



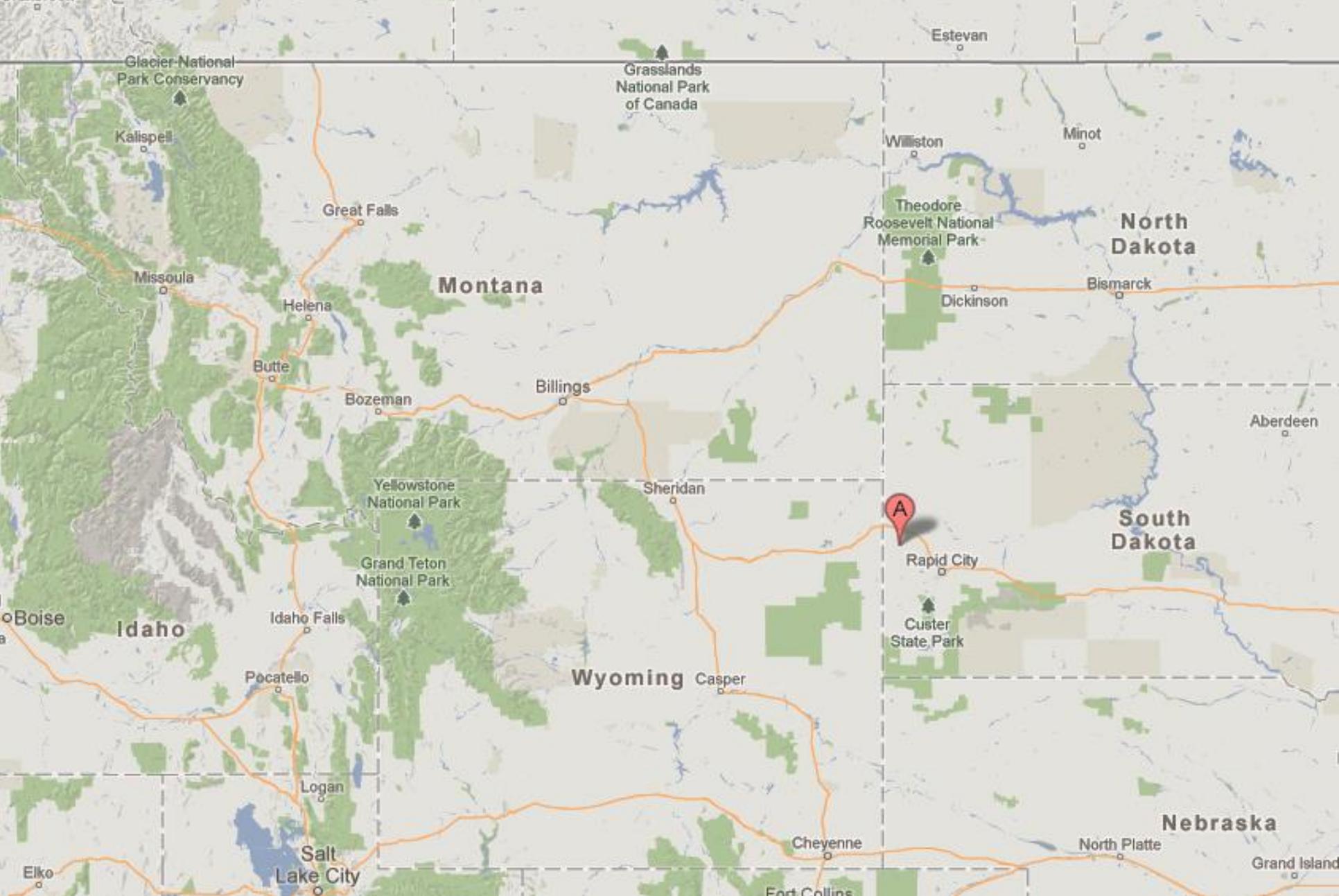
*Wharf Resources
Heap-Leach Gold Mine Permitting,
Northern Black Hills, South Dakota*

*Crystal M. Hocking
Mine Design, Operations, and Closure Conference
May 8, 2013*



Presentation Overview

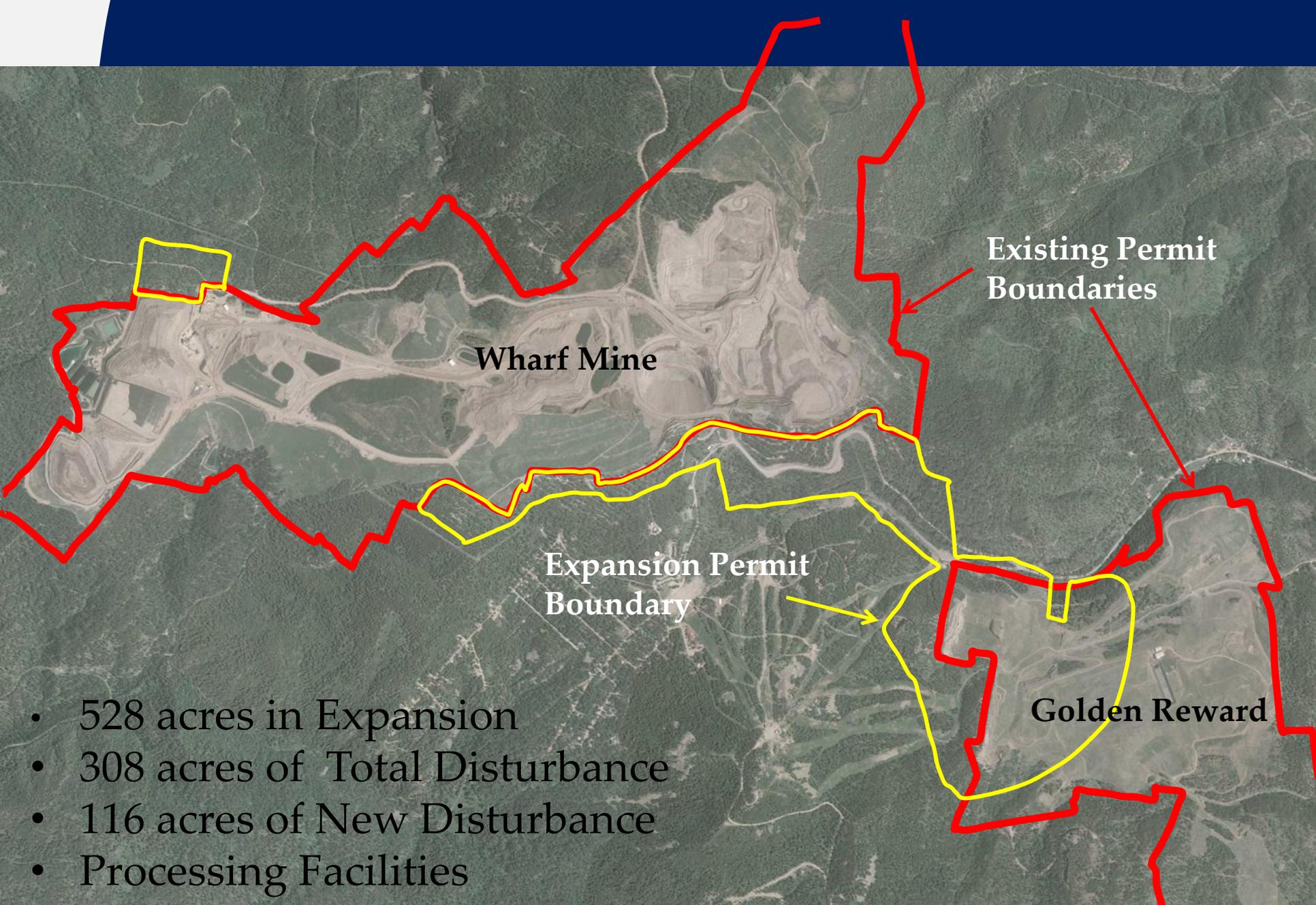
- Wharf and Expansion Project Overview
- Permitting Process
- Summary of Baseline Environmental Studies
- Reclamation Plans for the Area



Wharf Mine Facts

- Mining Type: Open pit, truck and loader operation
- Processing Method: Heap-leach, recovery via carbon columns
- Minerals: Primary Au with secondary Ag
- Total Acres: ~1 500 permitted (400 released)
- Rock Mined: 9 million tons/yr
- Ore Processed: 3 million tons/yr
- Gold Produced: 60,000 ounces/yr
- Average Grade: 0.74 g/ton





Existing Permit Boundaries

Wharf Mine

Expansion Permit Boundary

Golden Reward

- 528 acres in Expansion
- 308 acres of Total Disturbance
- 116 acres of New Disturbance
- Processing Facilities

General Mine Expansion Layout Map

Wharf Mine

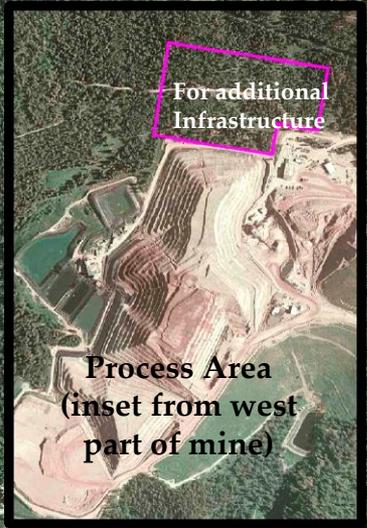
Hwy 473 Reroute

Expansion Permit Line

Seasonal Haul Road

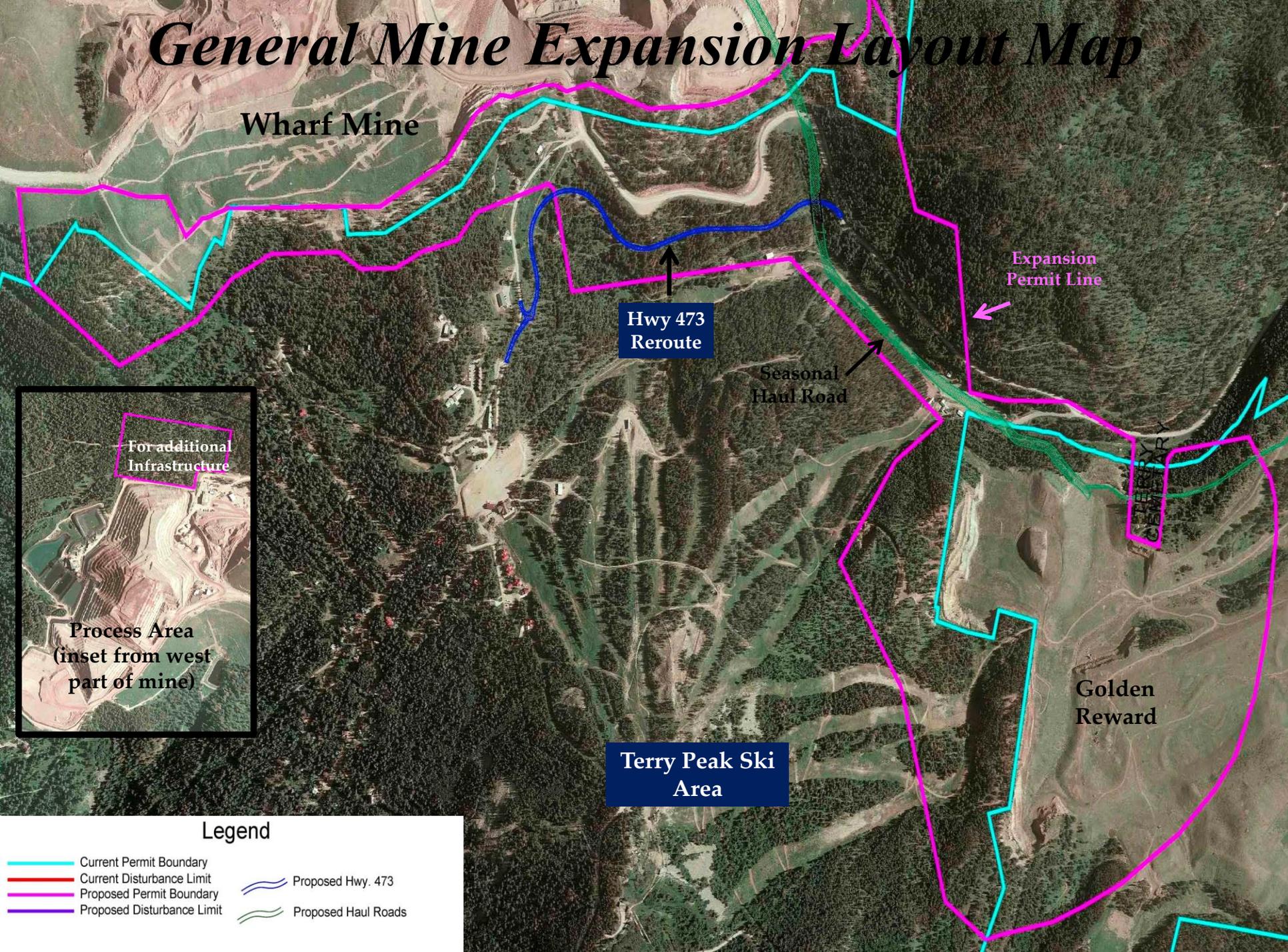
Golden Reward

Terry Peak Ski Area



Legend

- Current Permit Boundary
- Current Disturbance Limit
- Proposed Permit Boundary
- Proposed Disturbance Limit
- Proposed Hwy. 473
- Proposed Haul Roads

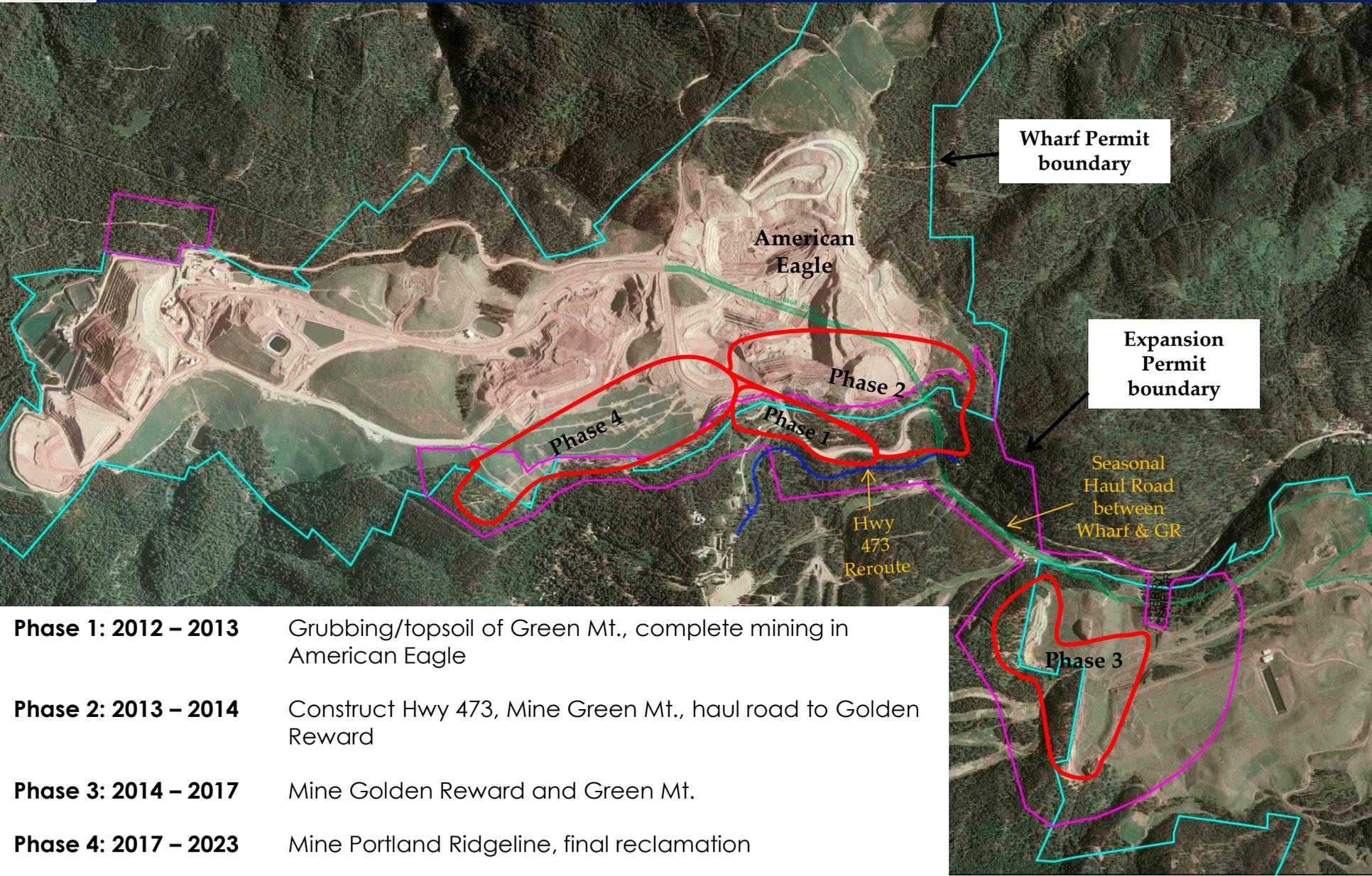


Expansion Area Mining Methods

- Continue same mining process– truck and loader heap-leach process
- Same size work force
- Use of same infrastructure– all located at Wharf.
- All ore will be processed at Wharf
- Maintain high standards of erosional control, use Best Management Practices (BMPs)



Expansion Area Mining Schedule



Wharf Permit boundary

Expansion Permit boundary

Seasonal Haul Road between Wharf & GR

Hwy 473 Reroute

American Eagle

Phase 4

Phase 1

Phase 2

Phase 3

- Phase 1: 2012 – 2013** Grubbing/topsoil of Green Mt., complete mining in American Eagle
- Phase 2: 2013 – 2014** Construct Hwy 473, Mine Green Mt., haul road to Golden Reward
- Phase 3: 2014 – 2017** Mine Golden Reward and Green Mt.
- Phase 4: 2017 – 2023** Mine Portland Ridgeline, final reclamation



Mine Permitting Process



Required Mine Permits

- **County – Lawrence County Office of Planning and Zoning**
 - Conditional Use Permit
- **State – South Dakota Department of Environment and Natural Resources (SD DENR)**
 - Determination of Special, Exceptional, Critical, or Unique Lands
 - Large-Scale Mine Permit
- **Federal – BLM**
 - Plan of Operations
 - Environmental Assessment



State Permit Review Agencies

- SD Department of Environment and Natural Resources
Historical Society
- State Archaeological Research Center
- SD Department of Tourism
- SD Department of Resource Conservation & Forestry
- SD Department of Education & Cultural Affairs
- SD Department of Health
- SD Game, Fish, & Parks
- U.S. Fish & Wildlife Service
- USDA Natural Resource Conservation Service



SD DENR Permitting Process

1. Project Initiation and Kickoff Dec 2009
2. Develop Sampling Plans Dec 2009
3. Sampling Plan Discussion and Revisions with DENR Jan – Apr 2010
4. Baseline Environmental Sampling Fall 2009 – Winter 2011
5. Submit Unique and Scenic App Sept/Oct 2010
6. Submit Large-Scale Mine Permit Application Feb 2011
7. Board Hearing on Unique and Scenic Application March 2011
8. Revisions to LSMP and Response to DENR and Agency Comments Mar-Oct 2011
9. Board Large Scale Mine Permit Hearing and State Permit Approval Nov 2011



BLM Permitting Process

The proposal was to mine and reclaim 0.12 acres of the 0.74 acres of BLM-administered surface within the 528-acre Wharf Mine expansion project.

- | | |
|---------------------------------|---------------------|
| 1. Plan of Operations Submitted | July 2011 |
| 2. Environmental Assessment | Dec 2011 – Mar 2012 |
| 3. Record of Decision/FONSI | May 2012 |

An aerial photograph showing a large-scale construction or mining site in a forested area. The site features extensive terraced earthworks, roads, and several large water treatment ponds. The surrounding landscape is a mix of cleared areas and dense forest. The text "Baseline Studies" is overlaid in the center of the image.

Baseline Studies

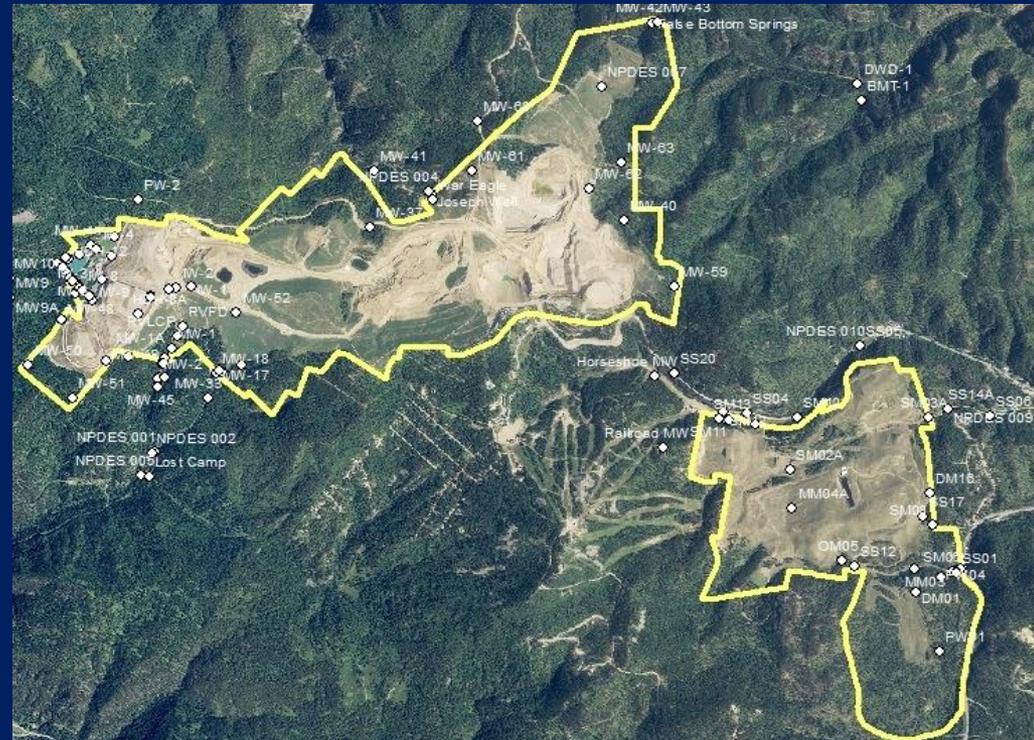


Required Baseline Studies

- **Hydrology**
- **Meteorology**
- **Air Quality**
- **Geology**
- **Slope Stability and Geotechnical**
- **Soils**
- **Vegetation**
- **Wildlife**
- **Aquatic Resources**
- **Cultural Resources**
- **Sound**
- **Socioeconomic**
- **Visual**

Water-Quality Monitoring

- 110 Sites
- Sampling Frequency:
 - Bi-weekly
 - Monthly
 - Quarterly
 - Semi Annually
 - Annually
- Reports to DENR





Surface Water and NPDES Monitoring

- 23 sites sampled, 11 considered baseline
- Eight tributaries have proposed surface disturbance related to the Expansion Project (Deadwood Creek, Nevada Gulch, Fantail Creek, Lost Camp Gulch, Stewart Gulch, Annie Creek, Long Valley, and McKinley Gulch)
- Sites are sampled 4 times a year
- Parameters analyzed include standard cations and anions, metals, and other constituents of potential concern, including cyanide and nitrate
- Statistical analyses for a 1-year baseline and a 5-year trend overview

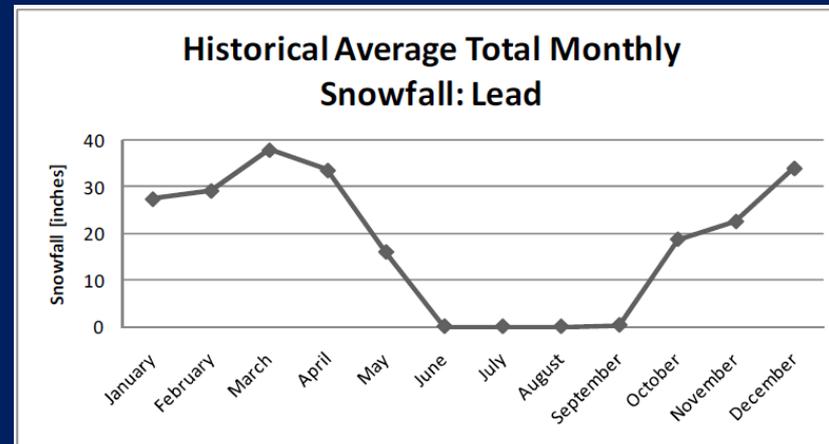
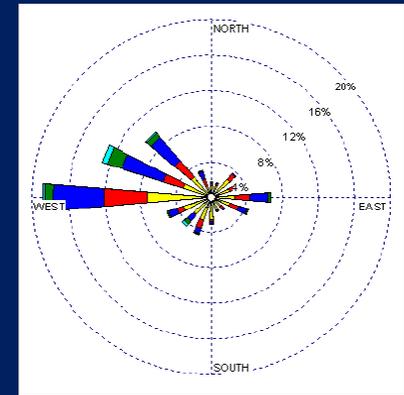


Groundwater Modeling

- **Pathway and Fate Modeling**
 - Predict nitrate impacts from mining activities (blasting and waste rock disposal)
 - Predict arsenic impacts from spent ore disposal
- **Visual MODFLOW With MT3DMS**
 - Model first developed by RESPEC in 1997 with updates in 1999, 2002, 2004, 2006, and 2009.
 - 2009 update included:
 - Updating pit boundaries and areas
 - Updating mining and backfill schedule
 - Scheduling and locations of spent ore disposal (optimized disposal location and quantities)
 - Refining model layers
 - Modifying Precambrian rock porosity

Meteorology

- Purpose – Conduct recent and historical analyses of meteorological conditions for fate and transport predictions.
- Analyzed 1-year (2009) and 5-year (2005-2009) data from 3 met stations (Lead, Spearfish, Wharf)
- Parameters
 - Temperature
 - Wind speed and direction
 - Precipitation
 - Dew point
 - Humidity
 - Barometric pressure



Air-Quality Program

Air Monitoring

- Ambient air network PM-10 discontinued in 2007
- Fugitive emissions from plant still monitored
- Values for the past 5 years are 1/10 of the Air Quality Permit limit



Proactive Dust Control

- Water haul roads and active mining areas
- Spray bars, foggers, and baghouse at crushing facility
- Vegetate disturbed areas as soon as it is practical

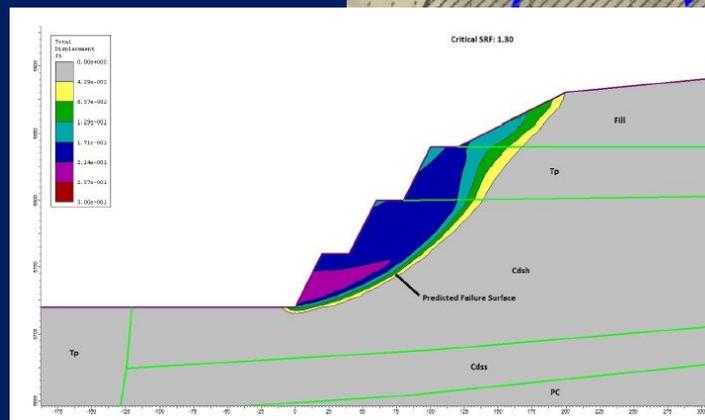
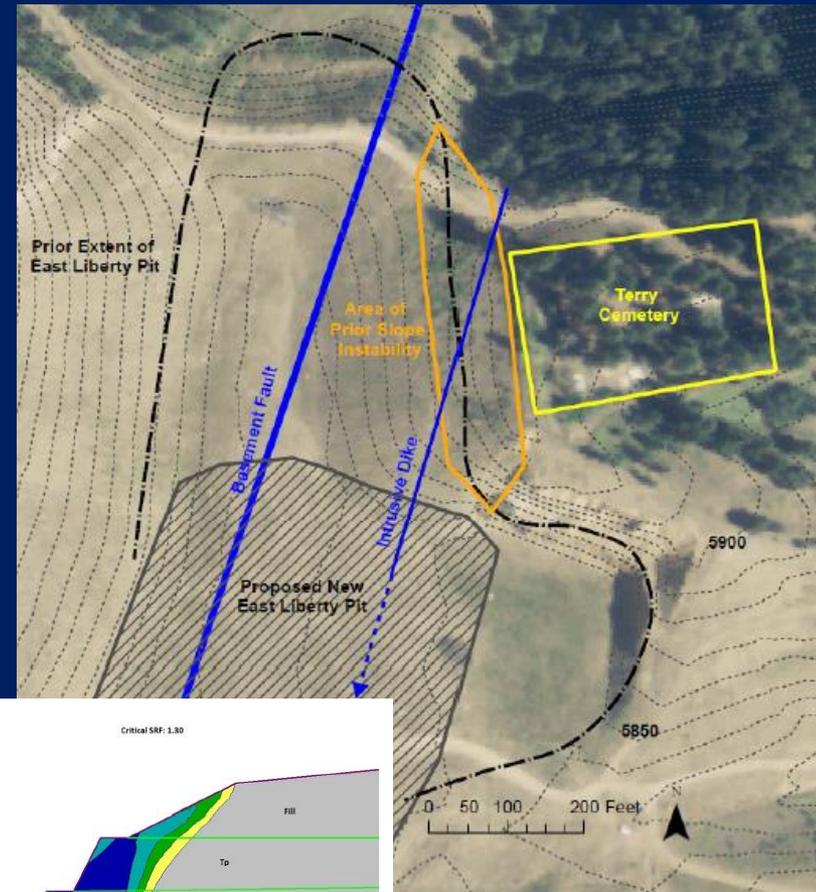
Geology and Geochemistry

- **General geologic setting and stratigraphy**
 - Mineralization primarily within Deadwood and Tertiary intrusives
- **Geochemical Testing**
 - ABA, MMRT, whole rock, and humidity cell
- **ARD Mitigation Plans**
 - Not mining acidic Precambrian rock



Slope Stability Modeling

- Modeled using
 - MVS– geology, cross-sections
 - Phase– 2D finite element
- Sensitivity analyses show the highwall will be stable
- Recommend benchmark monitoring



Soils

- **Soil Mapping**
 - 600 acres
 - 32 soil profiles and 2 road cuts
 - Soil Types
 - Physical and Chemical Properties
 - Topsoil Depth Survey
- **Soils are similar to those within other permitted mine areas and are typical for the Black Hills.**
 - Loam and rocky soils are dominant.
- **Adequate topsoil availability for reclamation.**
 - Topsoil salvage depths average 5.39 inches.
 - Total available topsoil is about 400,000 yd³.
- **Soils have low erosion potential and high revegetation potential.**



Vegetation

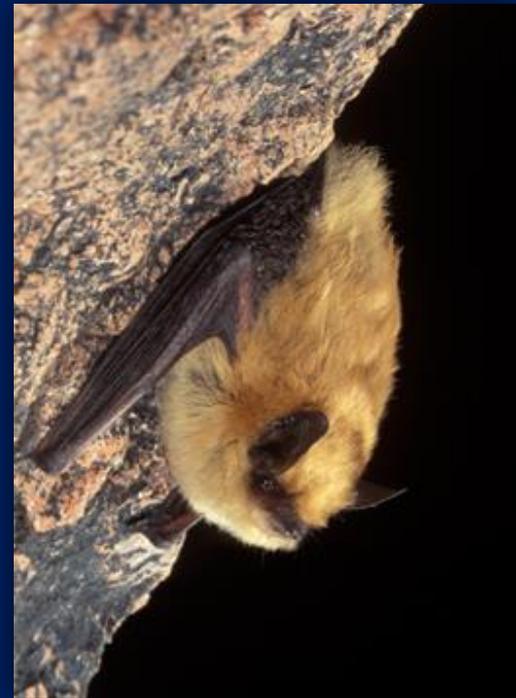
- **Vegetation Mapping**
 - 600 acres
 - Plant Species List
 - Ground Cover
 - Tree and Shrub Density
 - Conducted June & October 2010
- **No Riparian or Wetland Areas**
- **No Threatened or Endangered Vegetation Species**
- **No Sensitive Species in Disturbance Area**
 - 4x Mountain Huckleberry
 - 1x White-Veined Wintergreen





Wildlife

- **Wildlife Survey**
 - Expansion Area and 0.5 mile perimeter
 - Species List
 - Habitat Assessment
 - Bats (cave and addit searches)
 - Raptors
 - Owls
 - Threatened and Endangered Species
 - Conducted Nov 2009 – July 2010
- **No critical deer winter range**
- **No critical or unique wildlife habitats**
- **No threatened & endangered species**
- **No raptor nests (current or historical) exist within disturbance area**



Aquatic Resources

- **Aquatic Survey**
 - Habitat
 - Periphyton
 - Macroinvertebrates
 - Hess replicate
 - Kick composite
 - Fish
 - Backpack electrofishing





Cultural Resources



- **Several Previous Investigations**
- **Level III Pedestrian Survey of Expansion**
- **National Register of Historic Places**
 - Only 1 eligible site
 - Segment of Freemont, Elkhorn, and Missouri Valley Railroad
 - Located on Bald Mountain just above Nevada Gulch Road
 - Additional documentation, mapping, and photographs
- **SD Archaeological Research Center (SARC) found no impact to Cultural Resources**
- **Mitigation**
 - If any previously unrecorded cultural/historic properties are discovered, activity will be temporarily halted and SARC contacted.

Terry Cemetery



**Terry Cemetery placed on SD's preliminary list of
Special, Exceptional, Critical, or Unique Places.**

Sound

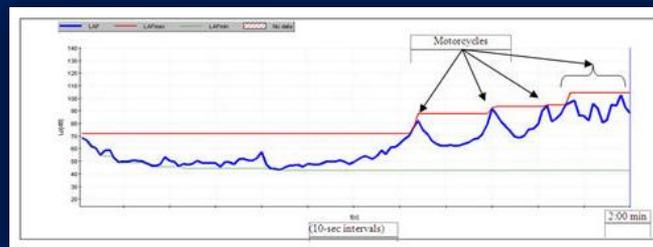
- **Sound Monitoring**

- 11 sites
 - located at nearby recreational areas and residences
- 3 Recording Events
 - morning, afternoon, rally
 - Conducted July and August 2010
- 10 minute duration

- **Most of the high values of “noise” recorded were from wind, wildlife (woodpeckers), and motorcycles.**

- **No significant mine noise**

- Low boy, back up alarm, water truck, shift change traffic





Socioeconomic Assessment

- Review of Current Lawrence Co. Infrastructure
- Economic Aspects of Wharf Resources
- Economic Impacts Associated With Expansion
- Housing, Education, and Infrastructure
- Adjacent Land Use Issues (Recreation)



- 150 Full-Time Jobs for 7 years

- \$3-5M per year in state taxes

- \$20M per year spent in SD



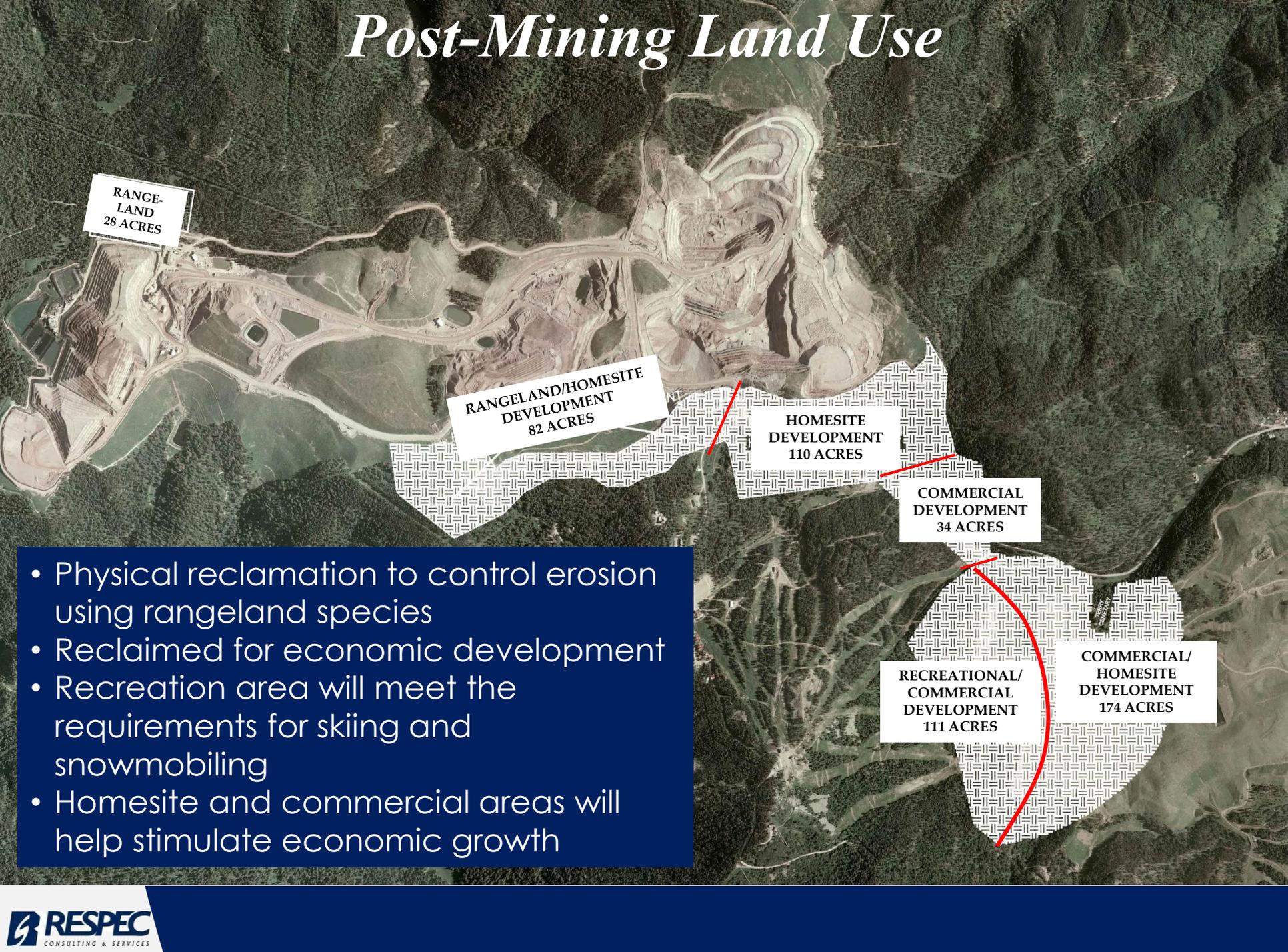
*Reclamation Plans and
Postmining Use*

Reclamation Plans

- **Concurrent reclamation and mining**
- **Reclamation complete 2 years after mining**
- **Fewer exposed highwalls**
- **Multiple post mining land uses to stimulate economic development**
 - Recreation
 - Residential
 - Industrial/Commercial and
 - Woodland grazing
- **Year round tourism destination**



Post-Mining Land Use



RANGE-
LAND
28 ACRES

RANGELAND/HOMESITE
DEVELOPMENT
82 ACRES

HOMESITE
DEVELOPMENT
110 ACRES

COMMERCIAL
DEVELOPMENT
34 ACRES

RECREATIONAL/
COMMERCIAL
DEVELOPMENT
111 ACRES

COMMERCIAL/
HOMESITE
DEVELOPMENT
174 ACRES

- Physical reclamation to control erosion using rangeland species
- Reclaimed for economic development
- Recreation area will meet the requirements for skiing and snowmobiling
- Homesite and commercial areas will help stimulate economic growth

Effects on Recreation and Skiing

Current Impacts

- Mining operations at Wharf are visible from top of Terry Peak
- **Current and past mining operations have had no significant impact on recreational usage.**
 - Statistical evidence that user visits correspond to snow conditions.
 - Visitor volume increased from 50k to 80k during mining between 1986 to 1996 with current visits from 80k to 120k.
- Wharf Contributions
 - Parking lot material
 - Investments in snow making equipment
 - Ski Lodge & chair lift contributions

Expansion Mining Impacts

- Seasonal mining cycle (April – Nov) with intermittent reclamation to improve aesthetics
- Little visual change toward east (Golden Reward)
- Increased views of mining operation to north (Wharf)



Effects on Recreation and Skiing

Post-Reclamation Impacts

- Extended ski runs on eastern slope of Terry Peak
- Replacement of oldest chair lift
- New snowmobile trails
- Additional opportunities for cross-country skiing and snowshoeing
- Additional areas open for commercial and residential development
- **Overall enhanced winter recreation opportunities represent a substantial long-term economic benefit to the county.**



Enhanced Reclamation at Golden Reward



Current

Conceptual



Summary

- 7 year mine life extension
- 116 additional acres disturbed
- No impact on the Terry Cemetery
- No interruption to the ski season
- Major benefits to the ski area
- Improvements to Highway 473
- Enhanced reclamation
- Large economic benefits





THANK YOU!

Crystal M. Hocking, P.G.
Crystal.Hocking@respec.com
www.respec.com



Innovation • Collaboration • Inspiration

Thinking Together to Inspire