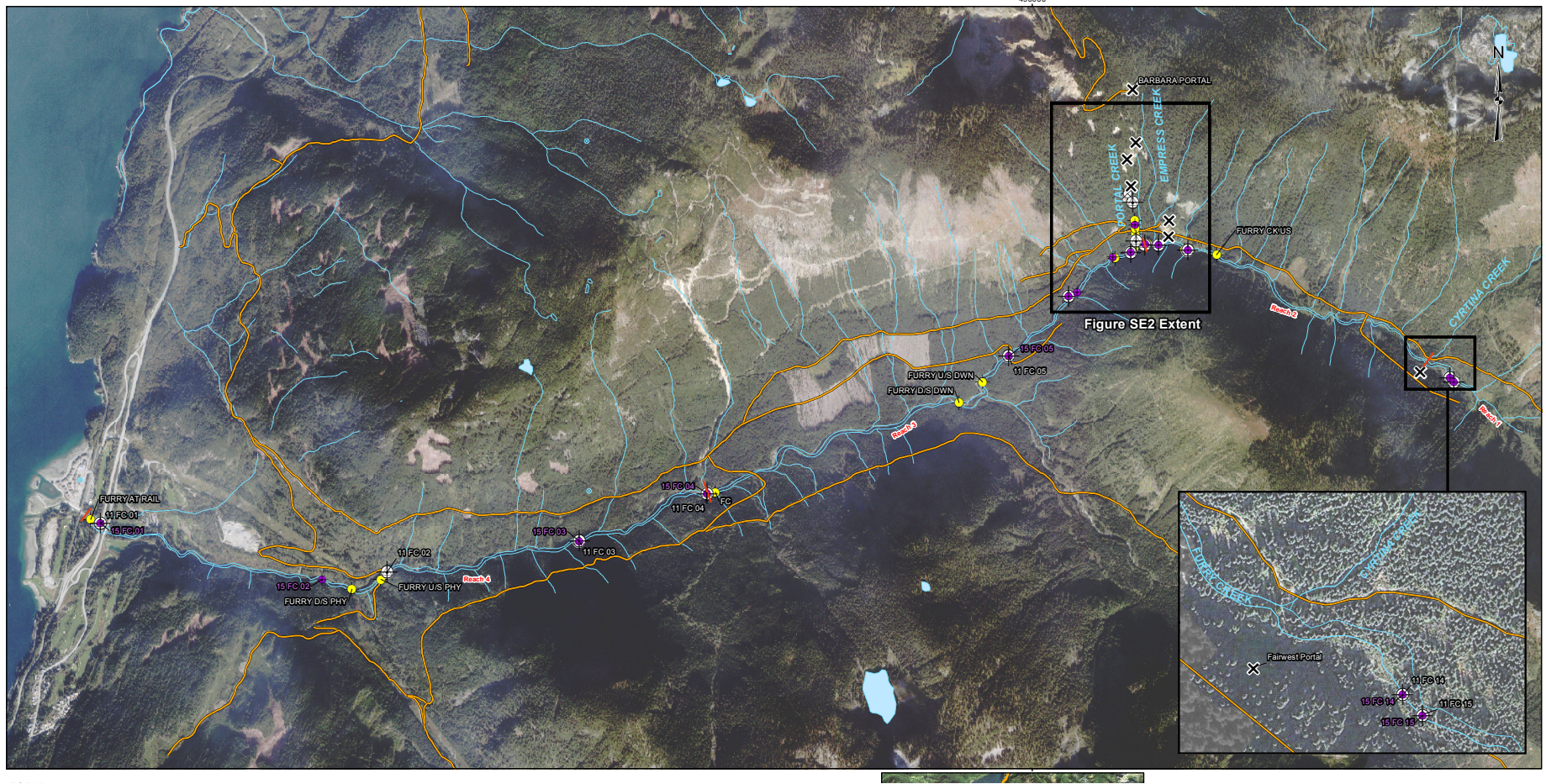
# Britannia Mine Study Areas





# Furry Creek

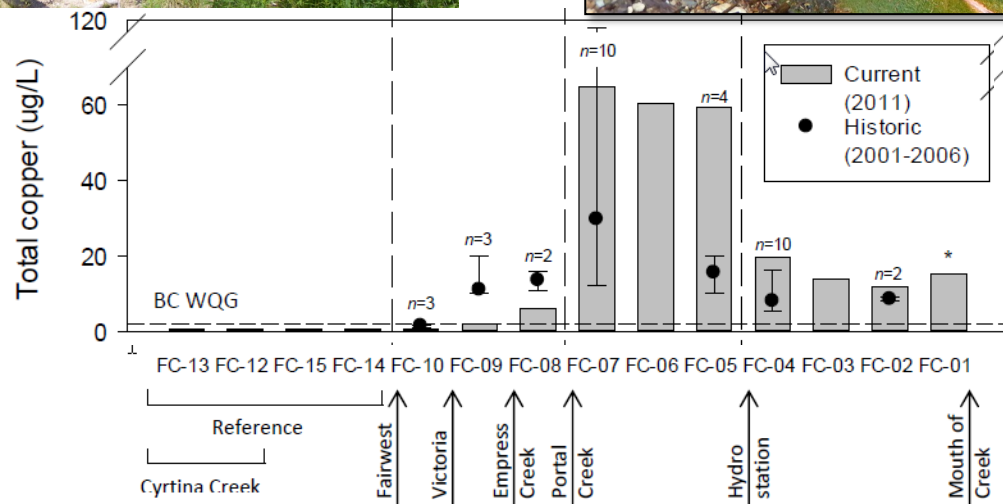
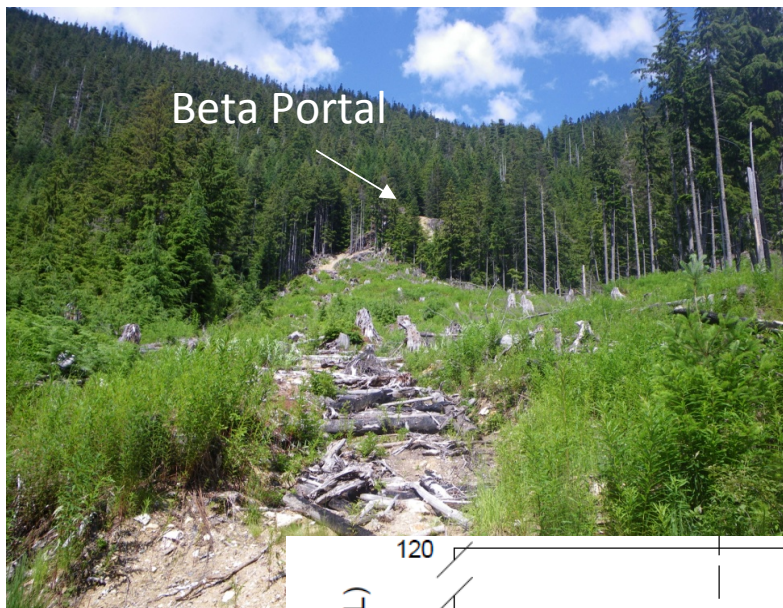
## SITE LOCATION





# Furry Creek

## BETA PORTAL REMEDIATION

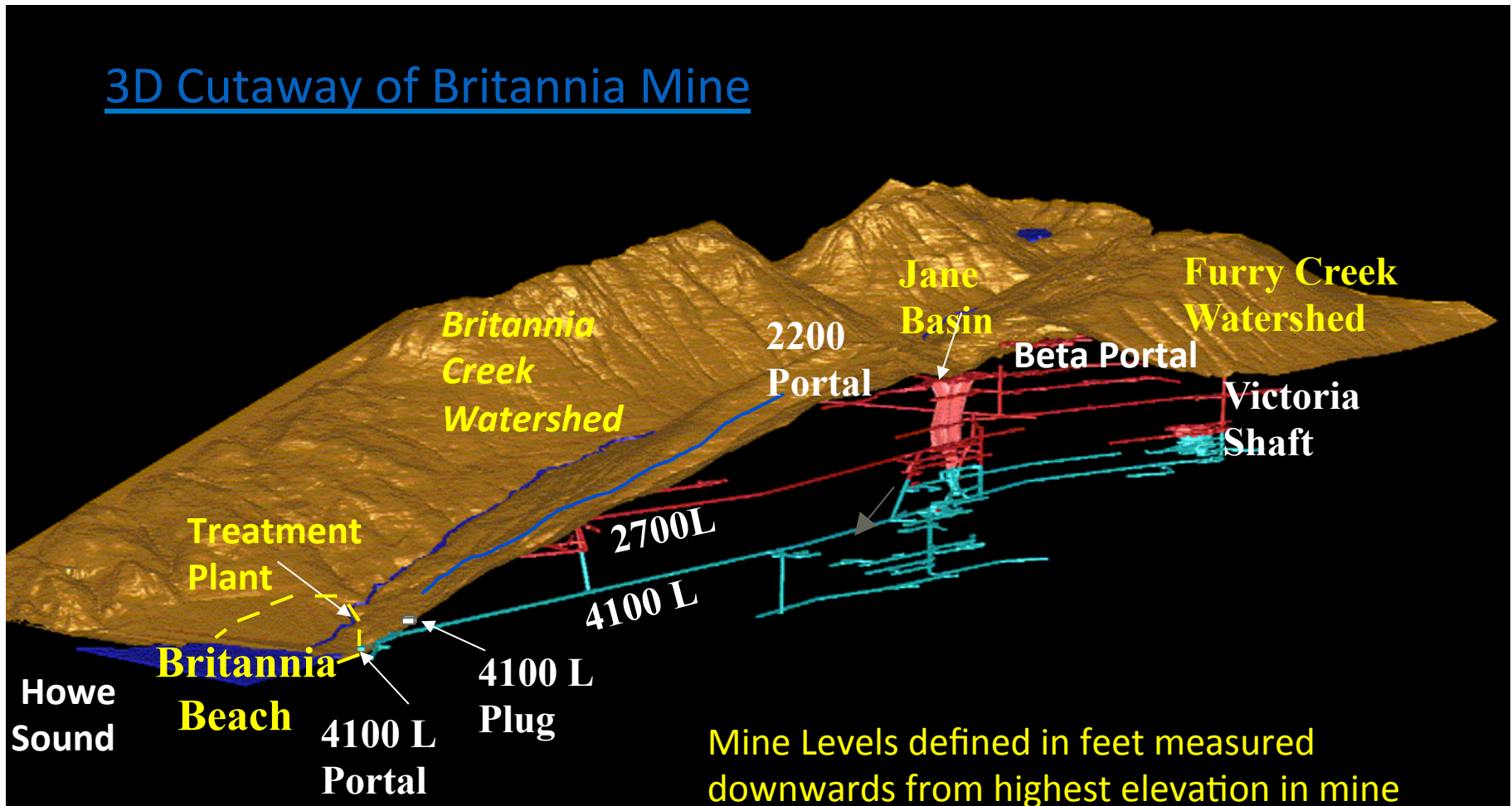


# Furry Creek

## BETA PORTAL REMEDIATION REMEDIAL OPTIONS ANALYSIS

- Evaluated several options involving = Re-injection into the mine and treatment at the water treatment plant

### 3D Cutaway of Britannia Mine

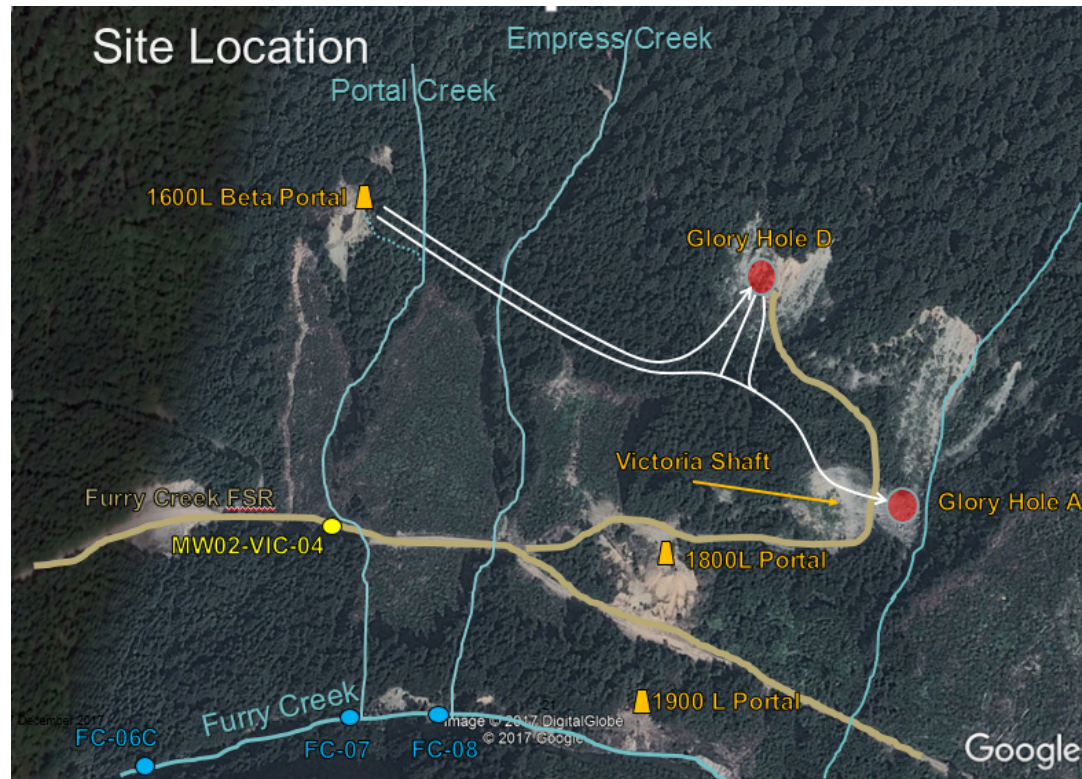




# Furry Creek

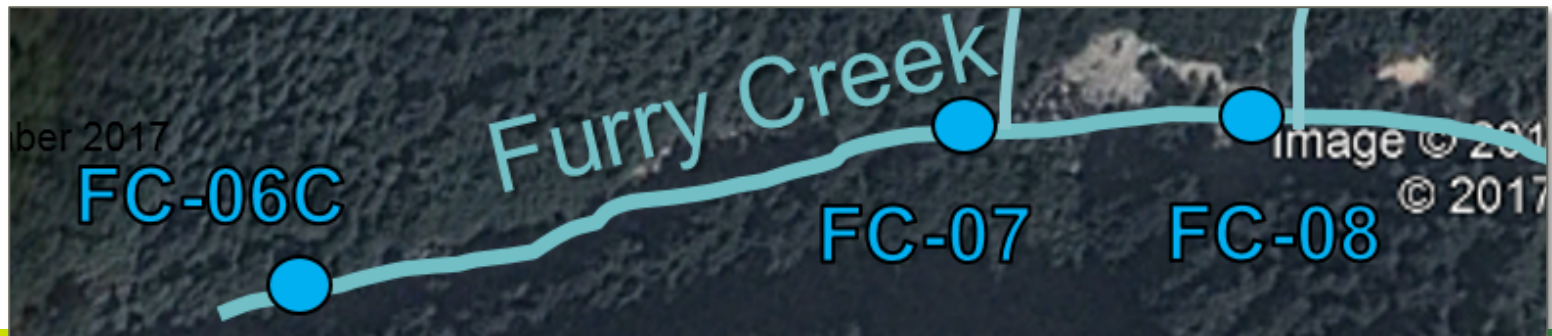
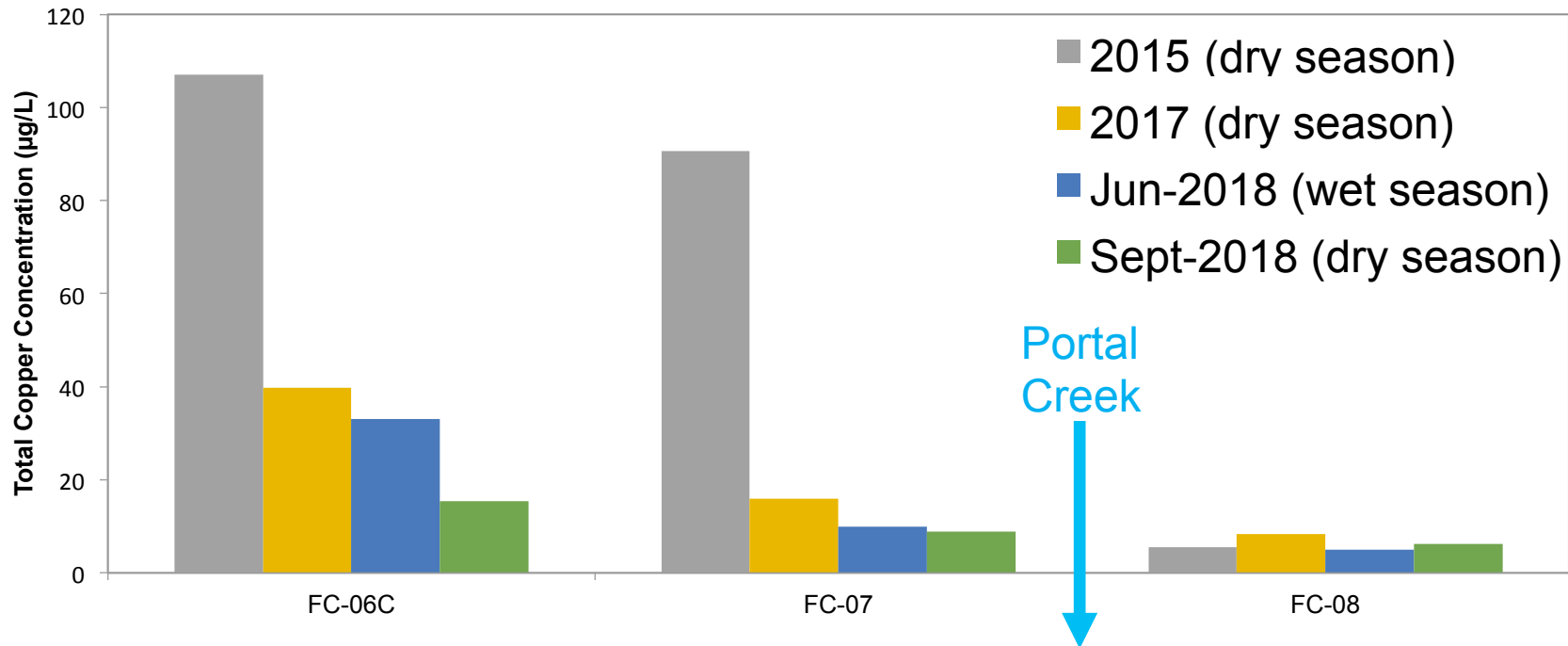
## BETA PORTAL REMEDIATION REMEDIAL OPTIONS ANALYSIS

- Preferred Option - Re-injection into the Glory Holes (GH)
- Construction completed in 2016



# Furry Creek

## BETA PORTAL POST-REMEDIATION MONITORING

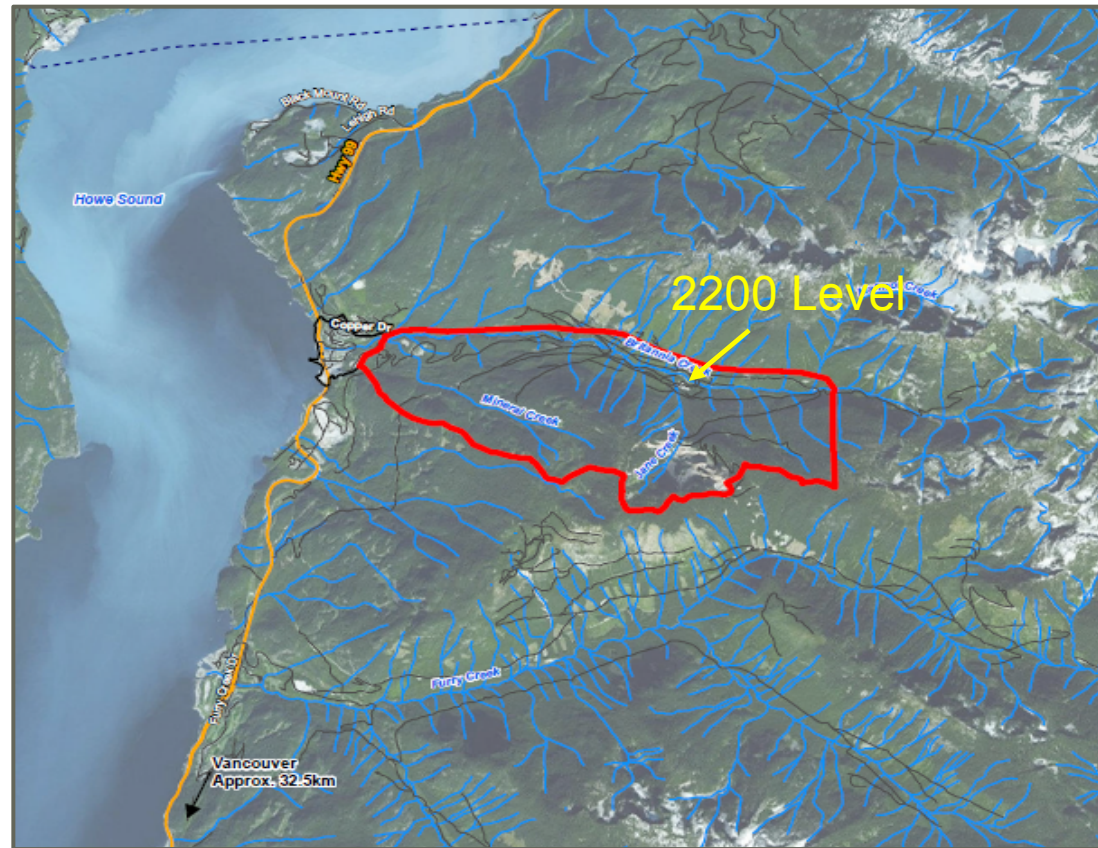




# Britannia Creek

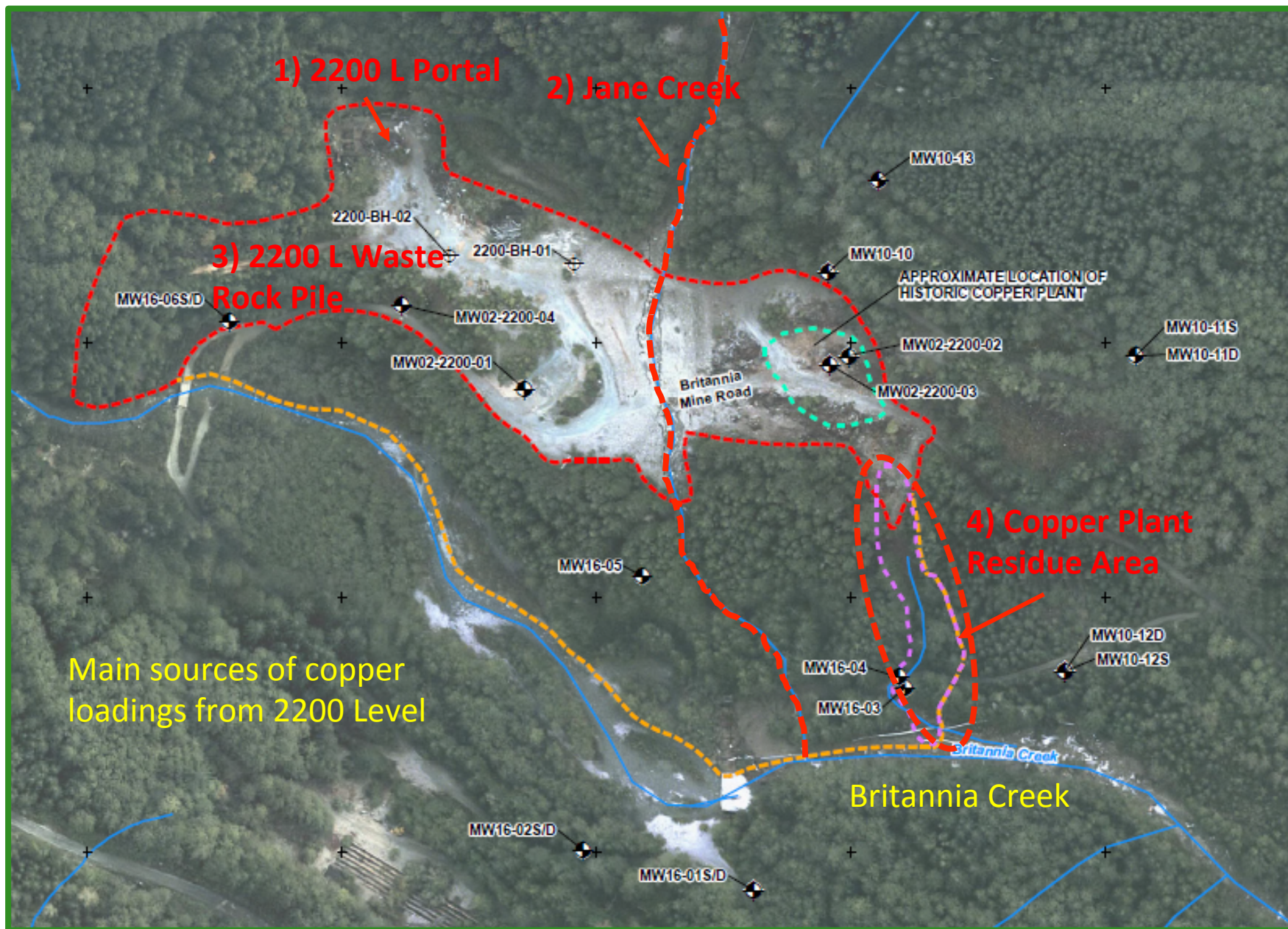
## INVESTIGATION AND RISK ASSESSMENT

- Initiated similar approach at Britannia Creek as Furry Creek
- Investigation complete
- Detailed risk assessment underway



Britannia Creek Study Area







# Britannia Creek

## 2200 LEVEL PORTAL

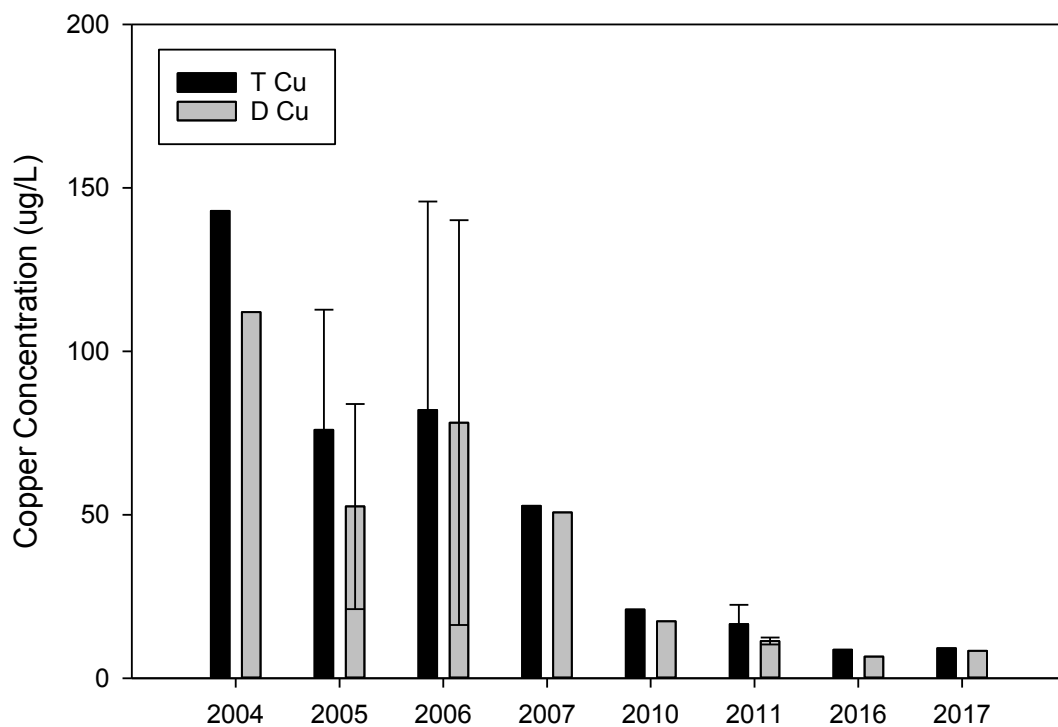
- Identified as a primary source of loading of Cu loading to Howe Sound during earlier remedial phase
- Plug installed in 2001



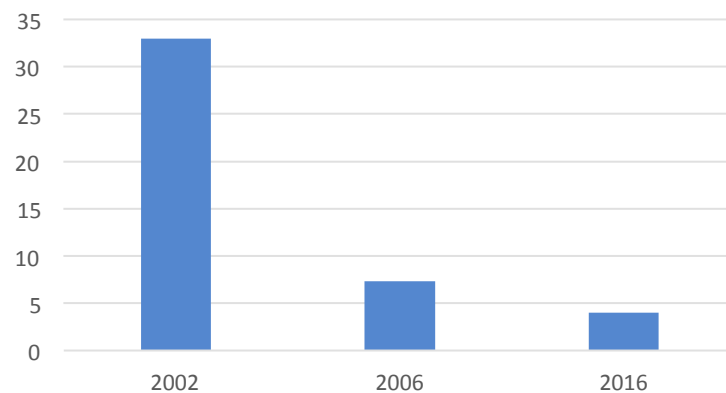
# Britannia Creek

## POST 2200 LEVEL PLUG

Britannia Creek d/s Jane Creek



Dissolved Copper in Groundwater (mg/L)

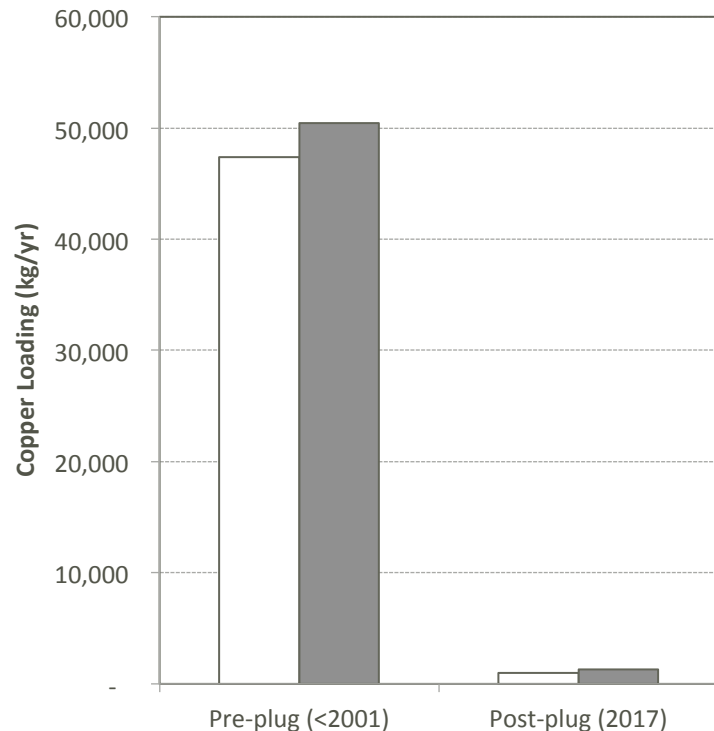




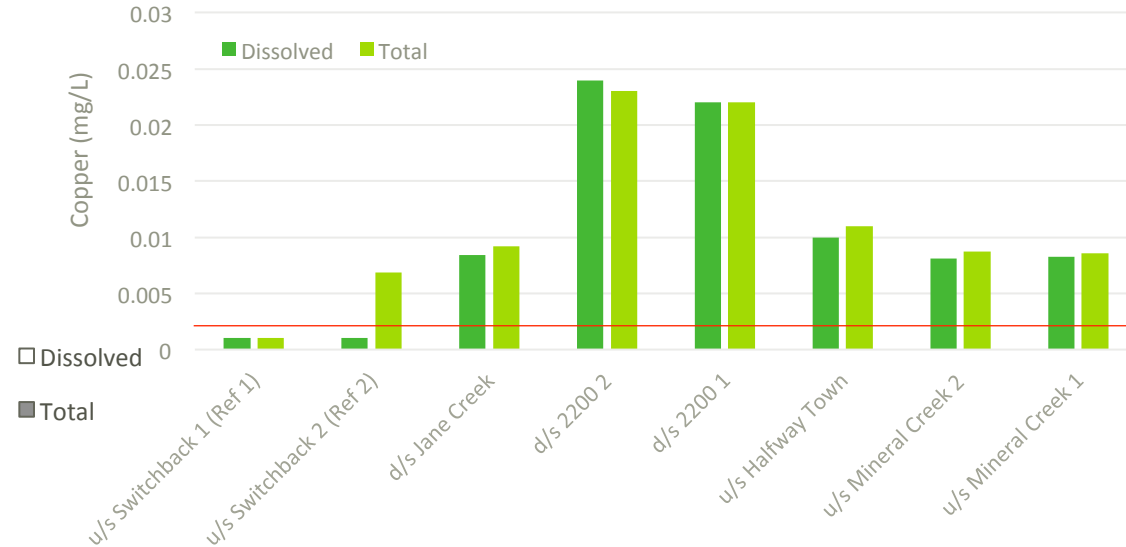
# Britannia Creek

## BRITANNIA CREEK LOADINGS ASSESSMENT

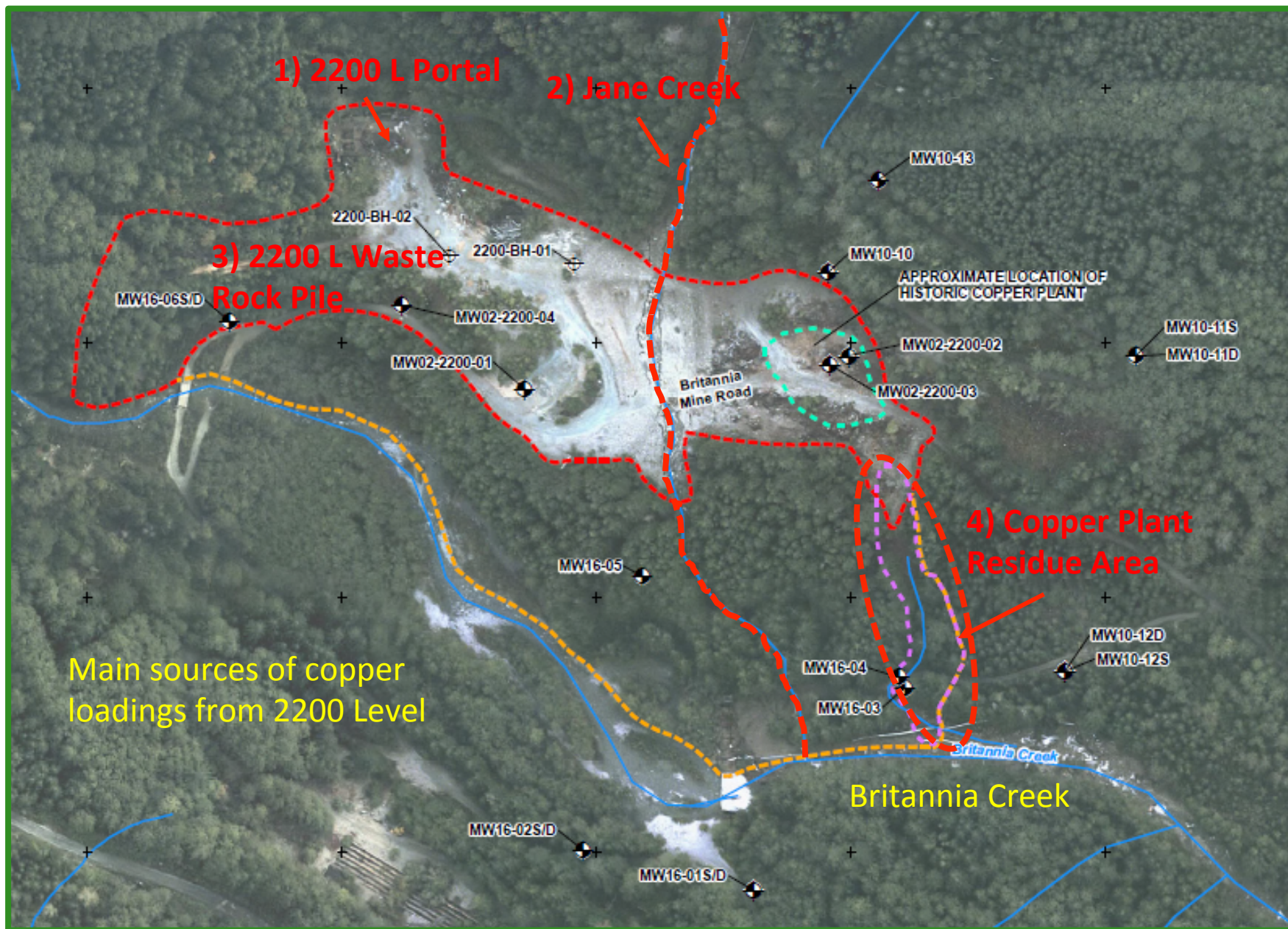
- 2200 L is still primary source of copper loading to Britannia Creek



Copper in Britannia Creek



Loadings to Britannia Creek

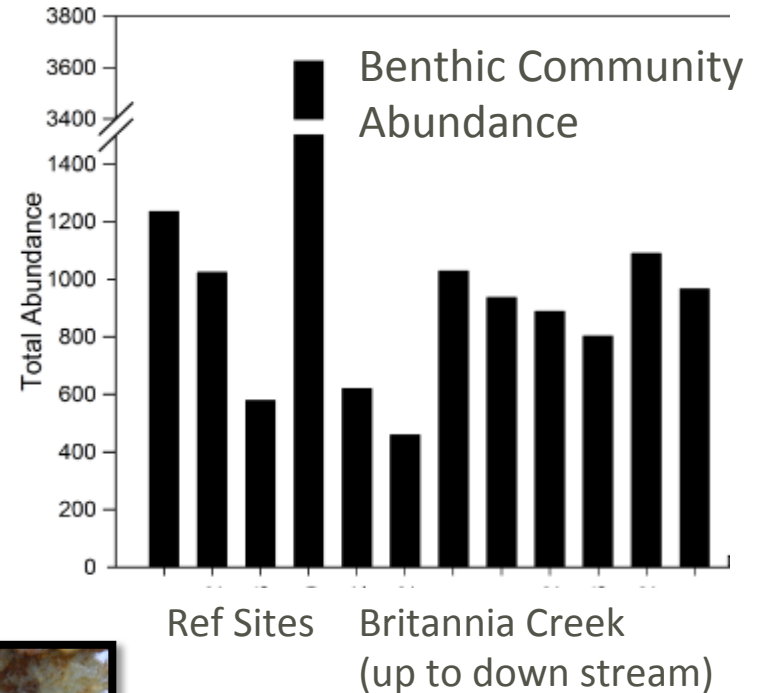
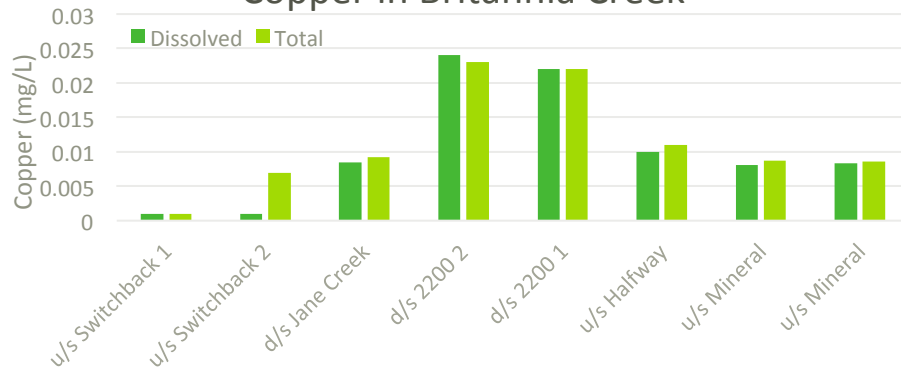




# Britannia Creek

## DETAILED RISK ASSESSMENT

Copper in Britannia Creek



- Surface water and sediment chemistry
- Periphyton
- Benthic invertebrates
- Fish presence
- Tissue chemistry



# Fan Area

## STORMWATER MANAGEMENT



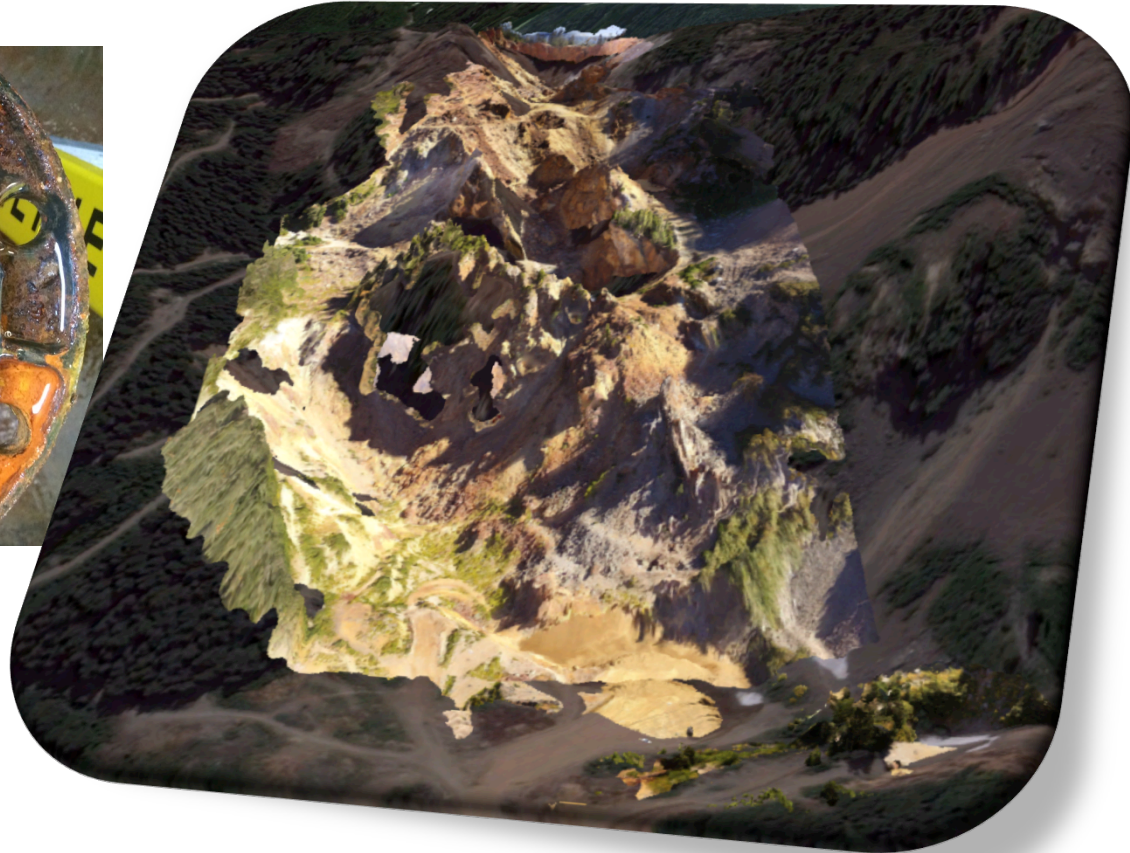
- Stormwater monitoring completed
- Loadings understood
- Copper launders removed
- Engineering underway



# Operation and Maintenance Challenges



Scaling of the Groundwater Management System (GMS) Forcemain



On-site sludge disposal

# Scaling of the GMS Forcemain

## GROUNDWATER MANAGEMENT SYSTEM (GMS)

- Objective: Capture most highly contaminated groundwater in Fan Area
- Pumped up to treatment plant
- Operational since 2005





# Scaling of the GMS Forcemain

## THE PROBLEM

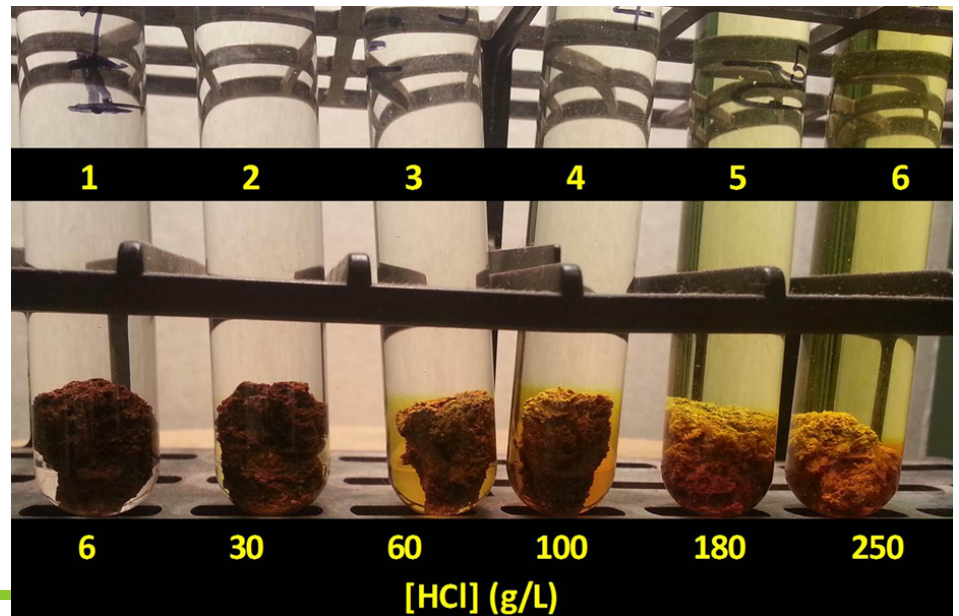


Iron scale formation  
restricting flow of  
groundwater to  
treatment plant

# Scaling of the GMS Forcemain

## THE APPROACH

- Options analysis
- Bench scale testing
- Preferred option selected: Injection of 37% HCl
- Through ITT process, work awarded to Quantum Murray

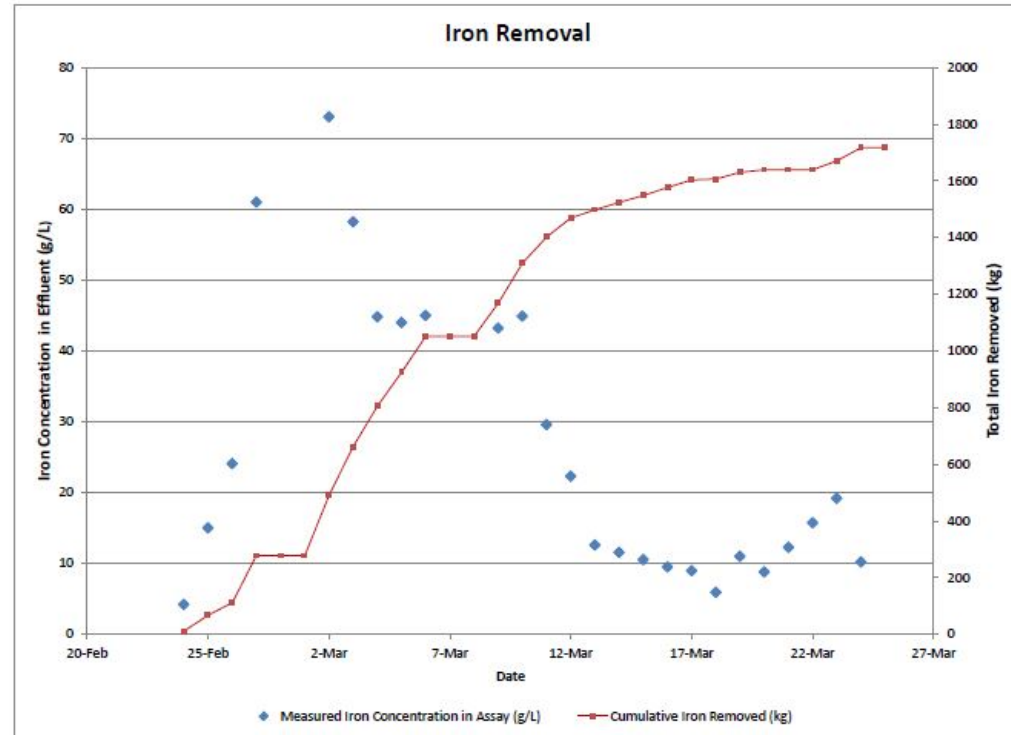




# Scaling of the GMS Forcemain

## CLEANING PROCESS

- Total process took 8 months
- Cleaning stage took 5 weeks



Results of daily assays for iron during cleaning stage

# Scaling of the GMS Forcemain

## CAMERA INSPECTIONS AND FLUSHING – POST CLEANING



Residual Scale Concretions

Charge flushing



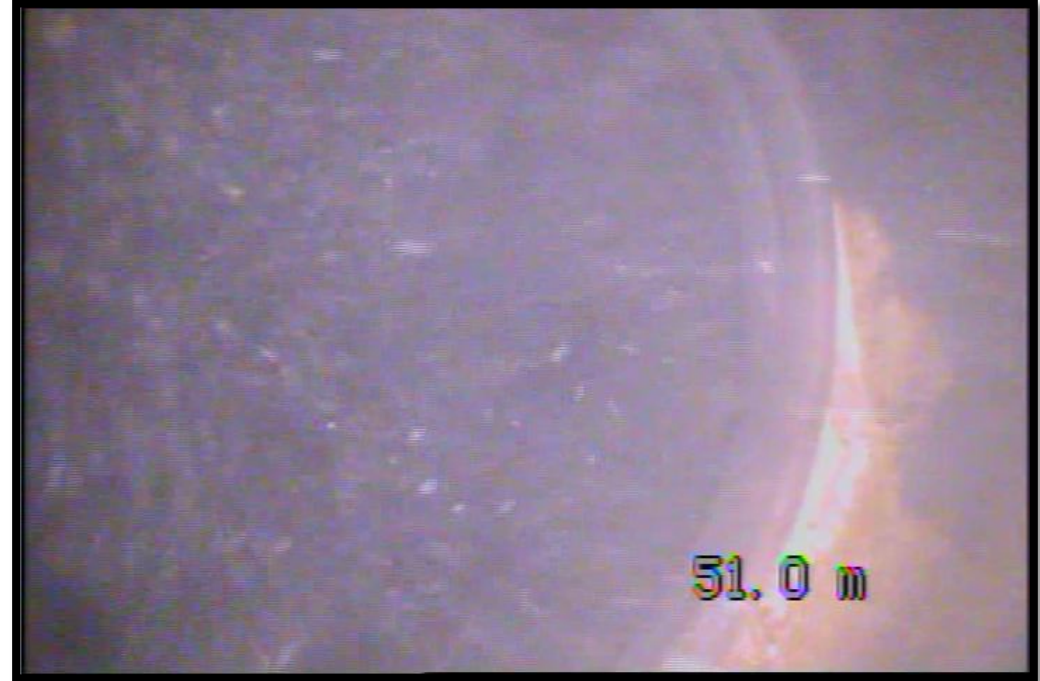


# Scaling of the GMS Forcemain

## POST CLEANING



Initial condition

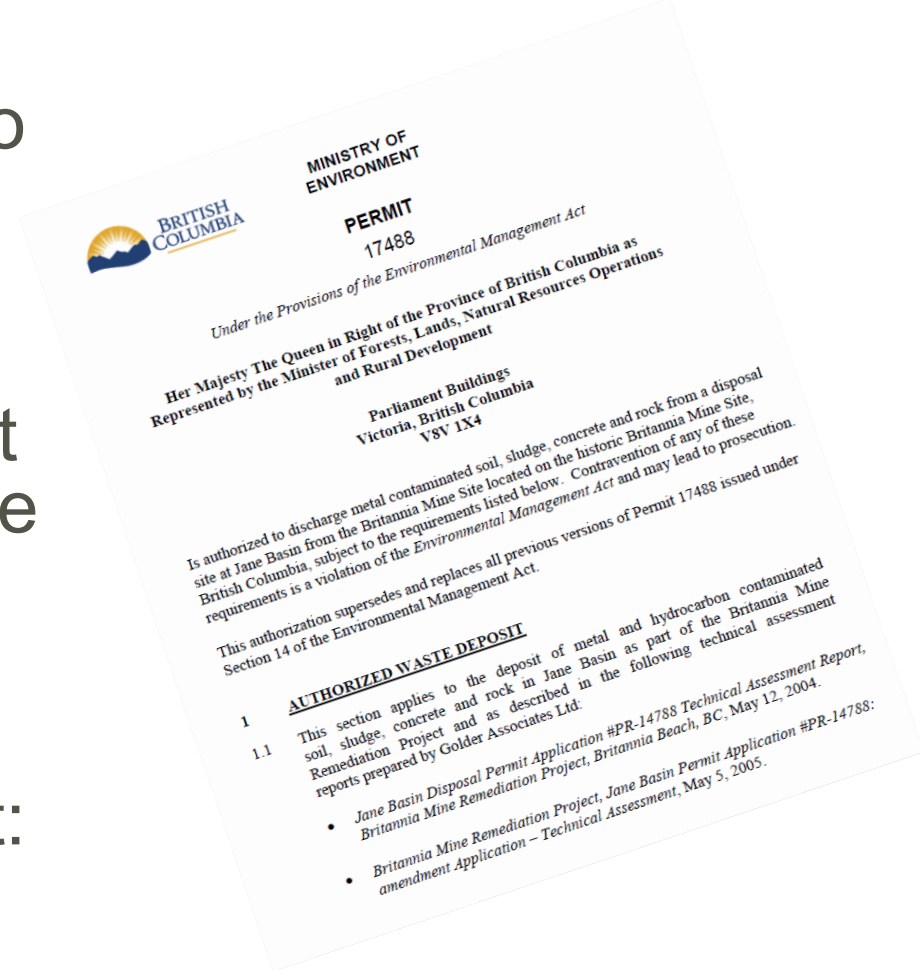


Final condition

# Jane Basin Disposal Facility

## EVALUATION OF OPTIONS FOR FUTURE SLUDGE DISPOSAL

- Province holds permit to dispose of sludge from WTP on-site in Jane Basin
- Needed to revise permit to add a few other waste streams from other remedial activity at the Site
- As part of this looked at:
  - Remaining capacity
  - Future options





## CURRENT DISPOSAL FACILITY





# Jane Basin Disposal Facility

## CAPACITY

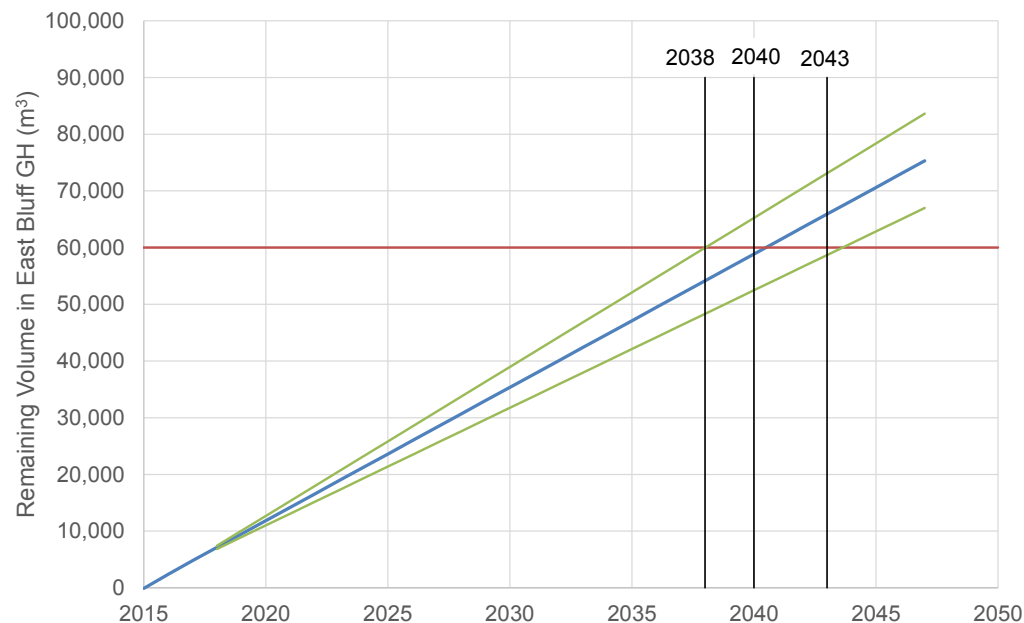


Image © 2013 DigitalGlobe  
© 2016 Google  
Image Landsat

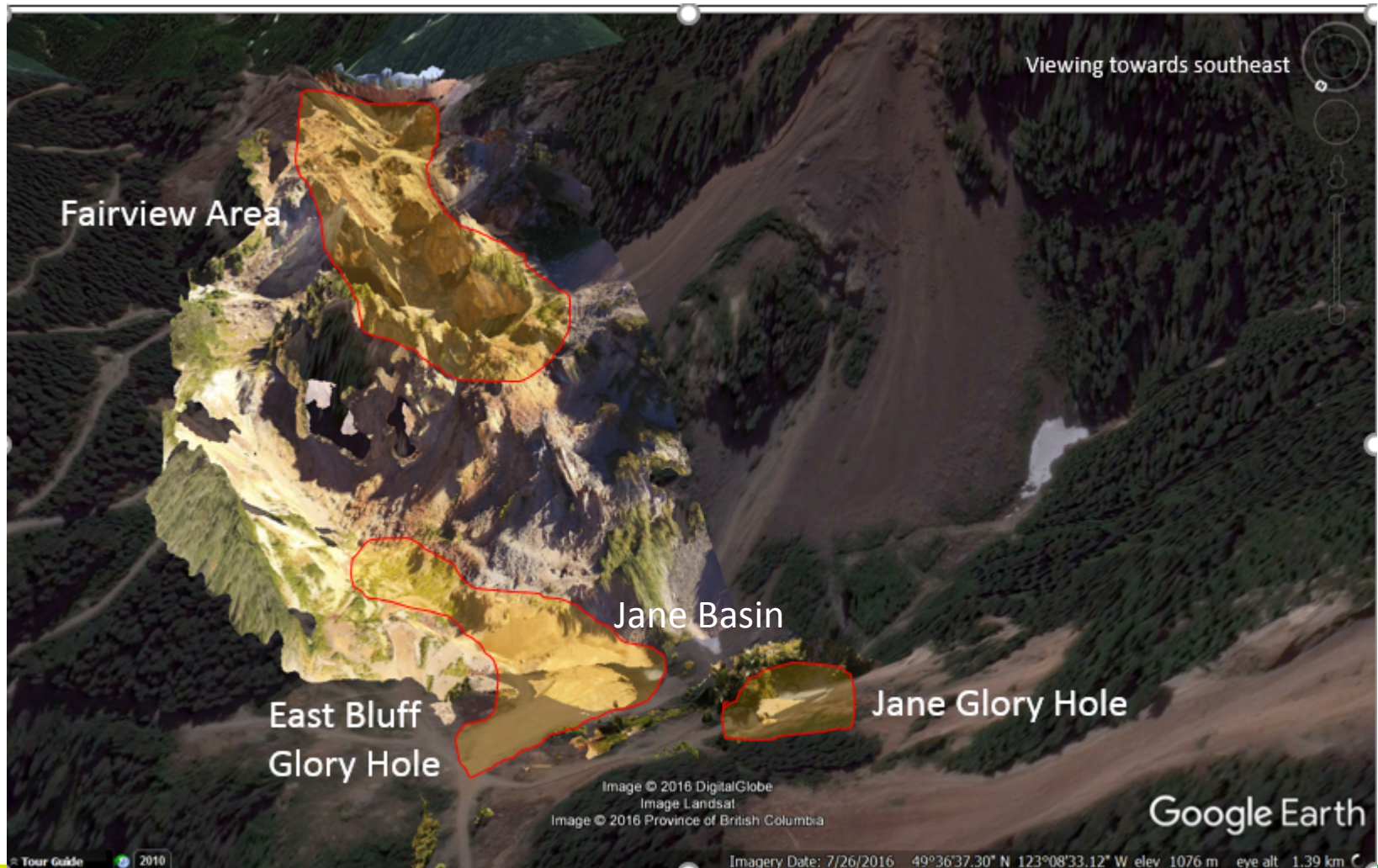
Google Earth

Imagery Date: 7/29/2013 49°36'45.29" N 123°08'24.18" W elev 1047 m eye alt 1.10 km



# Jane Basin Disposal Facility

## EVALUATION OF ALTERNATIVE OPTIONS



# Jane Basin Disposal Facility

## NEXT STEPS

- Short term and long term recommendations identified
- Work will be on-going



Fairview Area – Looking Southeast



# Questions?

