



STEP UP
YOUR GAME



Design and Engineering of Dry-Stack Tailings Storage Facility – Vulture Mine Project

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Carrie Côté, P.E. – Vice President

Kow Eshun, P.E. – Vice President



Sajjad Satvati, Ph.D., P.E.



- Role: Geotechnical Engineer
- Project Manager

Patrick J. Sullivan, Jr., P.E.



- Role: Project Manager
- Principal

Robert S. Livermore, GIT, CEM, CESCO



- Role: Principal
- Vice President
- Arizona Operations Lead
- Geological
- Environmental

Carrie Côté, P.E.

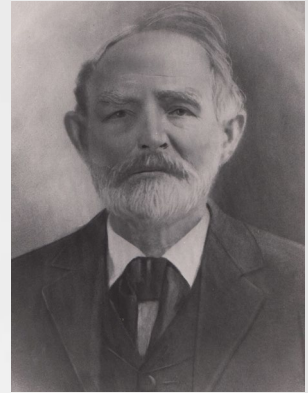


- Role: Quality Manager
- Vice President
- Water & Wastewater

History of Vulture Mine



- Discovered in 1863 by Henry Wickenburg
- Vulture City grew around the mine, over 5,000
- Arizona's most productive gold mine, until 1942
- 340,000 ounces of gold and 260,000 ounces of silver
- Challenges:
 - theft of gold (estimated \$200,000 worth)
 - temporary closures due to wartime regulations.
- After abandonment, Vulture City became a ghost town,
- The site is now privately owned and offers guided tours.



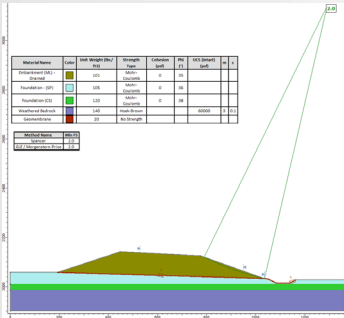
Introduction and Overview

- Client: Vulture Mine peak
- 8-year mining operation
- Mining 6.5 Million Tons Ore + Generating ~ 1.4 Million Tons tailings
- Designing a phased Tailing Storage Facility (TSF) on site to:
 - ensure safe storage, adherence to Arizona's BADCT standards
 - managing slopes, erosion control, and material handling
 - geosynthetics placement, seepage & stability evaluations, and
 - perimeter berm development
- Closure



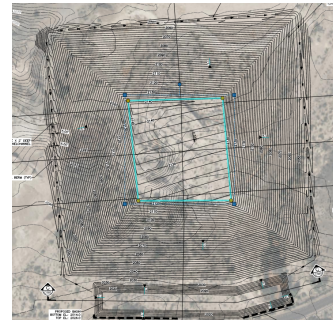
Design

Geotechnical Engineering



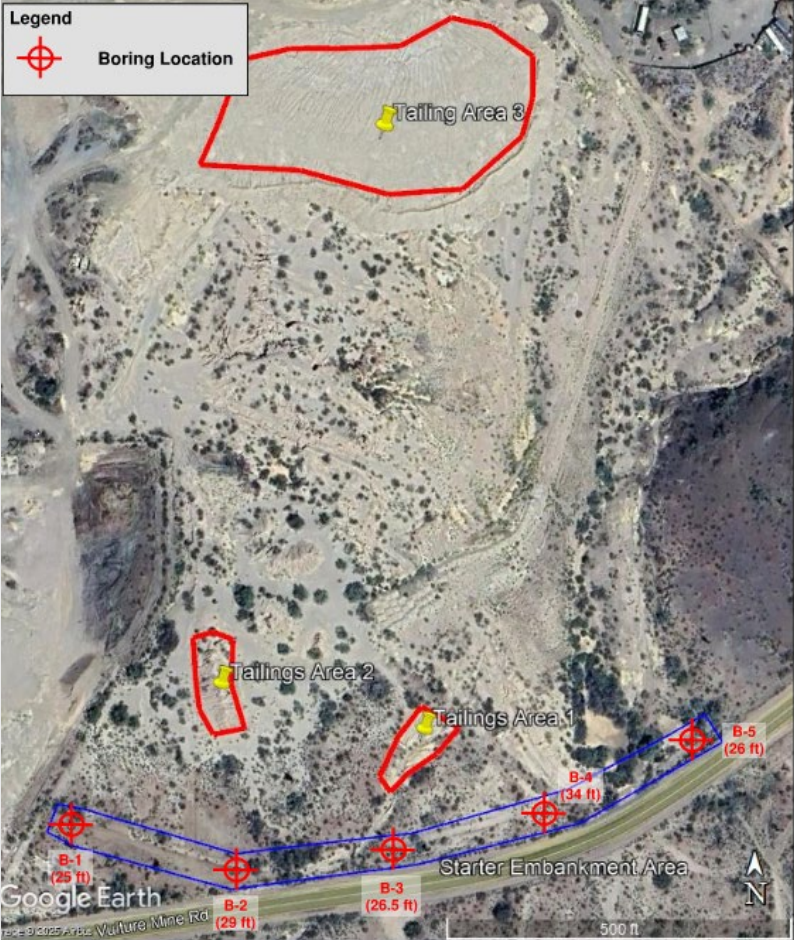
- Shallow bedrock
- +400 feet depth to groundwater
- Sandy and granular soils
- Existing Tailings: ML and SM
- Comprehensive lab testing
- 3H:1V slopes - stable:
 - Static (drained and undrained),
 - Pseudo-Static (undrained),
 - Rapid Drawdown (undrained).
- Seepage stability
 - For 100-year flood event
 - 48 hours, 3 feet pond water

Closure



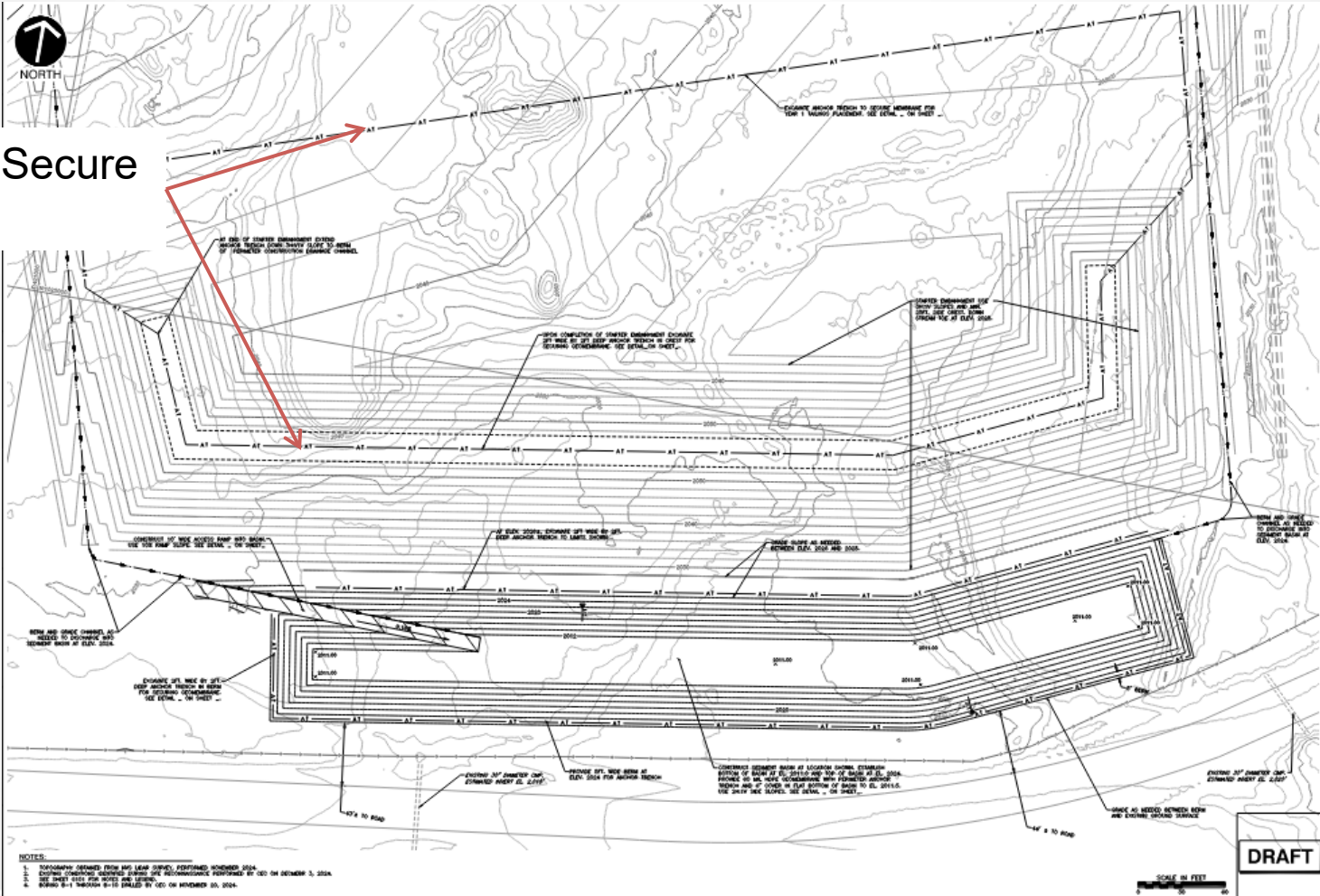
1. Concurrent closure of side slopes (no closure cost needed)
2. 12" cover of overburden (approx. 650K cf) at top of TSF
3. Lined Sediment Pond:
 - Assume clean closure – conduct sampling for closure
 - 1-2ft combined soil and rock over liner at base and on side slopes to close in place
4. Lined Channels:
 - Assume clean closure – conduct sampling for closure
 - 1-2ft combined soil and rock over liner

Site Investigation



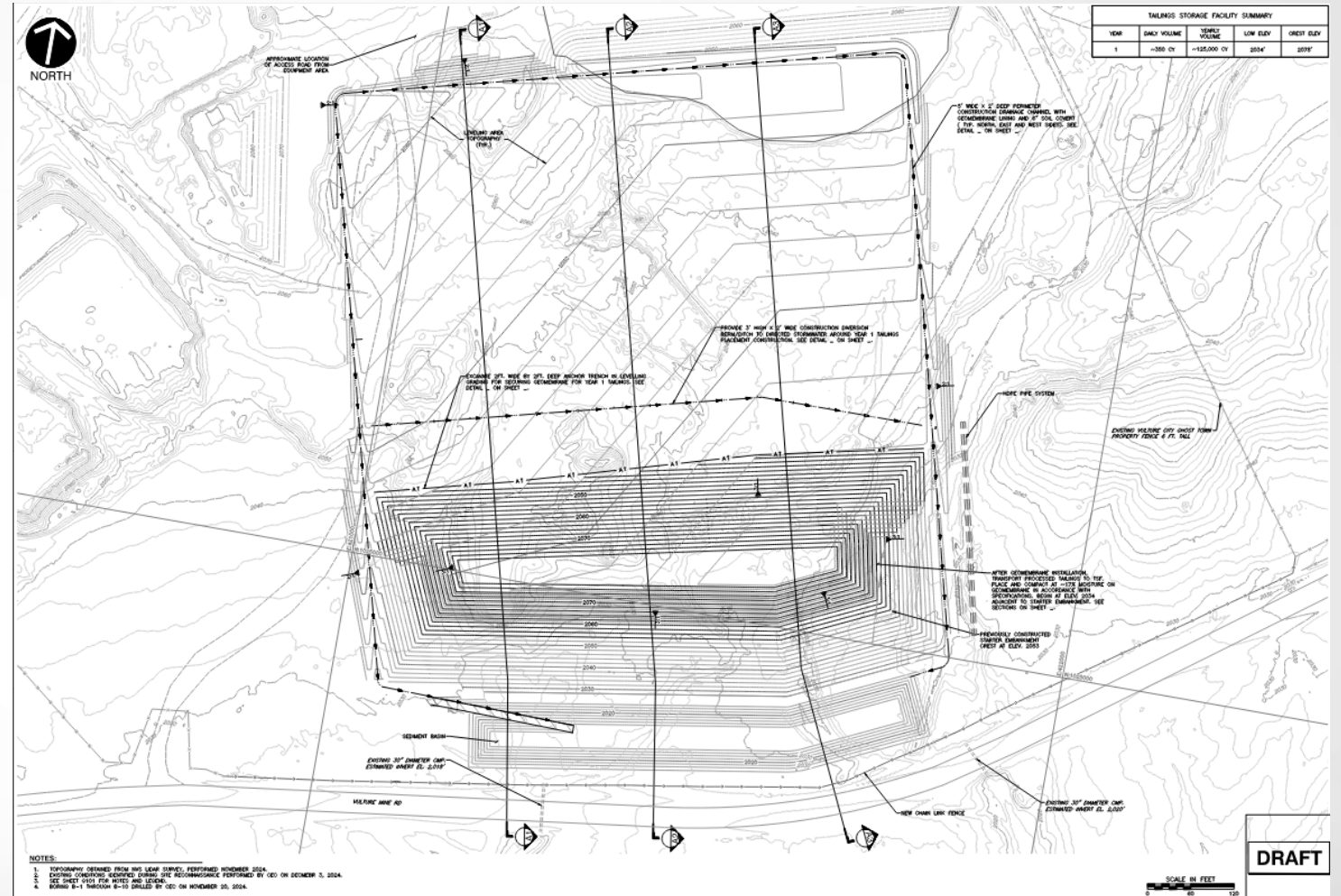
20-foot Height Starter Embankment

2'x2' Anchor Trench to Secure Geomembrane.



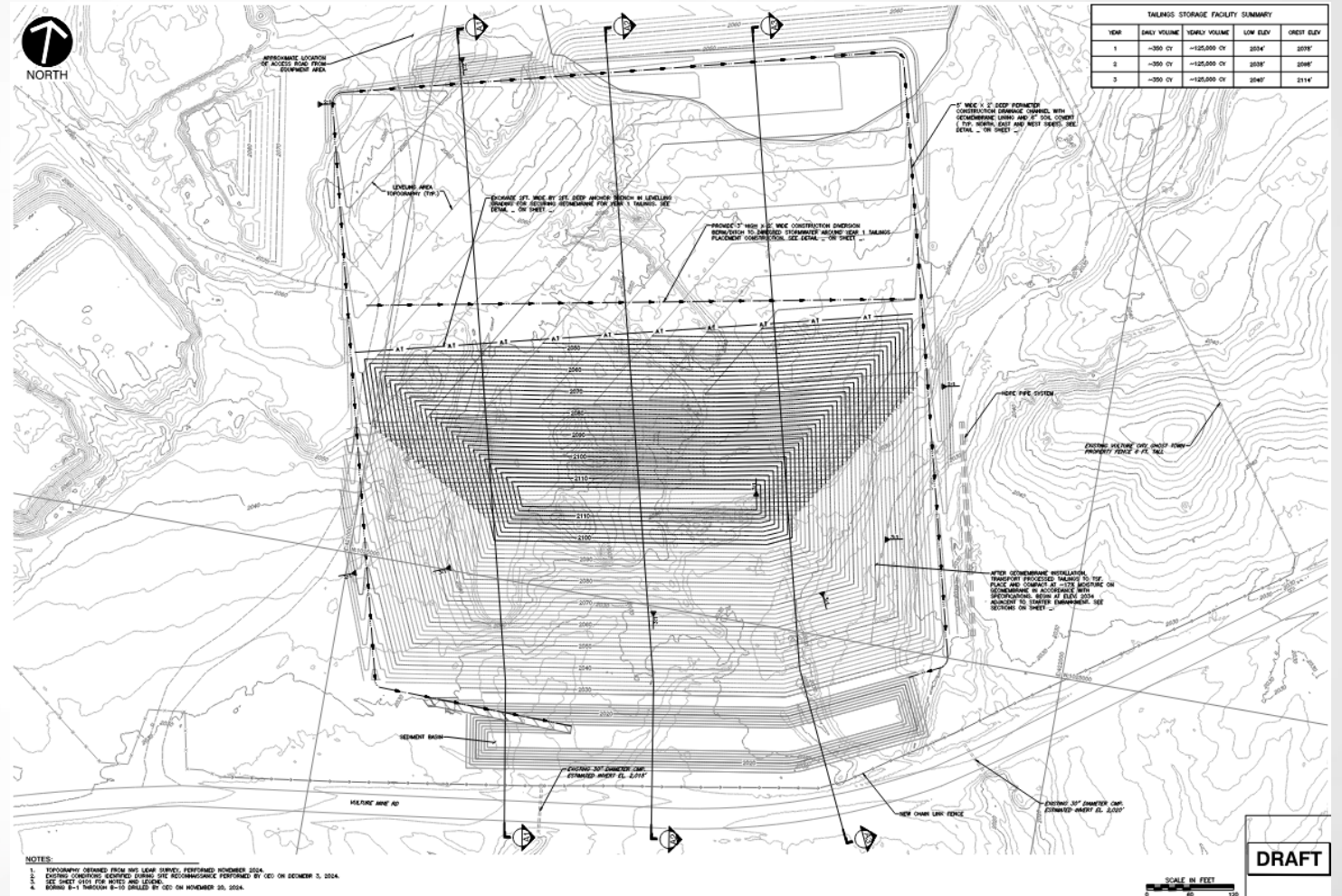
Year 1

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,034'
- Crest El: 2,078'



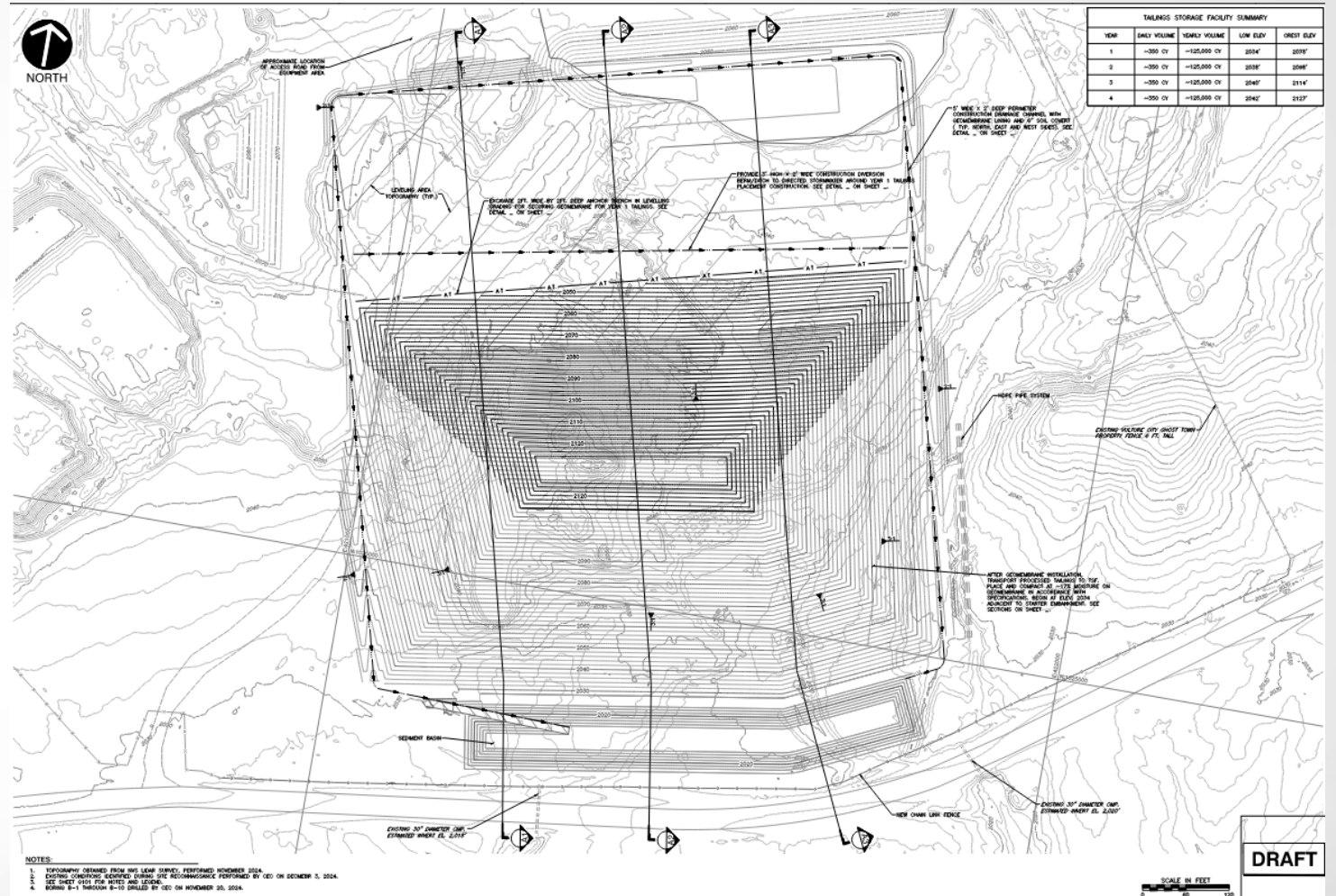
Year 3

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,040'
- Crest El: 2,114'



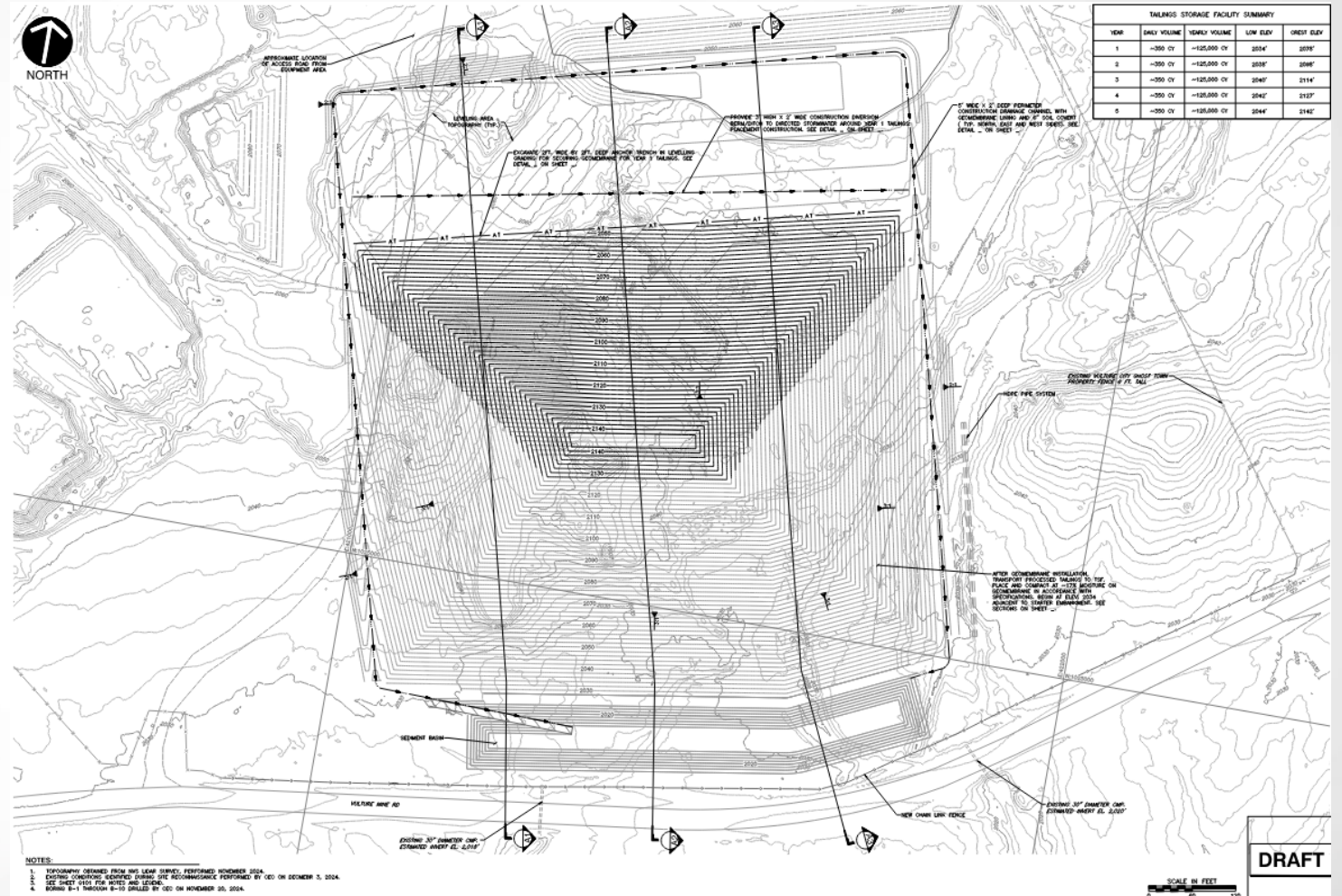
Year 4

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,042'
- Crest El: 2,127'



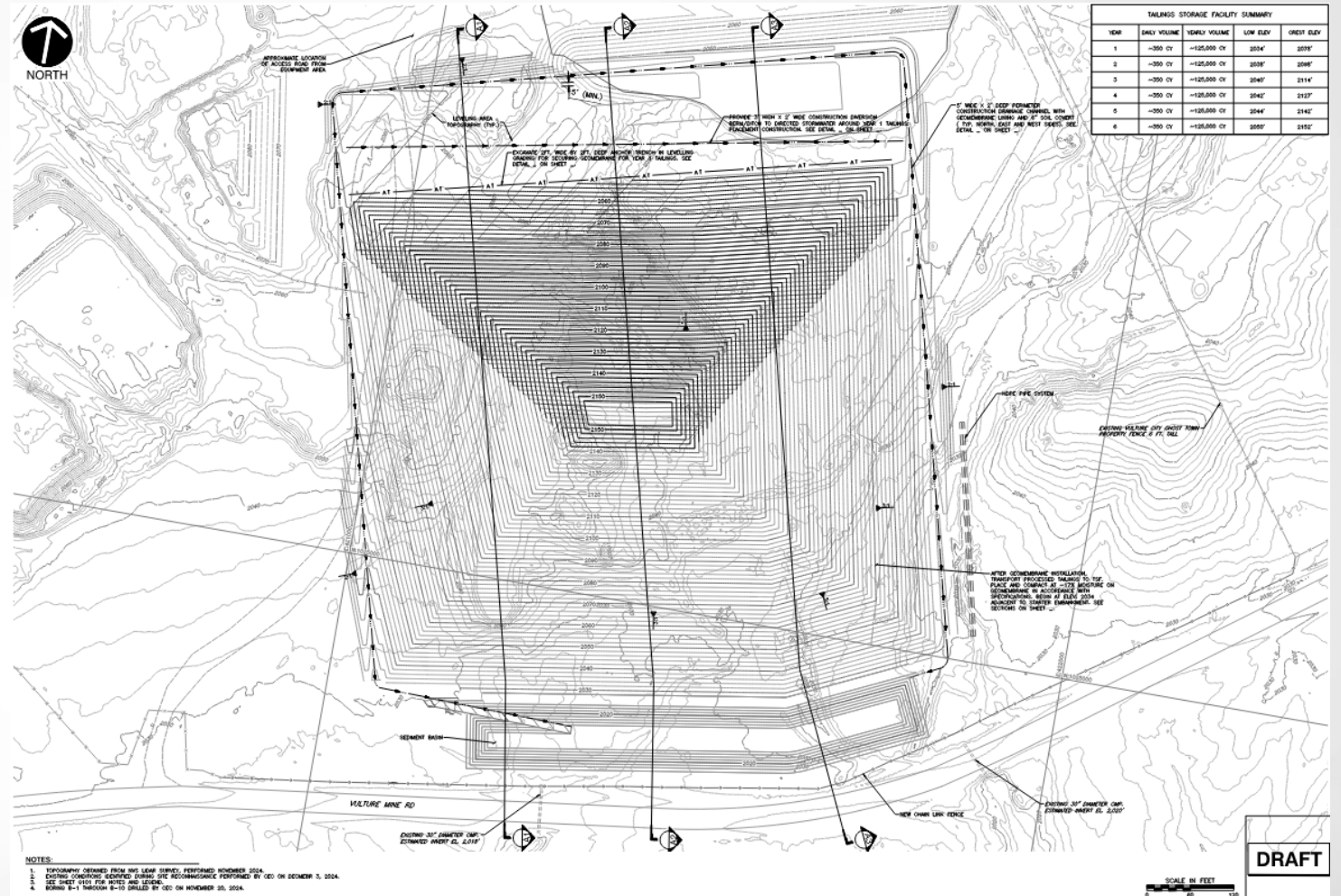
Year 5

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,044'
- Crest El: 2,142'



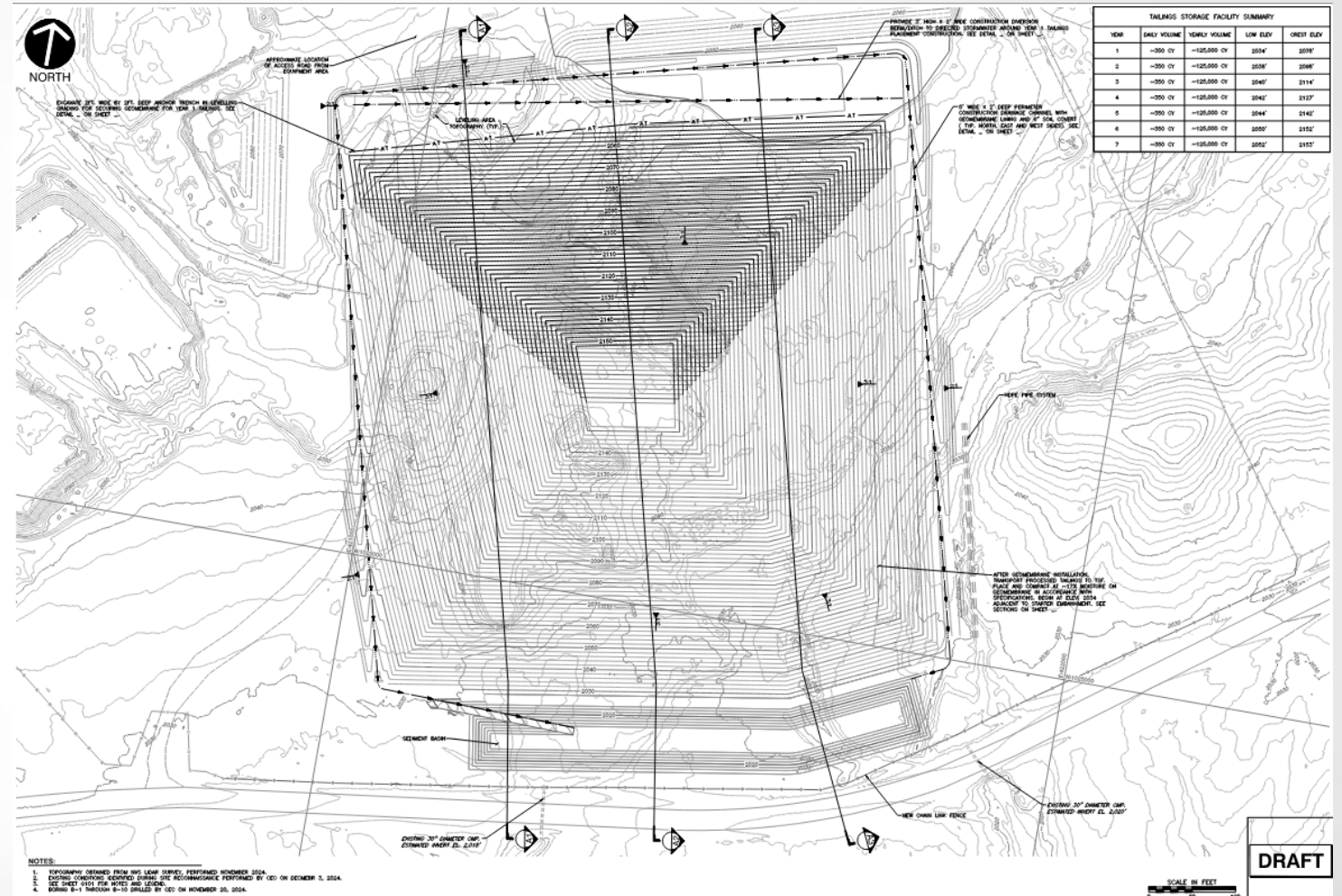
Year 6

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low EI: 2,050'
- Crest EI: 2,152'



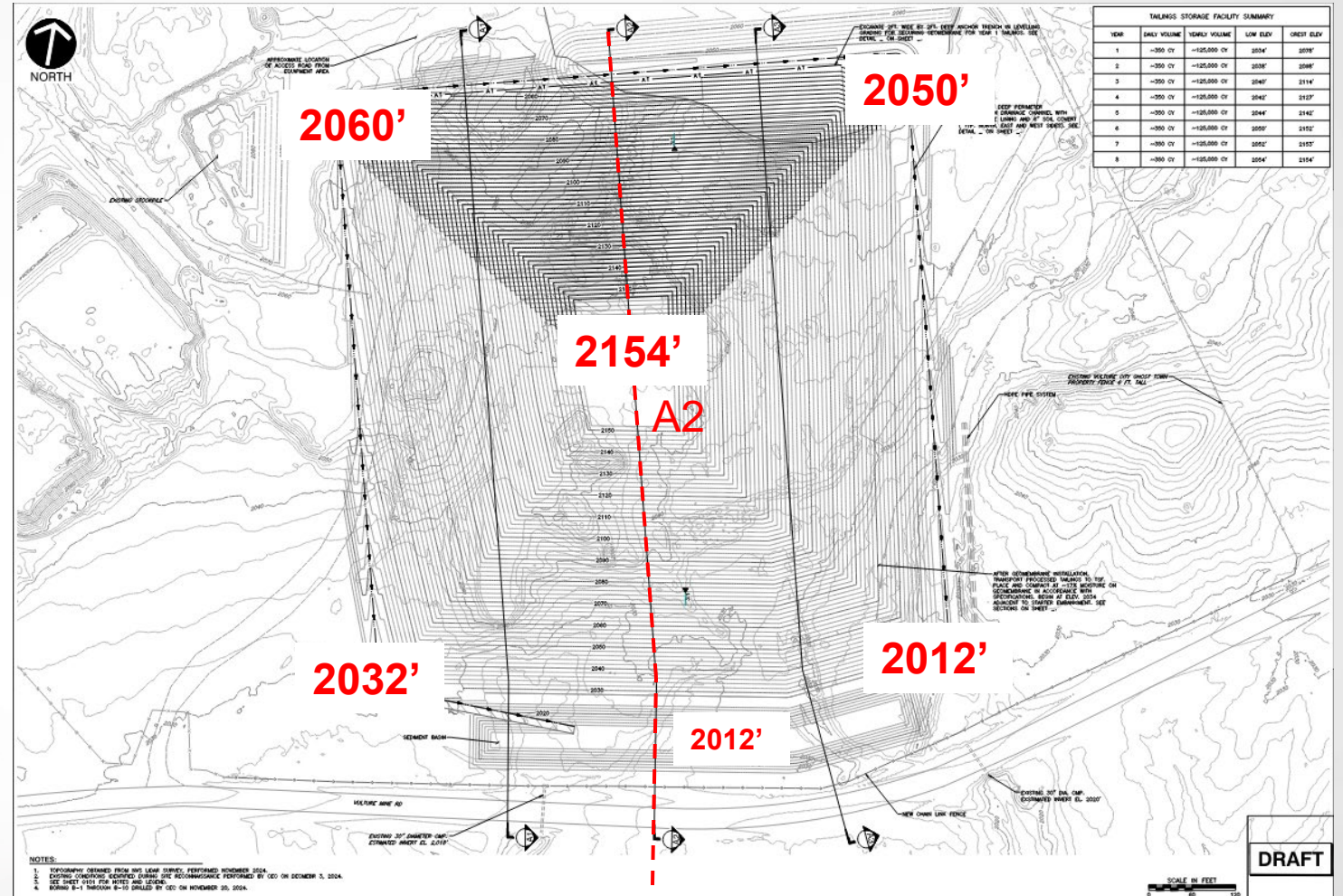
Year 7

- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,052'
- Crest El: 2,153'

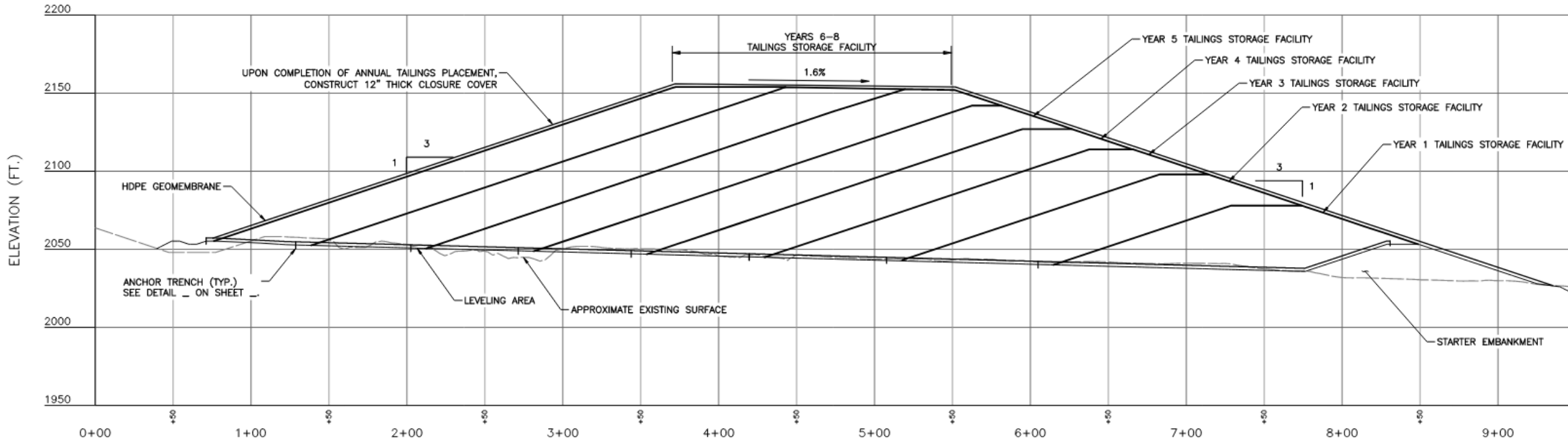


Year 8

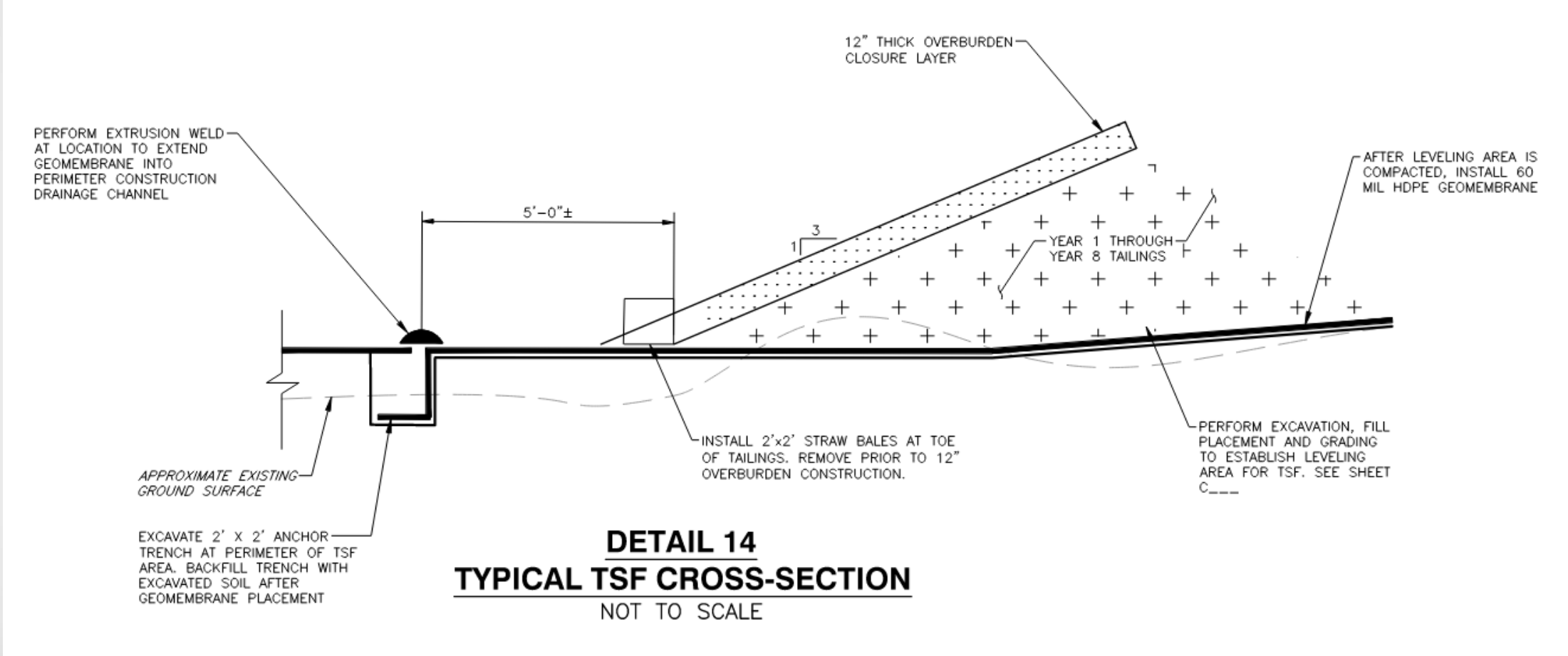
- Daily Volume: 350 CY
- Yearly Volume: 125,000 CY
- Low El: 2,054'
- Crest El: 2,154'



Cross Section A2



Typical TSF Cross Section Detail



Slope Stability Results

	Starter Embankment	Year 8	Arizona BADCT
Static – Long-Term	3.2	1.7	1.3 with Testing
Static – Short-Term	3.2	1.7	1.3 with Testing
Rapid Drawdown	3.2	1.8	1.2
Pseudo-Static	2.8	1.3	1.0
Seepage	2.2	1.5	1.4

Conclusions

- **Geotechnical Stability & Performance**

- The facility is designed to meet required stability factors of safety for static and seismic conditions.

- **Tailing Storage & Operational Considerations**

- The deposition plan ensures efficient use of storage capacity while maintaining environmental and geotechnical integrity.

- **Environmental & Regulatory Compliance**

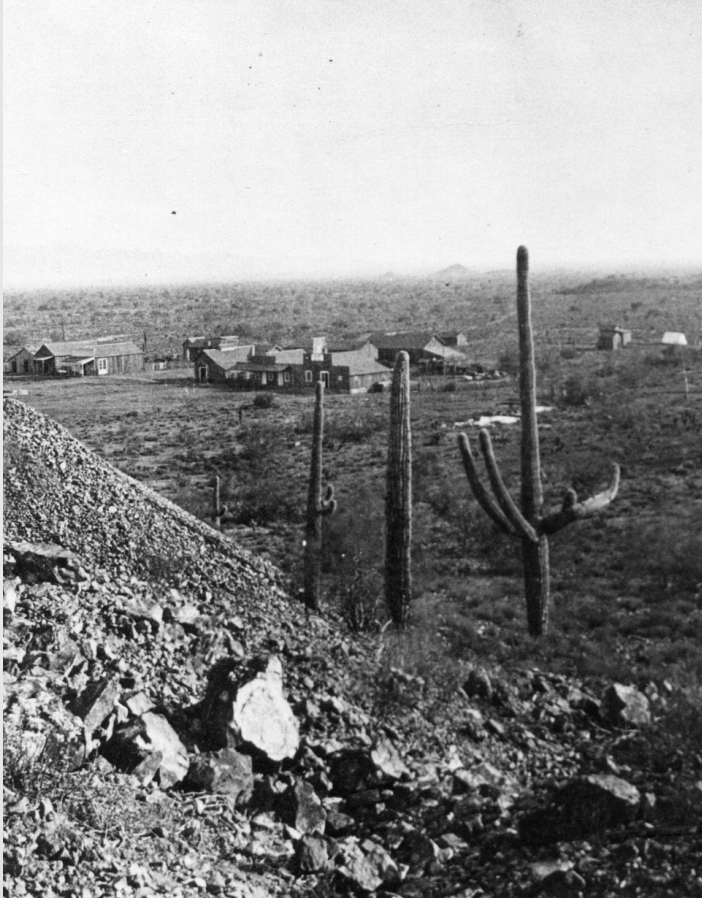
- The design aligns with local, national, and international regulatory requirements.
- Groundwater and surface water management strategies mitigate contamination risks.

- **Closure & Long-Term Sustainability**

- The closure plan includes capping, drainage control, and long-term monitoring to prevent environmental hazards. Design ensures long-term stability, minimizing risks of post-closure failure.

QUESTIONS?

Historical Photos



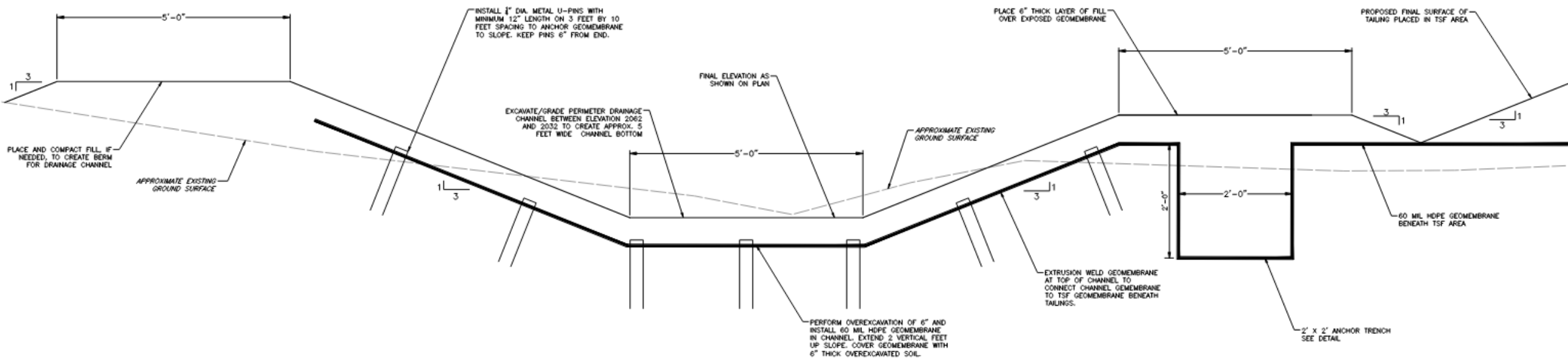
Historical Photos



Historical Photos



Perimeter Construction Drainage Channel



Sediment Basin – South of CS A2

