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**Sibanye  
Stillwater**

# Tailings Impoundment Closure Enhancement

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# Outline

**Project Overview**

**Tailings Characterization**

**Closure Cap**

**Closure Enhancement**

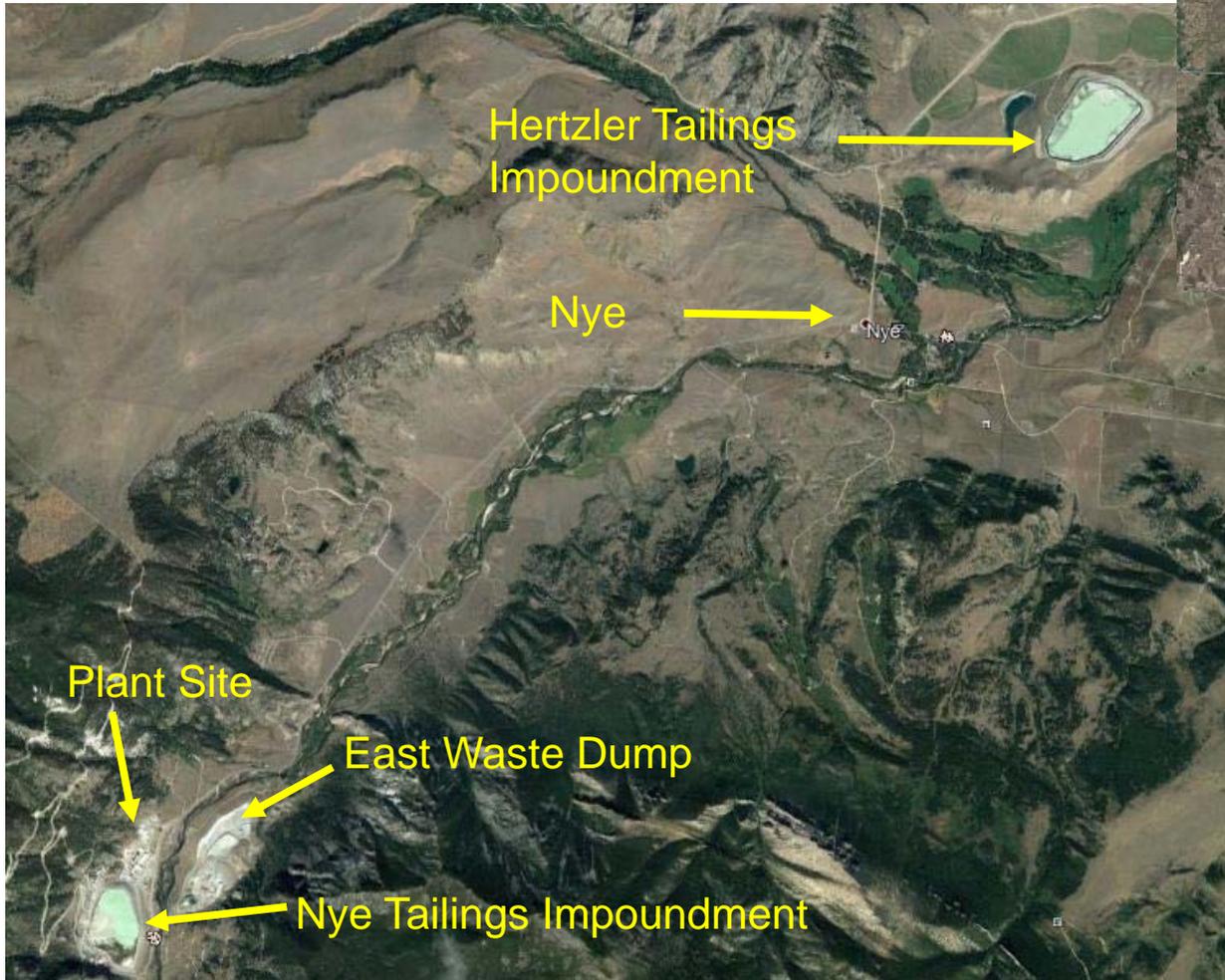
**Summary**



# Project Overview



# Stillwater Mine, Montana



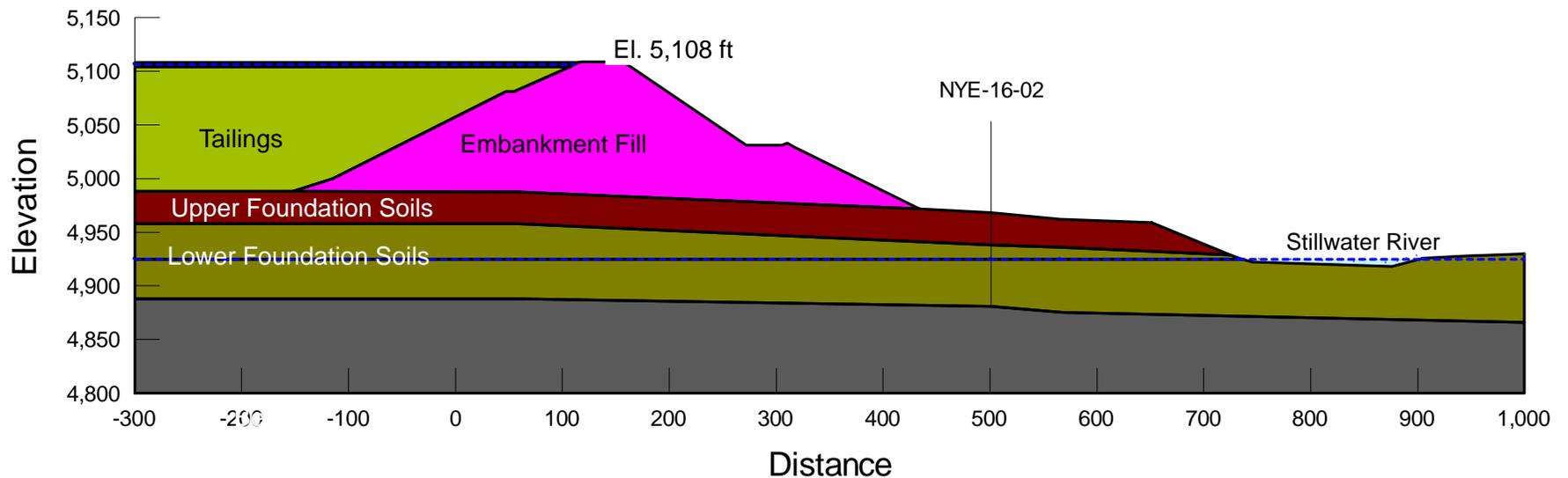
- Stillwater County
- 5 miles southeast of Nye, MT
- Underground Platinum and Palladium mine



# Nye Tailings Impoundment

## Impoundment Section

- Embankment Height: 138 ft.
- Crest Width: 40 to 50 ft
- Downstream Slope: 1.7H:1V to 2H:1V (overall)
- 100 mil HDPE geomembrane to minimize seepage and contain tailings



# Nye Tailings Impoundment

## Closure Objectives

- Long-term public safety
- Protect air, surface water and groundwater resources
- Stable cover with long-term vegetation community
- Provide operational flexibility until final closure of the mine site



# Nye Tailings Impoundment

## Existing Closure Arrangement (for bonding)

- 4 ft. thick closure cap
- Surface water from closure cap reports to closure spillway at north end of impoundment
- Surface of facility revegetated



# Nye Tailings Impoundment

## 'New' Closure Opportunities

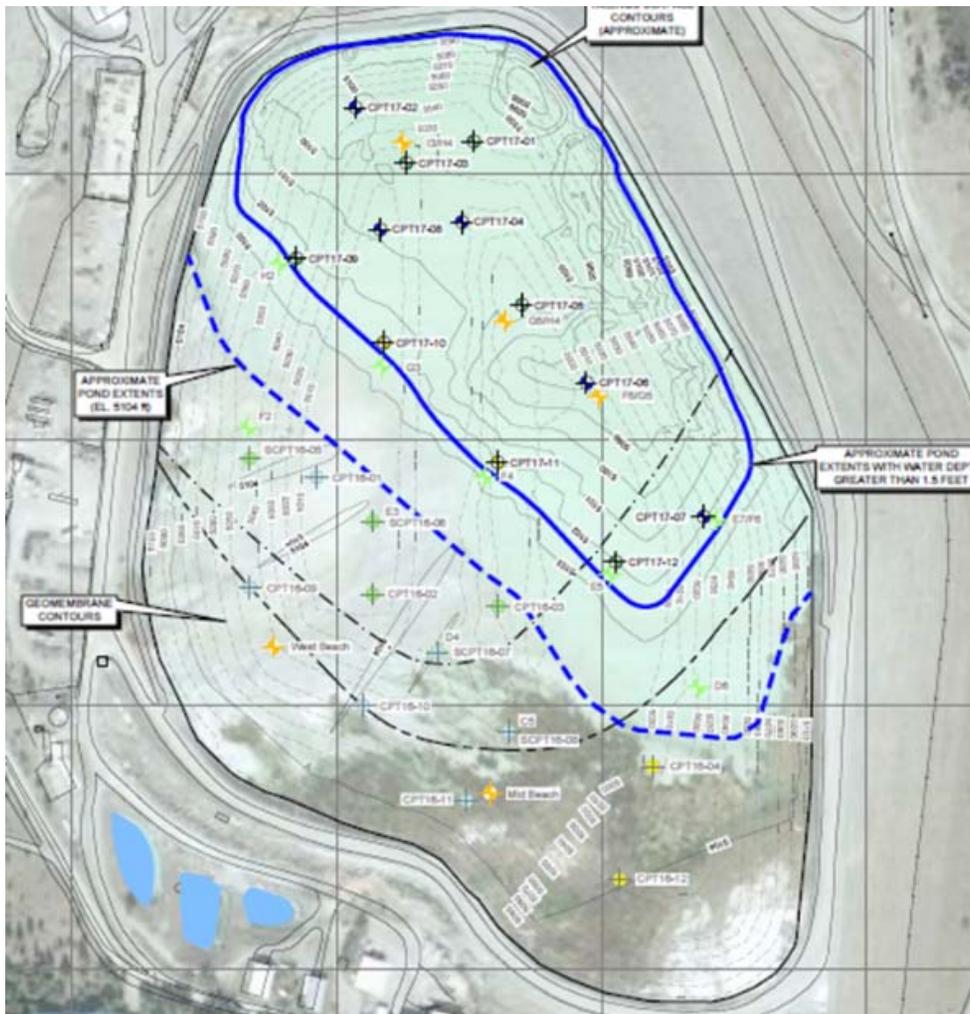
- Provide storage for waste rock
- Reduce the need for additional disturbance
- Promote further consolidation, densification, and dewatering of the tailings



# Tailings Characterization



# Site Investigation Locations



- 24 SCPTs
- 10 geotechnical drillholes
- 2 vibrating wire piezometers

# Site Investigations

## SCPTs, Insitu Testing, Undisturbed Sampling

### Amphibious SI Program

- Exposed tailings surface
- 12 SCPTs, 4 Drillholes, 2 VWP's



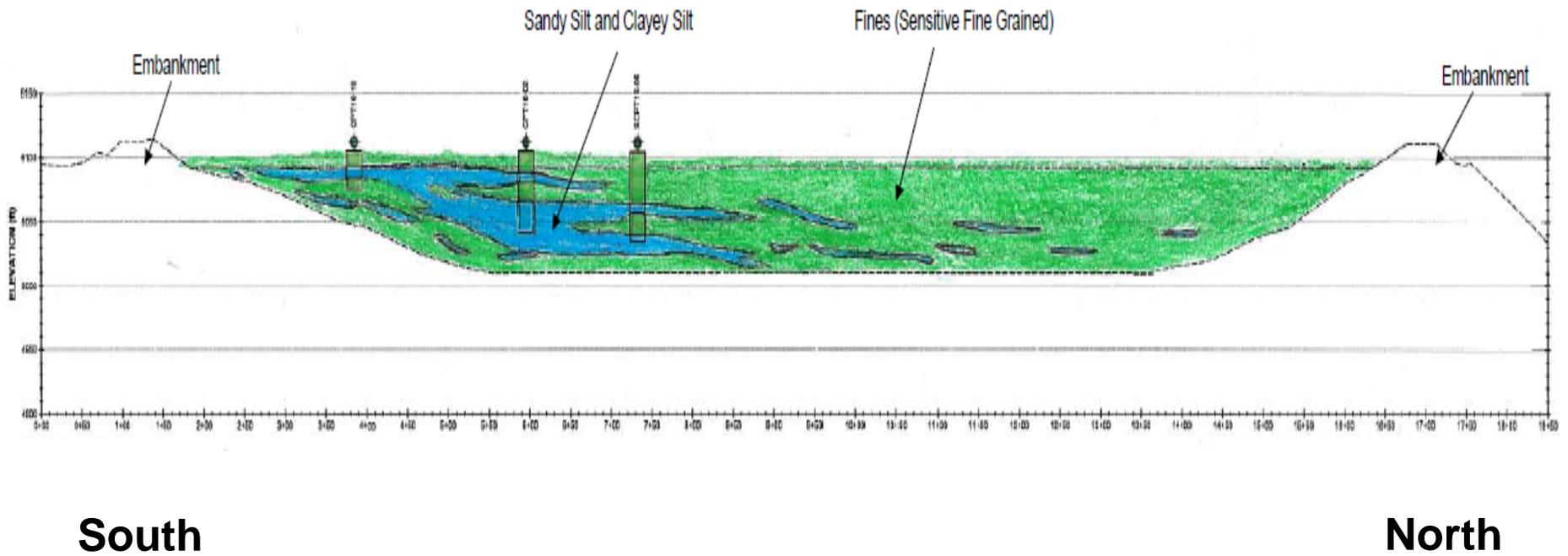
### Barge SI Program

- Operating pond area
- 12 SCPTs, 6 Drillholes



# Tailings Characterization

## In Situ Conditions



# Tailings Characterization

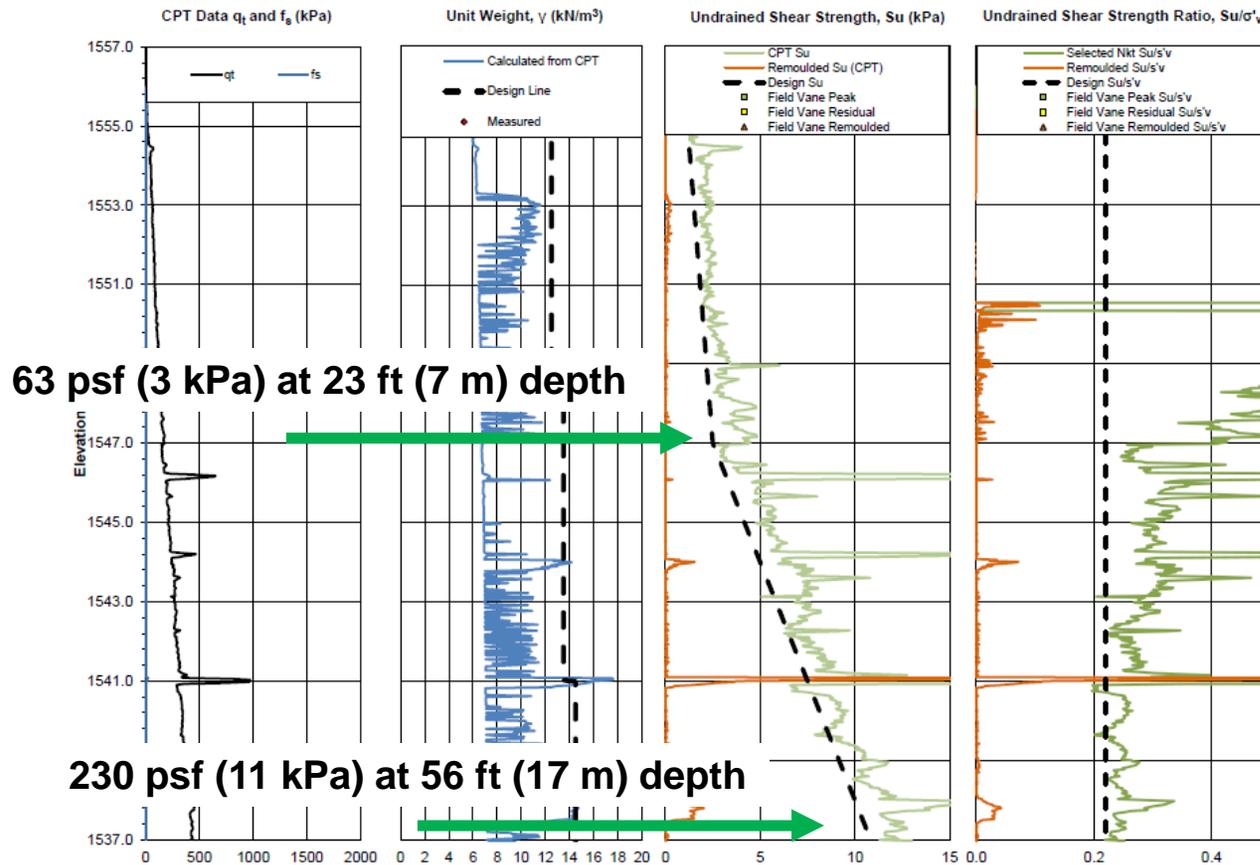
## In Situ Conditions



Tailings slimes sample from SCPT-18-08, 33 ft. to 53 ft. below tailings surface

# Tailings Characterization

## Downhole Plot – Slimes Tailings (SCPT18-08)



# Closure Cap

## Tailings Response

- Increase effective stress on tailings (weight of waste rock)
- Tailings consolidate as pore pressures dissipate
- Increased density and decrease in water content

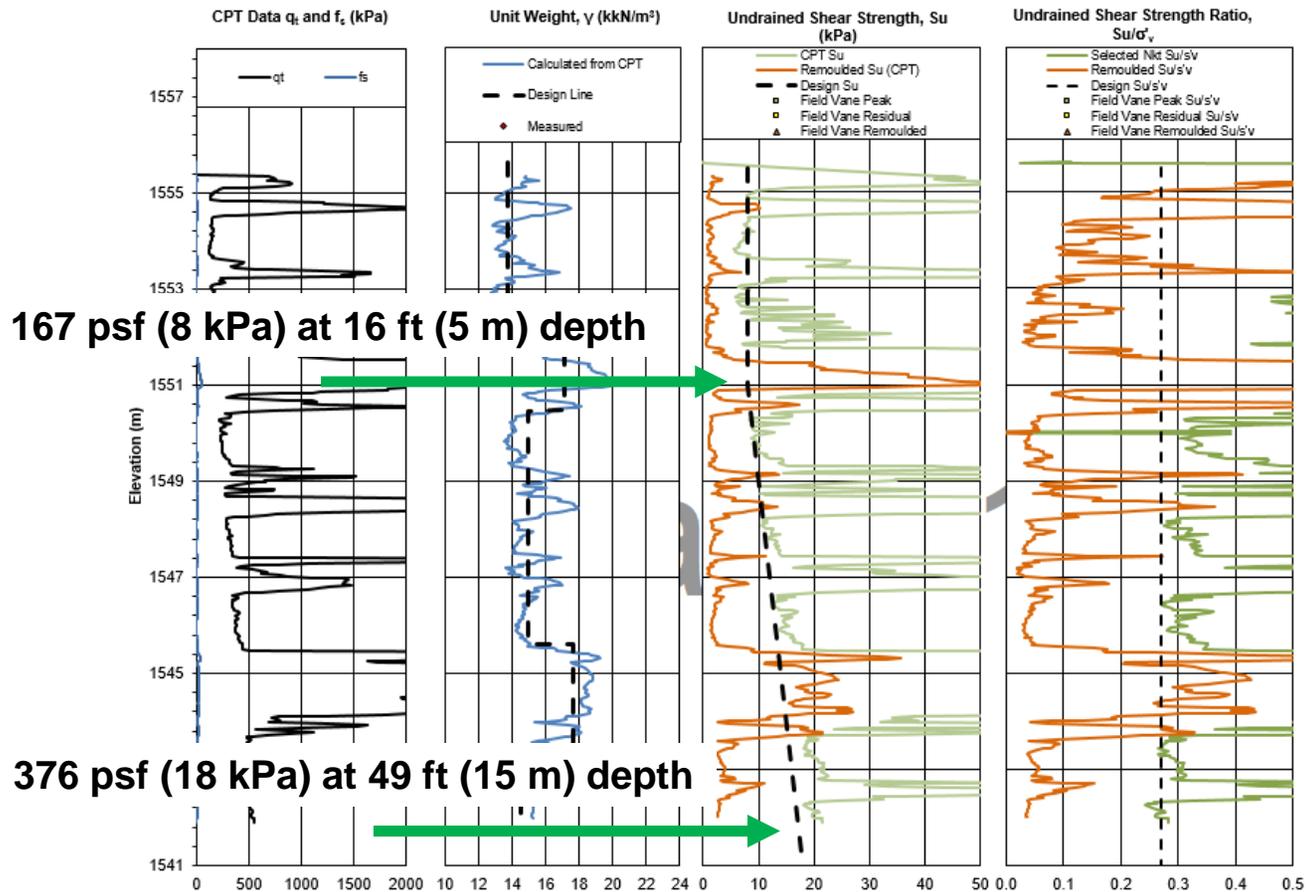
————— Density Increases & Water content Decreases —————>



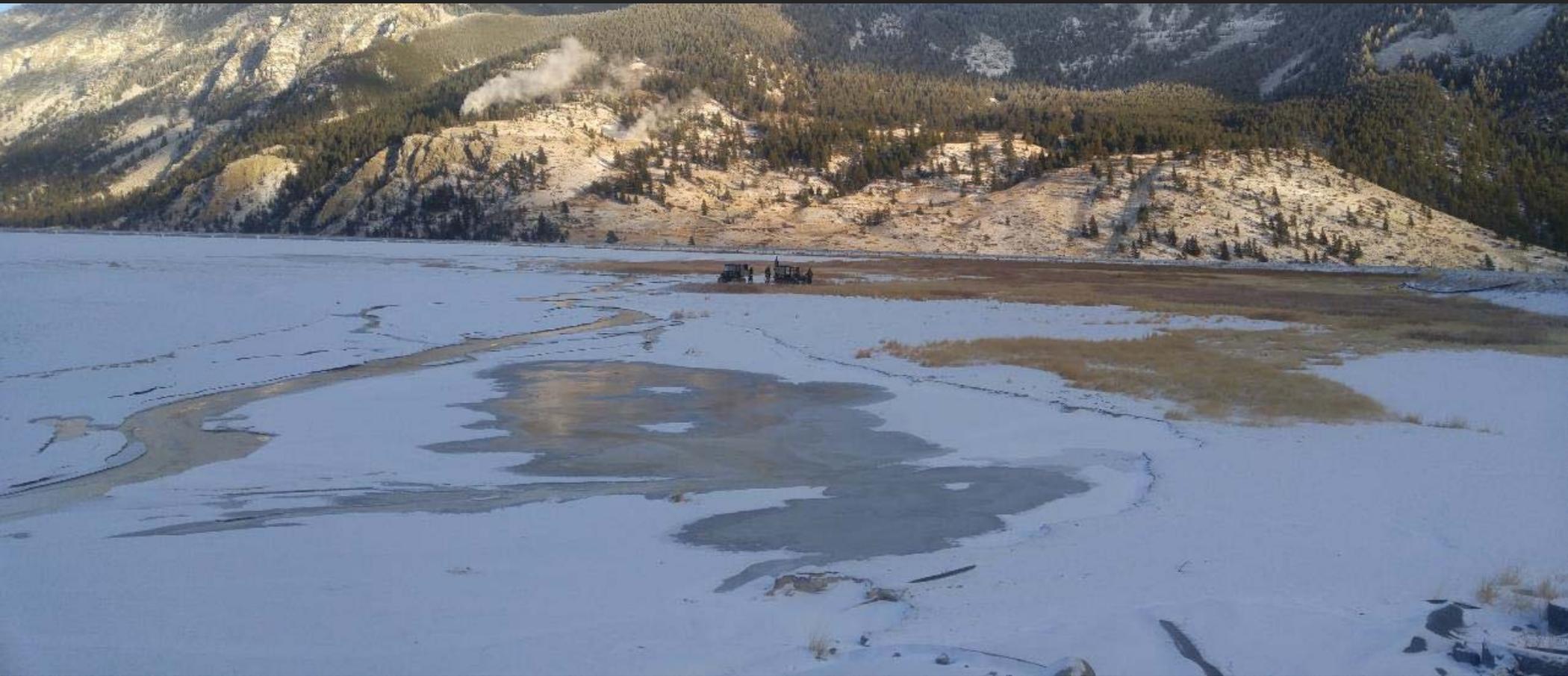
\*Data based on experience at other projects

# Tailings Characterization

## CPT Downhole Plot – Sandy Tailings (CPT16-12)

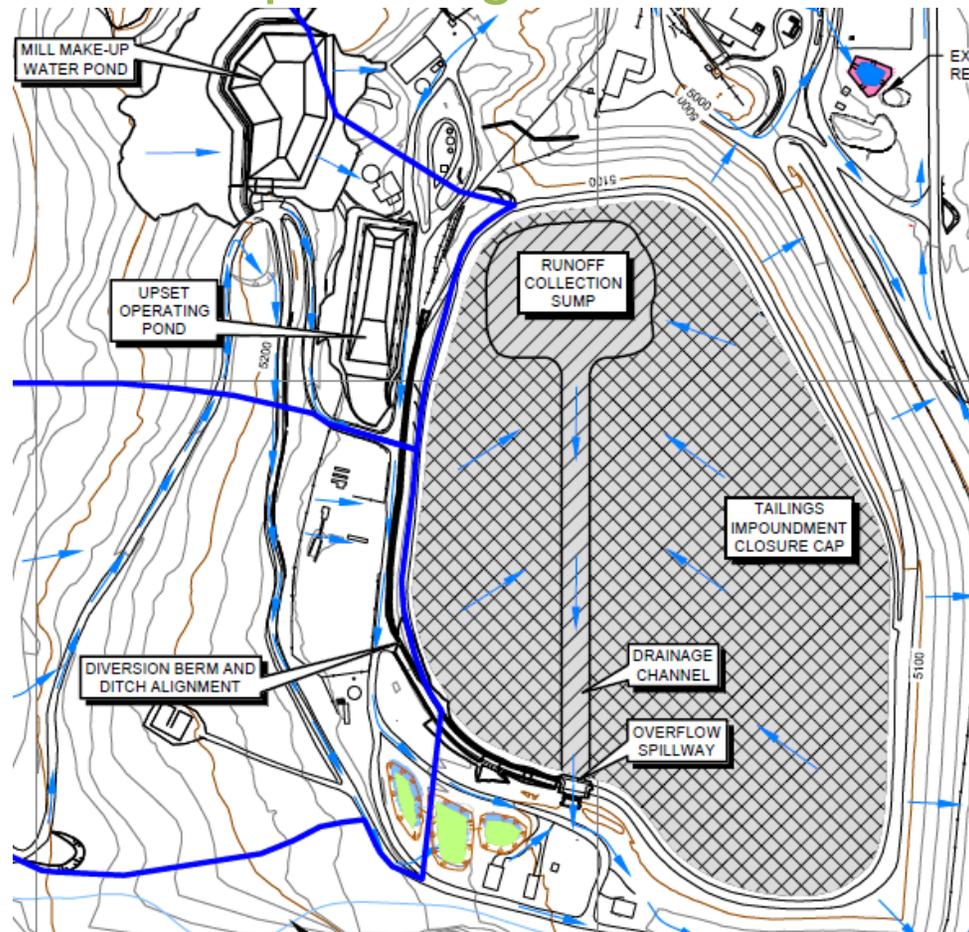


# Closure Cap



# Closure Cap

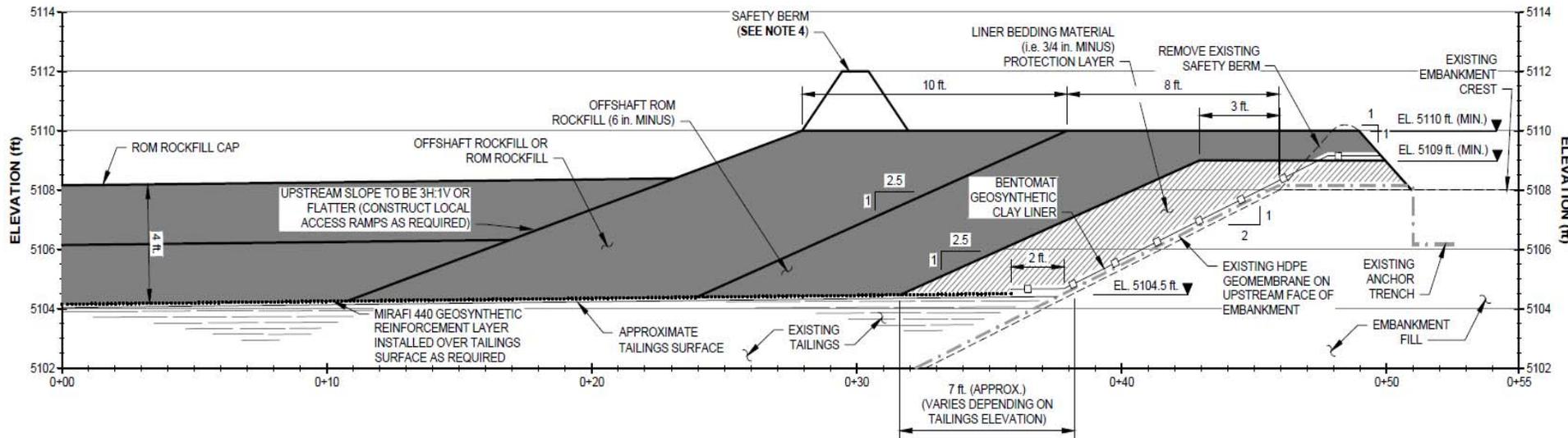
## 'New' Closure Cap Arrangement



# Closure Cap

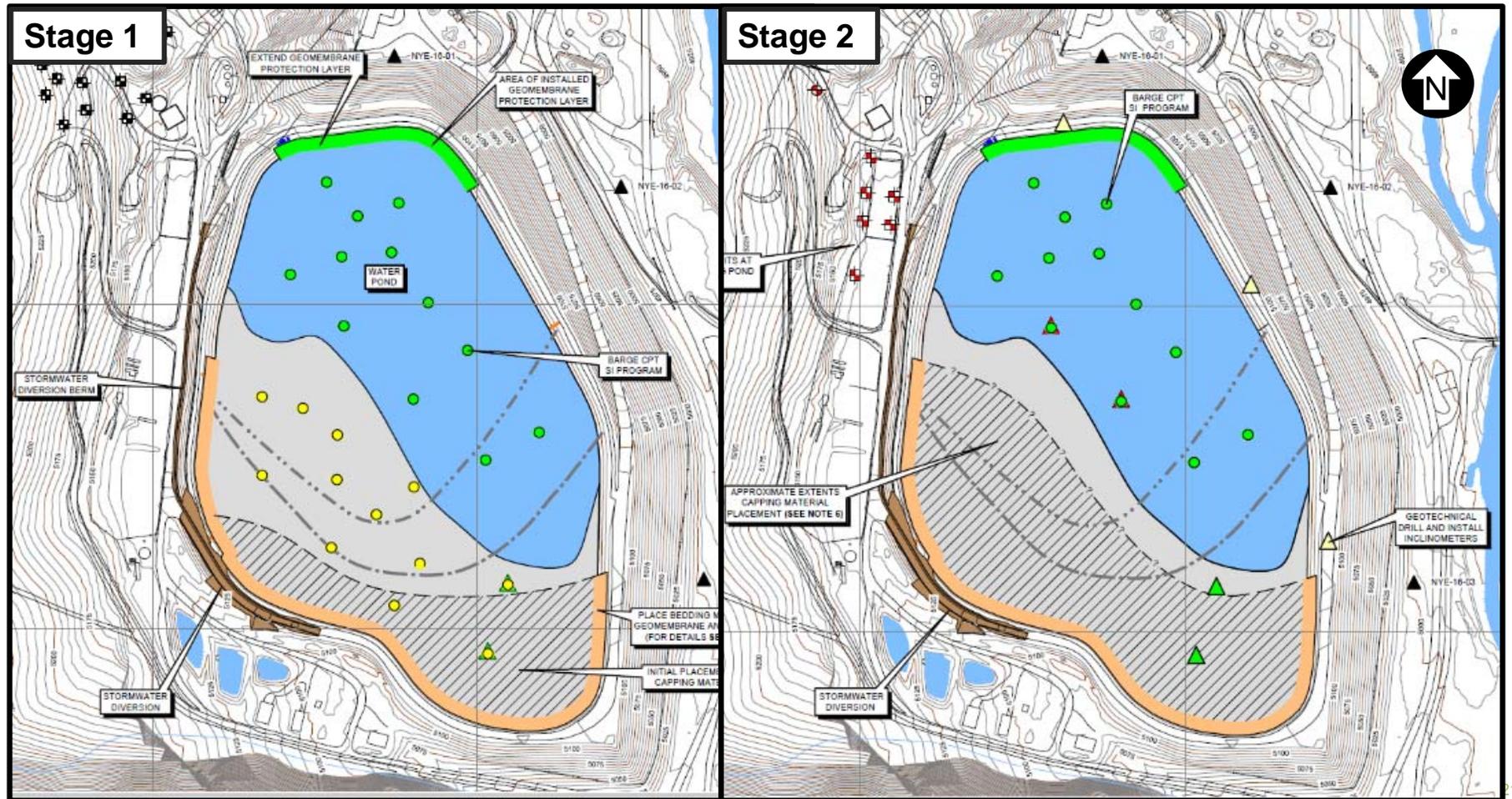
## Typical Section

- 4 ft. thick waste rock cap placed over geosynthetic reinforcement layer
- Geomembrane protection layer to be installed over the existing HDPE geomembrane liner



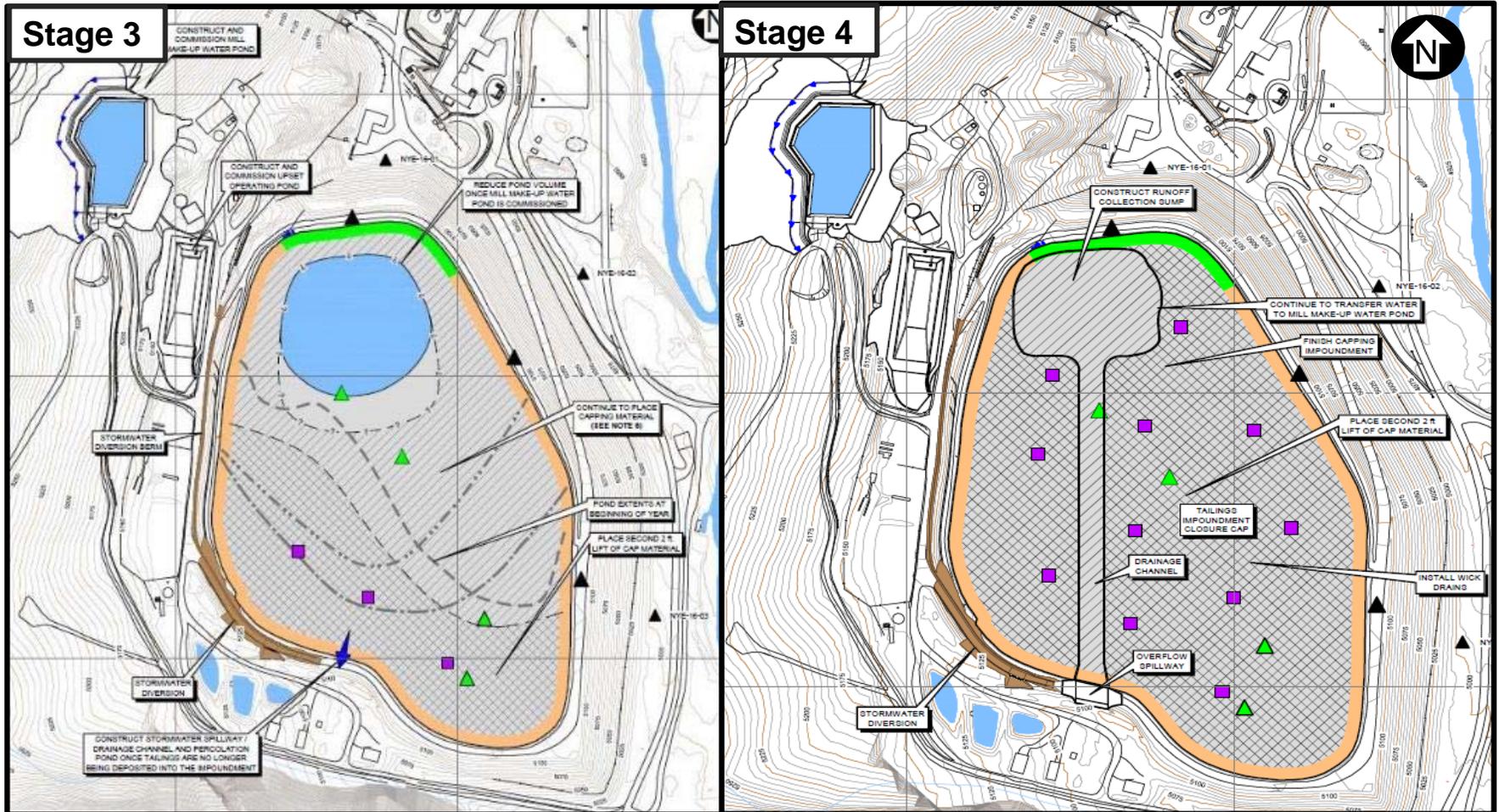
# Closure Cap Staging

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# Closure Cap Staging

*Knight Piésold*



# Closure Enhancement



# Closure Enhancement

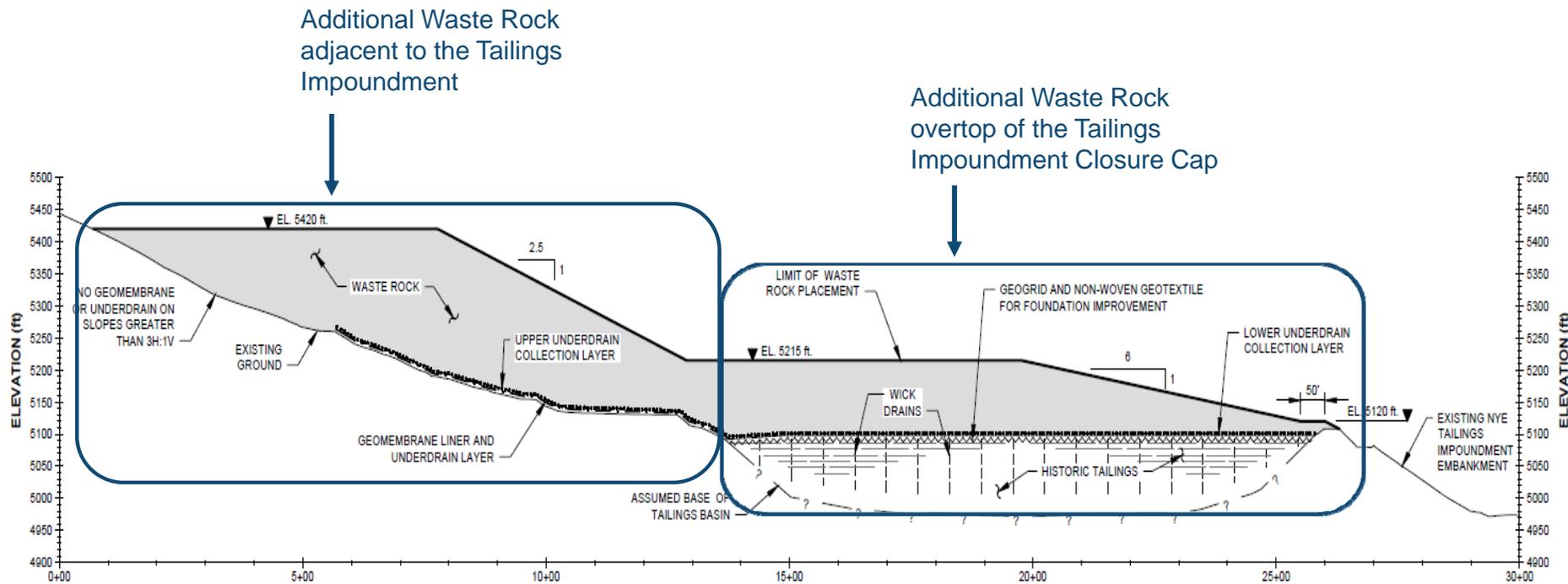
## Objectives and Opportunities

- Waste rock currently stored at the East Waste Dump
- Waste rock can be used to cap the Nye Tailings Impoundment to develop a stable post-closure landform
- Potential to store additional waste rock on and/or adjacent to the closed Nye Tailings Impoundment
- Provide further tailings consolidation, increase density of in place tailings and enhance stability of the post closure landform



# Closure Enhancement

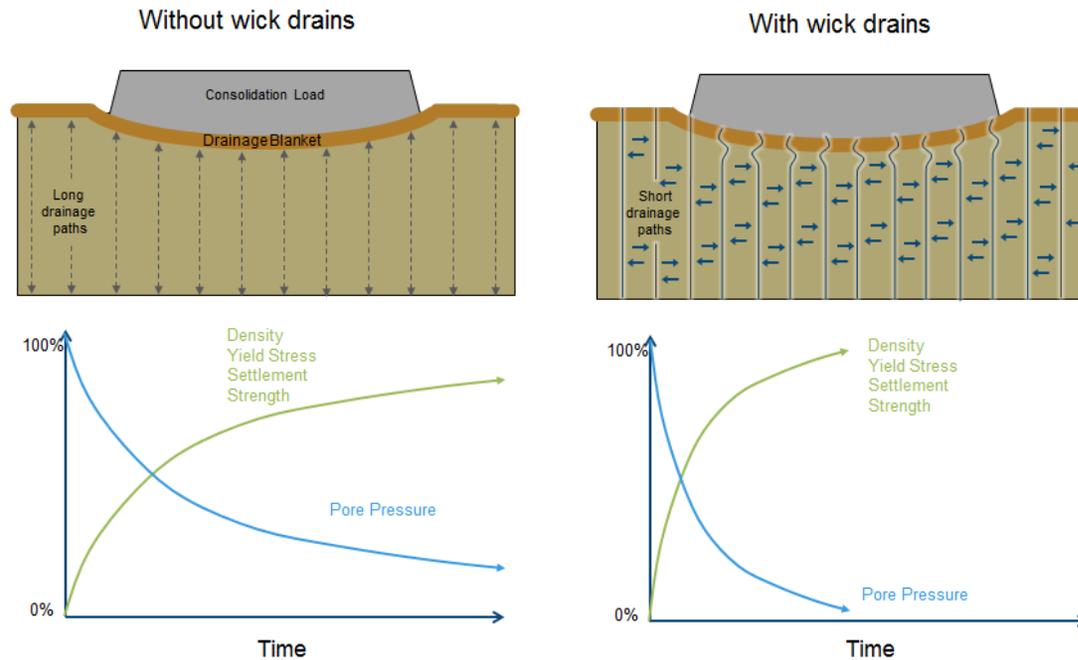
## Conceptual Arrangement



# Closure Enhancement

## Waste Rock Consolidation Loading

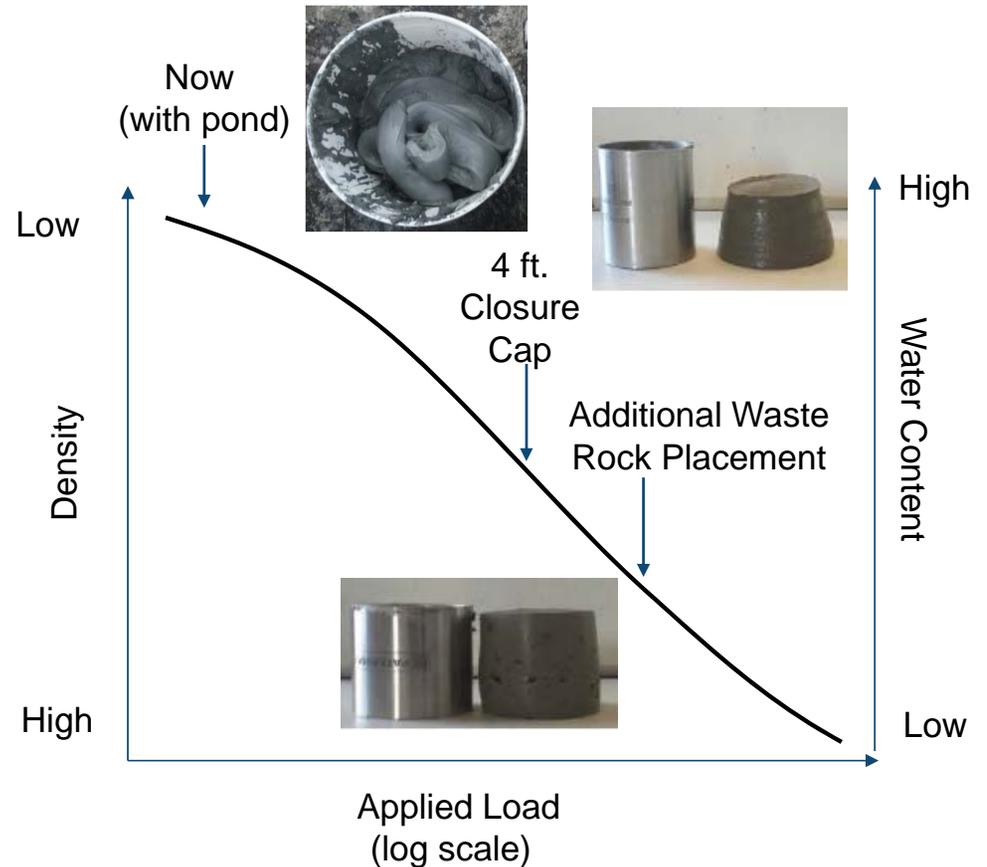
- Increase density at depth
- Consolidation will be a function of time and drainage (accelerated with wick drains)
- Improved drainage will enhance stability during ongoing waste rock placement



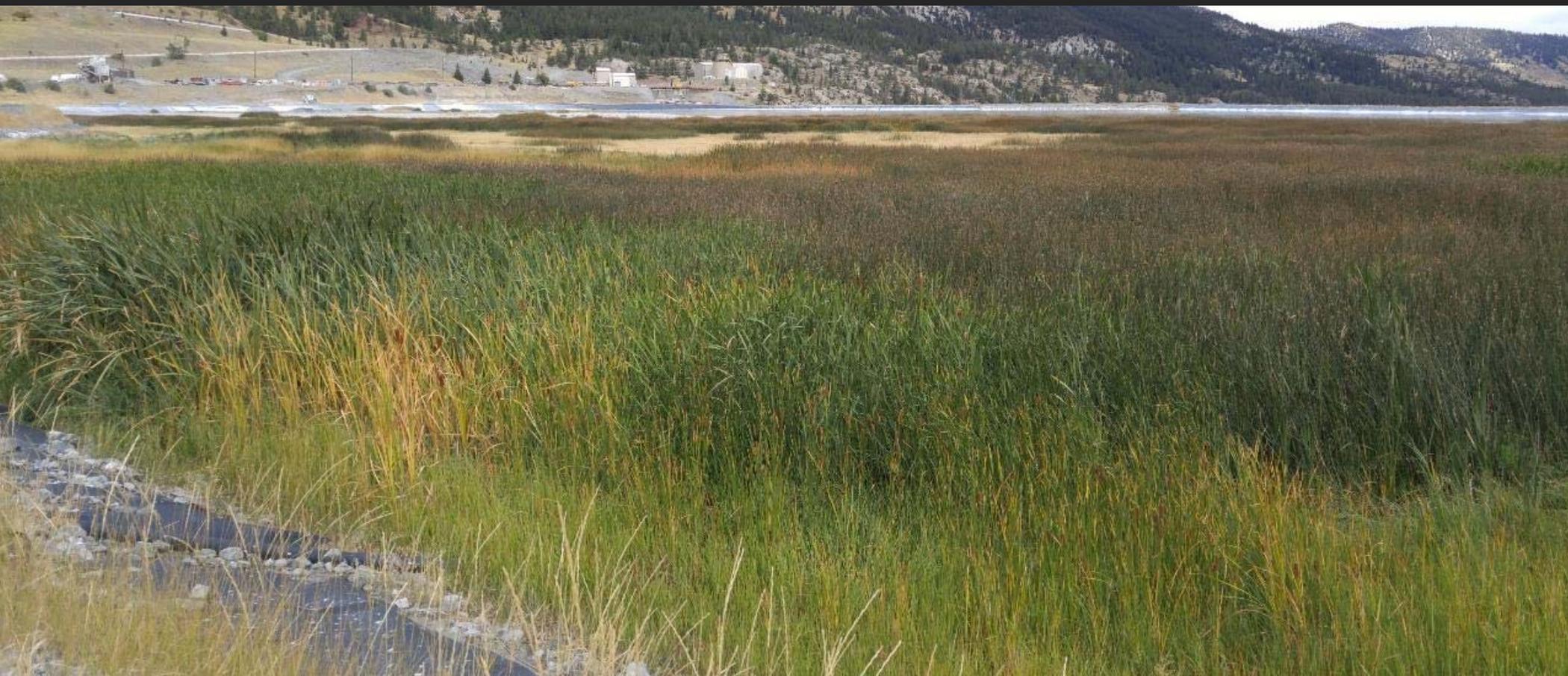
# Closure Enhancement

## Effect of Additional Waste Rock Placement

- Further reduction in moisture content and increase in density
- Higher loads required to achieve similar effect as Closure Cap at depth



# Summary



## Summary

- The Nye Tailings Impoundment continues to provide secure storage of fine grained tailings
- Placement of the Closure Cap will consolidate and densify the saturated fine grained tailings.
- Increasing the Closure Cap thickness will enhance the stability of tailings impoundment and allow for additional waste rock to be integrated into the post closure landform
- Key benefits include:
  - Reduced mine footprint due to waste dump integration with closed tailings impoundment
  - Dense non-flowable tailings result in Low consequence dam safety classification for a hypothetical dam breach post closure
- Closure of the impoundment is being developed with Sibanye-Stillwater and their stakeholders. This is recognized as the best technology and best practice for closure of the Nye Tailings Impoundment.



# Q&A

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