Overview, Lessons Learned and Best Practices Derived from Independent Optimization Reviews of Superfund Mining Sites

CLU-IN Internet Seminar **May 24, 2017**

U.S. Environmental Protection Agency

Introduction

- Welcome
- Webinar Logistics
- Presenters
  - Kirby Biggs; EPA OSRTI TIFSD
  - Jody Edwards, P.G.; Tetra Tech
- >15 nations attending!

Webinar Outline

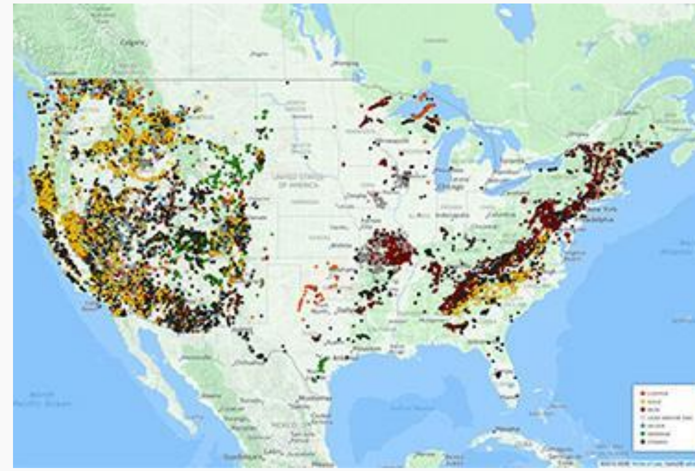
- Status of Mine Sites in USA
- What is Optimization?
- EPA National Optimization Strategy
  - Optimization Mine Sites Initiative
  - Lessons Learned
- Mine Site Characterization Best Practices
- Optimization Review Case Studies
- Summary
- Questions

Elizabeth Mine, VT

Mine Sites Status in USA

Abandoned Hardrock Mine Sites

- Estimated 100,000 – 500,000 abandoned mine land (AML) sites
  - ➢ Less than 500 AML sites documented
  - ➢ 139 AMLs on NPL or being addressed by Superfund Alternative Approach
- *Internal and external collaboration* to address sites efficiently and effectively
  - ➢ EPA National Mining Team
  - ➢ Federal Mining Dialogue
  - ➢ Abandoned Uranium Mines Workgroup
- Increasing collaboration with state, tribal and private partners
- Specialty focus of EPA optimization review program



EPA National Mining Team

Key Functions

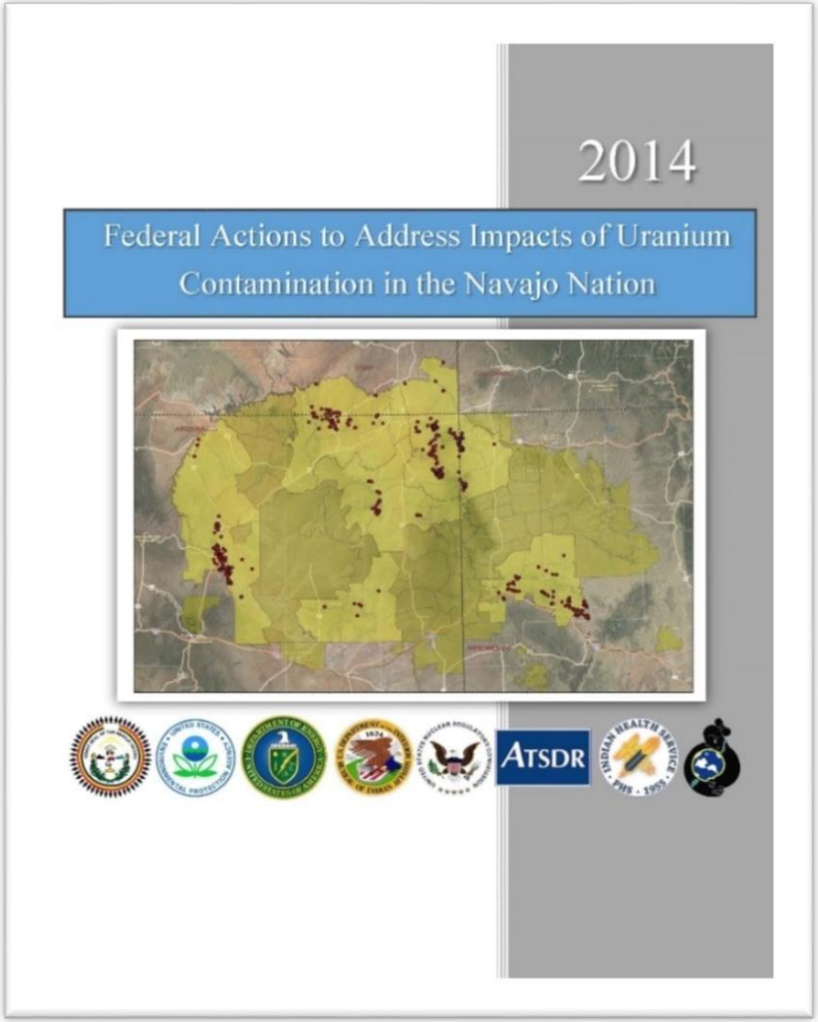
- Support mine related policy and regulatory issues
- Provide technical information and site-specific assistance on Superfund sites
- Improve EPA management of mining issues
- Support Federal Mining Dialogue and other federal coordination activities
- Support Optimization Studies at Mine sites

Federal Mining Dialogue (FMD)

- Principals
  - ➢ Department of the Interior
  - ➢ Department of Agriculture
  - ➢ EPA
- Additional Participants
  - ➢ Department of Energy
  - ➢ Department of Justice
  - ➢ US Army Corps of Engineers
  - ➢ Office of Management and Budget
  - ➢ ASTSWMO
- Open exchange of information on common challenges
- Coordinating on development and publication of Best Practices

Abandoned Uranium Mine (AUM) Sites

- 4,200+ sites identified, many more not inventoried
- Many reside on tribal and federal lands
- Mine site sizes vary but most are large, remote, and difficult to access
- 37 large mines located in six states
- Places to dispose waste is a challenge
- Collaborative efforts to address sites



What is Optimization?

EPA's Definition of Optimization

Systematic site review by a team of independent technical experts, performed at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness and cost efficiency, and to facilitate progress toward site completion.

Applies to Any Site, Program or Remedy

Types of Sites / Programs	Example Types of Remedies Evaluated
▪ DNAPL sites ▪ Dry cleaners ▪ Gas stations ▪ Industrial facilities ▪ Landfills ▪ MGP sites ▪ Mines / Mining districts ▪ Petroleum sites ▪ Sediment sites ▪ Wood treating sites --------------------------- ▪ CERCLA/Superfund ▪ RCRA ▪ State VCUP ▪ Brownfields ▪ Federal Facilities ▪ Tribal	▪ Groundwater extraction & treatment ▪ Air sparging / Soil vapor extraction ▪ Non-aqueous phase liquid recovery ▪ Biosparging ▪ *In situ* thermal remediation ▪ *In situ* chemical oxidation ▪ *In situ* bioremediation ▪ Sediment capping ▪ Permeable reactive barriers (PRB) ▪ Constructed wetlands ▪ Landfill gas collection ▪ Surface water diversion/collection/treatment ▪ Monitored natural attenuation (MNA)

Investigation > Feasibility Study > Design > Remedial Action > LTMO > O&M

Examples of Technical Support

- Programmatic support
- Strategic planning support
- Systematic project planning (SPP) facilitation
- CSM development
  - Project Life Cycle CSM
    - https://clu-in.org/download/remed/csm-life-cycle-fact-sheet-final.pdf
  - High-resolution site characterization (HRSC)
  - 3-dimensional data visualization and analysis (3DVA)
- Dynamic work strategy (DWS) development
- Third-party technical review of site work plans and reports
- Specialty characterization technology and sampling methods expertise

Typical Optimization Review Process

- Engagement
- Scoping
- Project kick-off
- Document / data acquisition and review
- Site visit and interviews
- Data analysis
- Preliminary findings
- Reporting
- Lessons learned compilation

Typical Site Visit Agenda

- Introductions
- CSM
- Remedy effectiveness/protectiveness
- Extraction/injection systems
- Treatment components
- Costs
- Environmental footprint reduction
- Site closure
- Debrief

Requires expert level, multidiscipline review team members

Sites That May Benefit From Optimization

- Sites with:
  - ➢ Protectiveness concerns
  - ➢ Technological challenges
  - ➢ CSM data gaps; high site uncertainties
  - ➢ High costs for remedial activities
  - ➢ Interim remedies
- Sites not meeting Remedial Action Objectives (RAO)
- Sites scheduled for five-year reviews (FYR)
- Sites in long-term remedial action (LTRA) and/or nearing operations and maintenance (O&M) transfer to States

Focus of Optimization Reviews

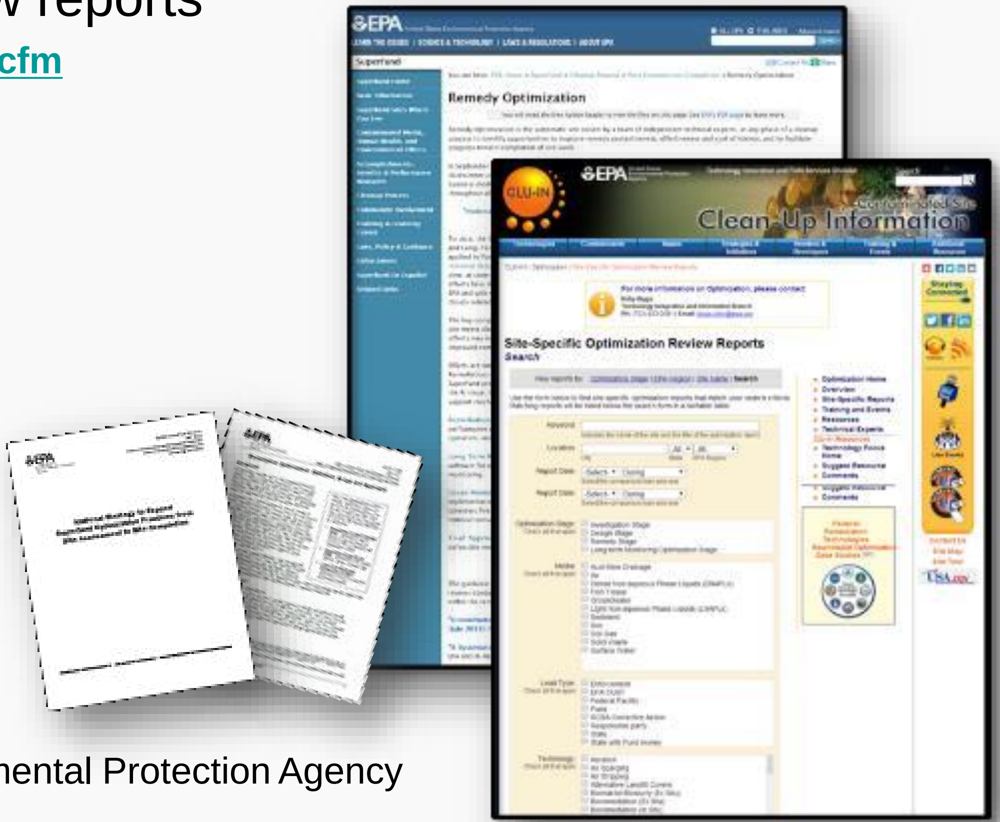
- Remedial goals
- Maximize value of existing site documents and data
- Conceptual site model (CSM)
- Remedy performance
- Protectiveness
- Cost-effectiveness
- Site completion / closure strategy
- Environmental footprint

Other Benefits of Optimization

- Site team and management provided with valuable 3rd-party perspective
  - Provides path forward strategy
  - Leverages adaptive management methods for flexibility
  - Helps build consensus among site stakeholders
  - Helps address community concerns
  - Balances technical input from site contractors
- Accelerates schedule for site closure
- Facilitates transfer of LTRA sites to States
- Cross-pollinates expertise among sites and site teams

EPA Optimization Resources

- Two locations for online resources
  - ➢ www.cluin.org/optimization
  - ➢ www.epa.gov/superfund/cleanup-optimization-superfund-sites
- *Remediation Optimization: Definition, Scope and Approach*
  - ➢ www.cluin.org/optimization/pdfs/OptimizationPrimer_final_June2013.pdf
- Site-specific optimization review reports
  - ➢ www.clu-in.org/optimization/reports.cfm



EPA National Optimization Strategy

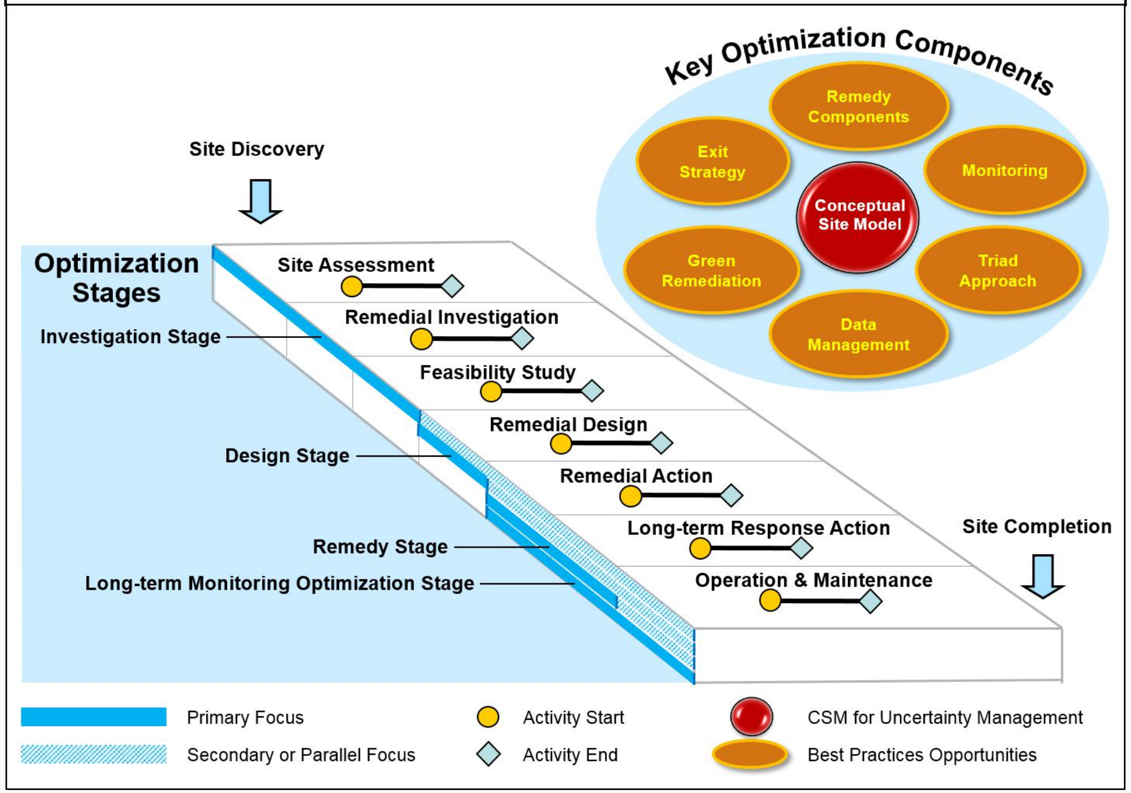
History of EPA Optimization Review Program

Year	Key Milestones
1997	Site optimization reviews initiated by EPA
1999	EPA-USACE-USAF collaboration on review practices
2000	Pilot project – applied USACE RSE optimization process at 4 P&T sites in LTRA phase
2001	Pilot project expansion – reviews at 16 additional P&T sites in LTRA phase
2002	Development of guidance documents; internet seminars to address lessons learned
2003	Diversification of site type (other than P&T); reviews performed earlier project phases
2004	'*Optimization Action Plan*' formalized optimization for Superfund Fund-lead LTRA sites
2004–2005	Pilot project in Region 3 for streamlined approach to optimization reviews
2010	After 150 sites reviewed, EPA directs development of National Optimization Strategy
2010–2012	Strategy developed by national EPA workgroup (HQ / Regions / Office of R&D)
2012	Formal release of *"National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion"*; Sept 12, 2012
2012–2013	Development of standard operating procedures (SOP) and other technical resources
2017	224 optimization reviews performed to date USA-wide
2017+	Expansion and training of optimization review resources; inclusion in new EPA contracts

EPA National Optimization Strategy

Issued September 28, 2012

EPA's National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion (2012)



- *Systematic site review by a team of independent technical experts…*
- *Performed at any phase of a cleanup process…*
- *Identify opportunities to improve remedy protectiveness, effectiveness and cost efficiency…*
- *Facilitate progress toward site completion.*

Completed Optimization and Technical Support Events

EPA Region	Number of Events 1997-2010	Number of Events 2011-2016	Total Events 1997 to Date	% per Region
1	10	13	23	10 %
2	12	14	26	12 %
3	18	8	26	12 %
4	11	4	15	7 %
5	12	4	16	7 %
6	5	16	21	9 %
7	7	15	21	9 %
8	4	19	23	10 %
9	6	21	27	12 %
10	10	16	26	12 %
TOTAL	95	130	224	100 %

National Optimization Progress Report

DRAFT Optimization Review Results

- Overall optimization program expanded
  - ~ 50 ongoing optimization events per year
  - ~ 20 optimization events completed per year
- Reviews during all Superfund pipeline phases
  - Pre-remedial action = ~ 35%
  - Remedial action = ~ 51%
  - Operations and maintenance = ~ 14%
- Evaluation of recommendations implemented
  - 61 sites reviewed between 2010 and 2015 were evaluated
  - 64% implemented, in progress, or planned
  - 15% under consideration
  - 16% declined
- Key results for all sites
  - 68% > improvements to the CSM
  - 60% > streamlined or improved monitoring
  - 39% > improved system engineering
  - 36% > change in remedial approach
- Technical support completed for 25 events
  - HRSC, 3DVA , Project Life Cycle CSMs, Environmental footprint analysis

Optimization Mine Sites Initiative

History of Mining Site Optimization

Year	Key Milestones
Mid-2000's	Mine site optimization reviews initiated at request of EPA Regions
2012	National Optimization Strategy released
2015	OSRTI evaluates results of 16 mining site pilot
2015	Mine Sites Initiative begins under National Optimization Strategy
2016	Focused reviews to support work at sites with fluid hazards
2017+	Mine site reviews ongoing focus of optimization program

Overview of Mine Sites Optimization Efforts

Mine Site Optimization Reviews to Date

Optimization Metric	Total to Date
Locations	
Events	51
Sites and Mining Districts	34
Individual Mine Workings and OUs	99
Type of Support	
Optimization Reviews	24
Technical Support	13
Focused Technical Reviews	14
Activity Status	
Completed	30
In Progress	17
Pending	4

Mining Sites Reviewed

- Mining Sites Initiative Optimization Reviews
  - Barker Hughesville, MT
  - Black Butte, OR
  - Bunker Hill, CA
  - Carpenter Snow Creek, MT
  - Carson River Mercury, NV
  - Central City/Clear Creek, CO
  - French Gulch/Wellington-Oro, CO
  - Gilt Edge, SD
  - Homestake Mining Co., NM
  - Iron King, AZ
  - Lava Cap Mine, CA
  - Silver Bow Creek/Butte, MT
  - Standard Mine, CO
  - Sulphur Bank, CA
  - Summitville Mine, CO
  - Tar Creek, OK

- Focused Technical Reviews
  - Capt. Jack Mill, CO
  - Elizabeth Mine, VT
  - Gold King Mine, CO
  - Klau Buena Vista, CA
  - Rico Argentine/St. Louis Tunnel, CA
  - Standard Mine, CO

Lessons Learned
Mining Sites Pilot

- Sites with older remedies present more opportunities to optimize
- Sites with high remediation costs often most complex, but present greater opportunities for cost savings
- Monitoring data collection and analysis can be a significant cost
- CSMs beneficial for reducing uncertainty in large, complex sites
- Important data gaps can arise in any project stage
- Primary remedies at pilot sites include active MIW treatment
- Treating MIW costly and often does not address source cleanup
- Alternative water quality criteria may be potential option for specific sites
- Institutional controls (IC) may be applicable when mine waste can not be effectively removed or contained
- Technical capabilities of project personnel important to project success

(Continued)

Lessons Learned

Mining Sites Pilot

- Use existing site attributes for remedial benefits
  - ➢ Evaluate these opportunities during RI to support FS or RD stages
  - ➢ Example: Monitor constituent levels before/after flow through existing wetlands
- Reduce labor costs through automation of MIW treatment systems
  - ➢ Examples: Installation of auto-samplers; automating water treatment controls
- Improve MIW capture via drains and flow control within mine workings
  - ➢ Example: Consider MIW from bedrock fractures, mineral veins and seeps
- Improve WTP efficiency and lower costs through reduction of inflows
  - ➢ Example: Modify surface water drainage to bypass openings in workings
- Low discharge requirements can require costly treatment methods
  - ➢ Particularly for sites with long-term MIW treatment needs
- Passive treatment systems require low MIW discharge and space
  - ➢ Adequate area and/or suitable topography may not exist

Lessons Learned
Mining Sites Pilot

Small Footprint Passive Treatment System
Balaklala Mine, CA

Lessons Learned
MIW-Focused Technical Reviews

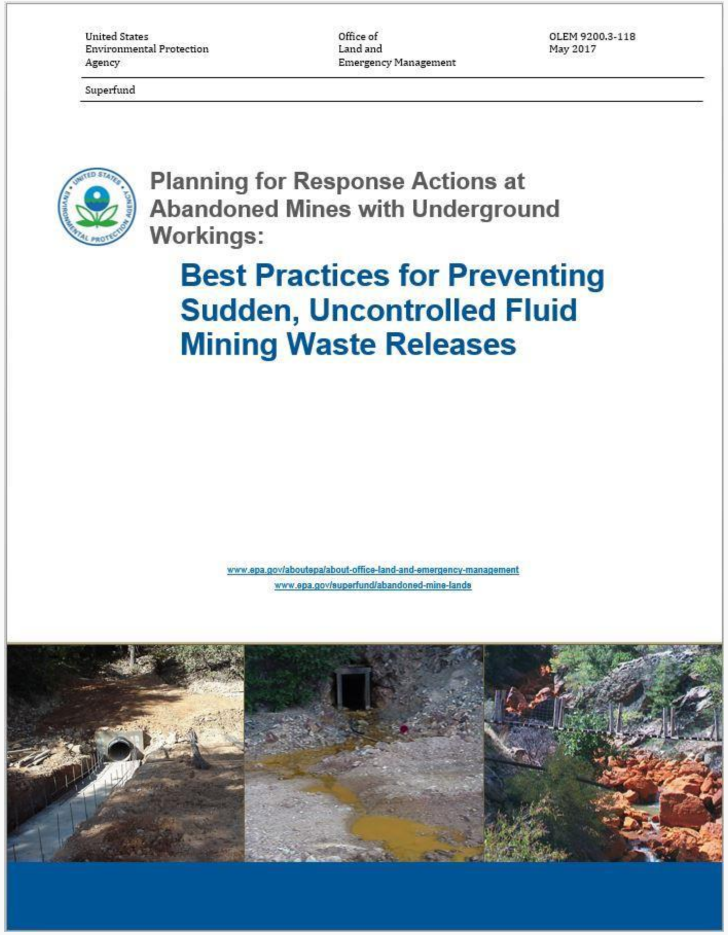
- Confirm MIW conditions and potential volume at risk of release prior to conducting invasive work
- Confirm existing capacity to capture and treat potential MIW releases
- Conduct Failure Mode & Effects Analyses (FMEA) on planned work activities to assess potential risks and consequences
- Mitigate risk or provide contingency to contain and treat potential MIW releases
- Develop contingency, notifications and emergency action plans (CNEAP)

Elizabeth Mine, VT

Site Characterization Best Practices

Best Practices: Underground Workings

- Preventing sudden, uncontrolled fluid mining waste releases
  - MIW, saturated sediments/sludge
- Applies to investigation, rehabilitation and remedial activities
- Extensive technical review by federal agencies and states
- Formal independent peer review
  - USGS
  - PADEP, WVDEC
  - NOVAGOLD Resources
  - Colorado School of Mines, U.Nevada-Reno



United States Environmental Protection Agency

Office of Land and Emergency Management

OLEM 9200.3-118
May 2017

Superfund

Planning for Response Actions at Abandoned Mines with Underground Workings:

Best Practices for Preventing Sudden, Uncontrolled Fluid Mining Waste Releases

www.epa.gov/aboutepa/about-office-land-and-emergency-management
www.epa.gov/superfund/abandoned-mine-lands

Best Practices Development Partners

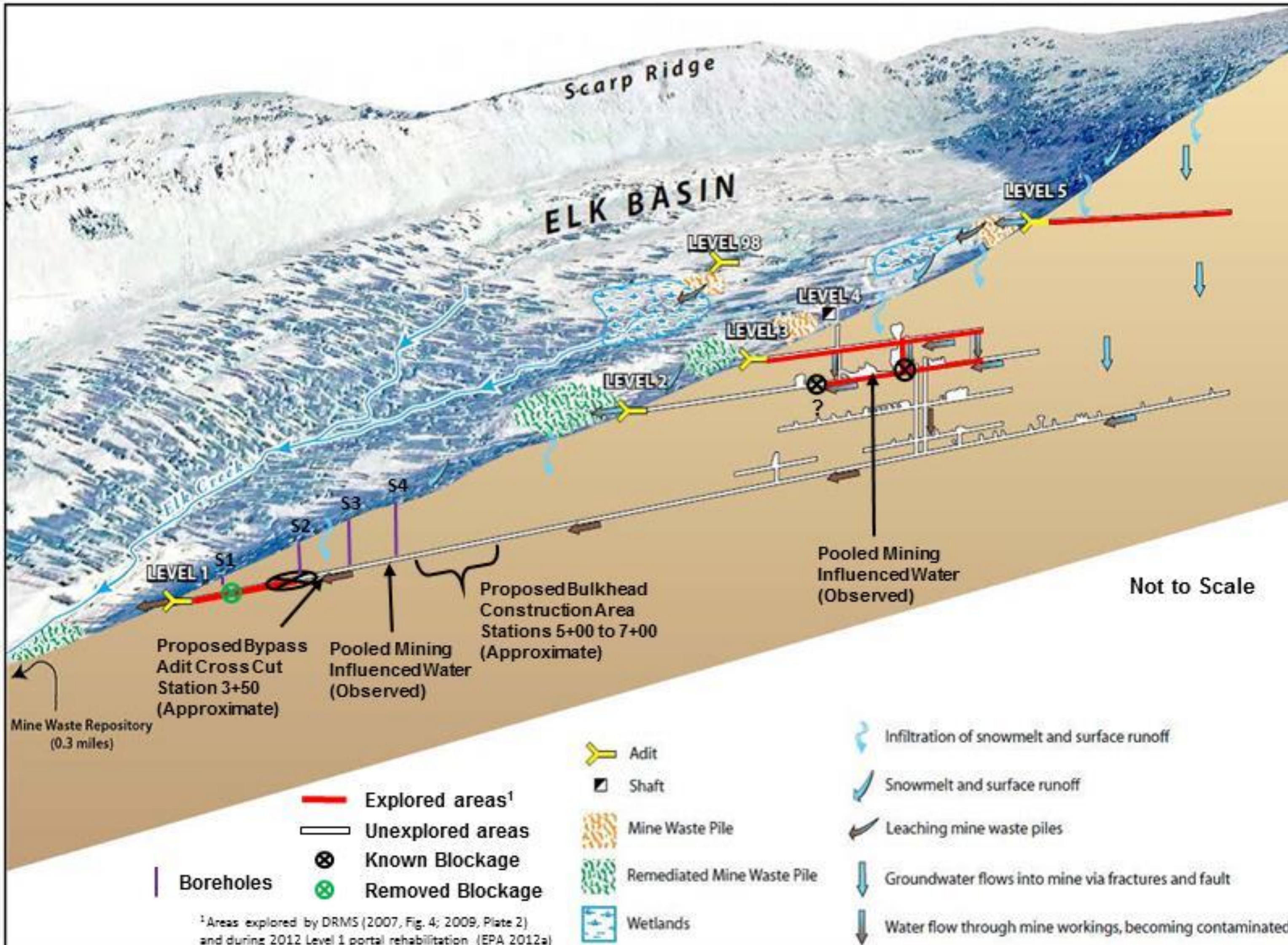
Contributing U.S. Federal Agencies

- Department of the Interior (DOI)
  - Office of Surface Mining, Reclamation and Enforcement (OSMRE)
  - U.S. Geological Survey (USGS)
  - Bureau of Reclamation (BOR)
- Environmental Protection Agency (EPA)
- Department of Labor
  - Mine Safety and Health Administration (MSHA)
- Department of Transportation (DOT)
  - Federal Highways Administration (FHWA)
  - Interstate Technical Group on Abandoned Underground Mines
- Department of Homeland Security (DHS)
  - Federal Emergency Management Agency (FEMA)
- Department of Agriculture
  - U.S. Forest Service (USFS)

Key Best Practices for MIW
Initial Assessment Activities

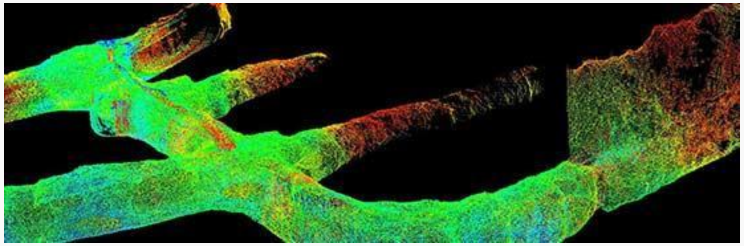
- Conduct initial site screening
  - Document and data review
  - Identify data gaps
  - Conduct site Visit
- Develop MIW CSM
  - Visualization of mine workings and MIW conditions
- Evaluate MIW pooling attributes
  - Hydrogeologic
  - Hydrologic
  - Geochemical
  - Geotechnical
- Develop qualitative water balance
  - Inflows - outflows

Example Simplified MIW CSM
Standard Mine, CO



Key Best Practices for MIW
Field Investigation Activities

- Plan and conduct minimally invasive measurement activities
  - Geophysical studies, tracer studies
  - Groundwater/MIW pooling water levels
  - Surface water flows and water quality
- Example downhole measurements
  - Water elevations using pressure transducers
  - MIW flow metering
  - Visual inspection using video
  - 3-D laser mapping of workings
- Develop detailed water balance
  - Calculate / estimate hydrostatic conditions



Key Best Practices for MIW
Field Investigation Activities

- Plan and conduct invasive measurement activities
  - Drilling using blow-out preventers
  - Downhole measurement through boreholes
  - Monitoring well installation and sampling
- Examples of drilling-related failure modes
  - MIW releases through drilled boreholes
  - Collapses or cave-ins within workings
  - Ground failure from weight of drilling equipment
  - Ground liquefaction from drilling vibration

Key Best Practices for MIW

FMEA

- Conduct Failure Mode and Effects Analysis (FMEA)
  - Qualitative or quantitative depending on available data
  - Multi-discipline team with diverse expertise and knowledge
    - One or more with prior FMEA experience
- Identify potential failure modes and related elements
  - Triggering event(s)
  - Likelihood of occurrence
  - Consequences and severity
  - Receptors
- Determine actions to eliminate or reduce failures

Example FMEA Worksheet
Qualitative

Failure Mode

Failure Mode Description

Factors Making Failure Mode More / Less Likely

Likelihood of Occurrence

Consequences

Risk Matrix

POTENTIAL FAILURE MODE PFM #2: Level 1 blockage inby of Sta 5+00 collapse by breakthrough blasting

DESCRIPTION: Blockage exists just inby of Sta 5+00. The blockage is not discovered by probe holes drilled from the bypass adit. Contractor proceeds with blasting the final 22 feet separating the bypass from Level 1. The blast impact fails the blockage and releases impounded MIW through the cross-cut and bypass adit and potentially over/through Level 1 partial blockage at Sta 2+80. Released flows overwhelm sediment pond system and MIW enters Elk Creek.

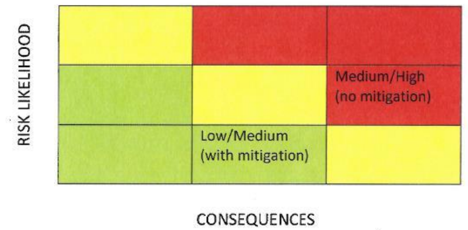
FACTORS MAKING PFM MORE LIKELY:

- Reduction in rock quality associated with shear zones or intrusive zones near Standard Fault
- Last photos taken 4 years ago and conditions could have changed due to last year's construction activities in the mine
- Construction of the bypass adit in 2015 could have destabilized conditions in Level 1
- Volume of impounded water is seasonally dependent. Can be significant in spring when construction is scheduled to resume
- Blockage is likely less stable with large volume of impounded MIW

FACTORS MAKING PFM LESS LIKELY:

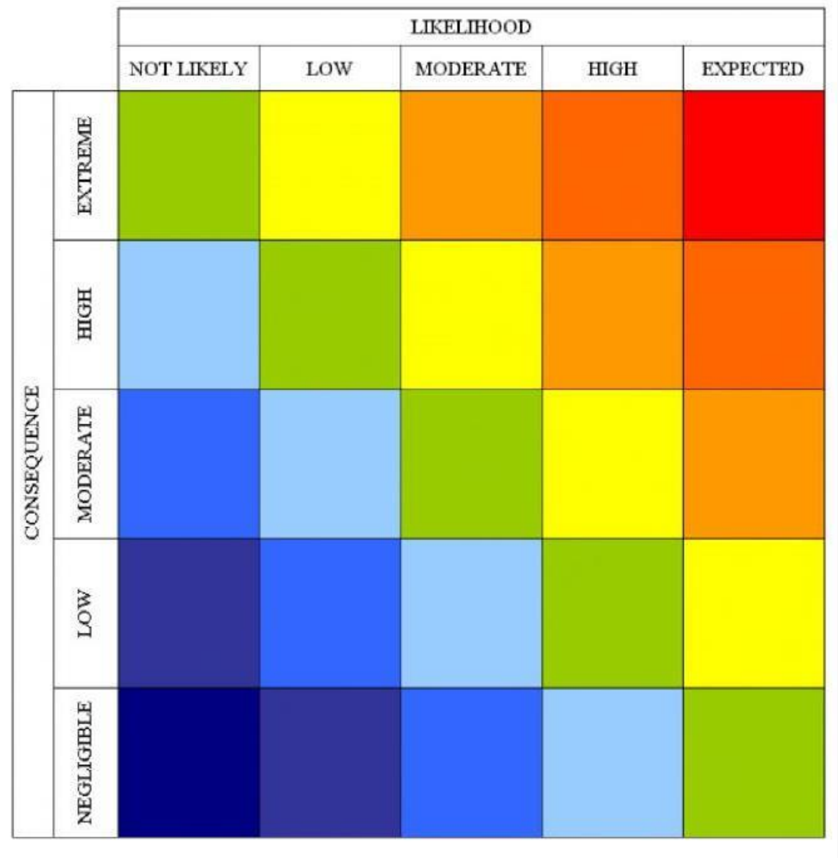
- Photos taken in 2012 at Sta 3+50 looking inby show clear adit with no evidence of blockage
- Rockmass quality improves inby of the existing blockage at Level 1
- Video camera through probe holes will be used to inspect conditions prior to blast
- The intent is to keep Sedimentation Pond at Level 1 empty in preparation for the breakthrough into Level 1

LIKELIHOOD CATEGORY: Medium with low confidence	COMMENTS: Blockage is hypothetical, conditions unknown. Seasonal variations in discharge flows from Level 1 are significant and could mask changes in the mine.
CONSEQUENCES: High with moderate confidence	COMMENTS: Fast release of potentially large volume. Impounded volume is unknown, more likely to be small, however, smaller volumes are less likely to be released.



Practices for MIW
FMEA Risk Matrix

- Matrix Axes
  - ➢ Consequence & Likelihood
- Color-coded risk levels
  - ➢ Red – Extreme Risk
  - ➢ Orange / orange-red – High Risk
  - ➢ Yellow – Moderate Risk
  - ➢ Green – Tolerable Risk
  - ➢ Blue – Low to negligible Risk
- Risk levels provide basis for risk mitigation activities



Key Best Practices for MIW

CNEAP

- Develop CNEAP
  - Contingency > Existing site infrastructure that would auto-manage MIW release (e.g., existing retention basin)
  - Notifications > For emergency response agencies and downstream receptors; dependent on severity of event
  - Emergency Action > Other actions taken if a release were to occur (e.g., site worker mustering locations)
- CNEAP content directly supported by FMEA results
- Designate CNEAP as governing document for managing, monitoring and response to potential MIW releases
  - Work plans, HASPs, plans and specifications, etc.

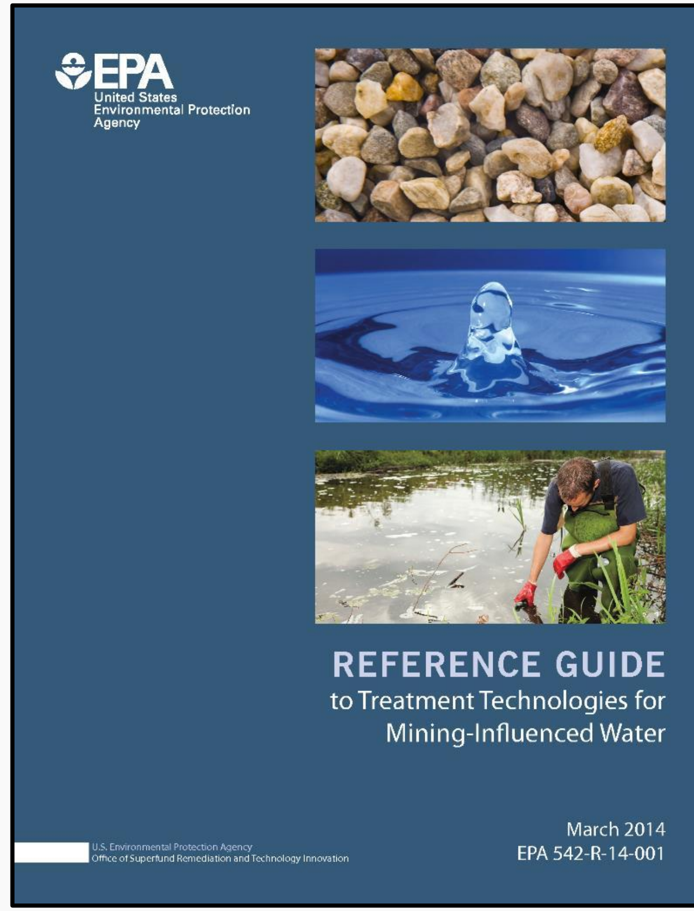
Key Best Practices for MIW

Data Evaluation and Reporting

- Collect and evaluate data
  - ➢ Correlate MIW pooling water levels and discharge location(s)
  - ➢ Update detailed water balance
- Update MIW CSM
- Identify needed mitigations
  - ➢ Example – pre-draining MIW prior to work activities
- Report findings to required parties
- Plan and implement mitigation efforts
  - ➢ Perform FMEA
  - ➢ Update CNEAP

Reference Guide to Treatment Technologies for Mining-Influenced Water

- Addresses 7 passive / 9 active technologies
  - Summary of 7 additional technologies
  - On-line searchable library of technologies
- Technology discussions include:
  - Technology description
  - Constituents treated
  - Operations
  - Long-term maintenance
  - System limitations
  - Costs
  - Effectiveness
- Living resource; update in process
  - Handbook for Treatment Technologies for Mining Wastes and Mining-Influenced Water
  - Updates the MIW guide and expands the state of knowledge to include mining waste



www.cluin.org/mining

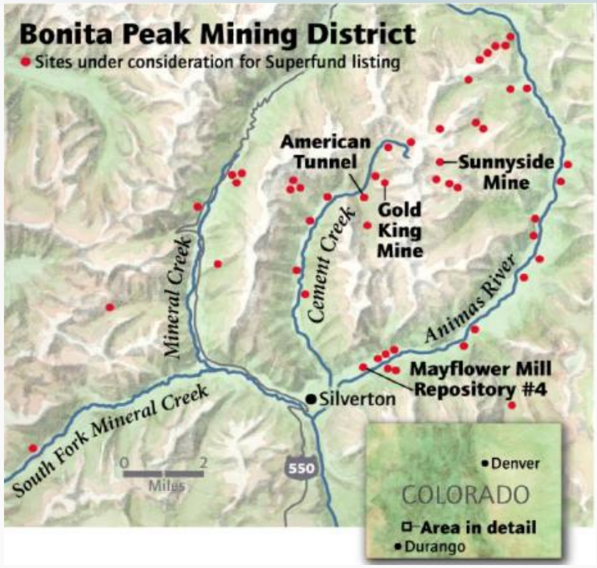
Optimization Review Case Studies

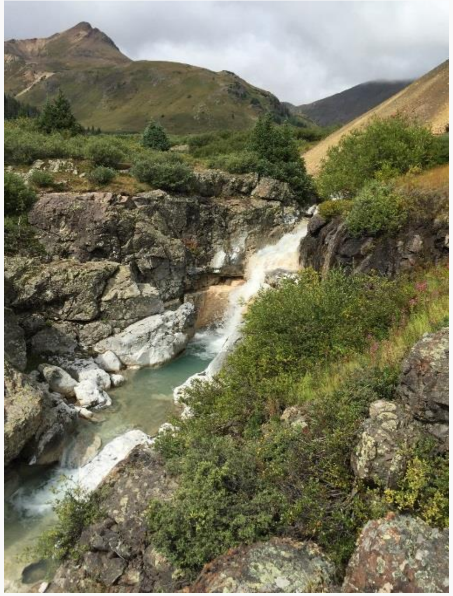
Bonita Peak Mining District
Site Information

- Optimization review and technical support for RI planning
- Newly listed Superfund site in Silverton, CO area
- 48 mines located in three adjacent, high-altitude drainage basins
  - Animas River / Cement Creek / Mineral Creek
  - Downstream confluence into Animas River
- "One government" project team
  - US EPA
  - US Bureau of Land Management (BLM)
  - US Forest Service (USFS)
  - Colorado Department of Public Health and Environment (CDPHE)
  - Colorado Division of Reclamation Mining and Safety (DRMS)
- Approximately 40 project team members
  - Program and project management
  - Technical, legal and communications

Bonita Peak Mining District

Site Information





Bonita Peak Mining District
Challenges

- High diversity in mine site characteristics
  - Portals located along river/creeks and steep terrain up to 12,000 feet MSL
  - Active MIW pooling and discharges; hydraulic interconnectivity
  - Direct sourcing to surface water from anthropogenic and natural sources
- Receptor diversity and issues
  - Downstream receptors – water quality impacts
  - Residents – impact to lives and economic livelihoods
  - Thriving ATV and 4WD adventure tours – direct exposure to tailings dust
  - Hikers and mountain bikers – direct exposure to impacted drinking water
  - Historic sites – preservation requirements
  - Tribal – impacts to cultural use
- Additional issues
  - Various funding levels/mechanisms and program requirements for each agency
  - Mixed land ownership – government, tribal, corporate, private
  - Mines easily accessible to nearly inaccessible
  - Short work season due to lengthy snow season

Bonita Peak Mining District
Technical Support Activities

- Conducted 1-week site visit reconnaissance
- Facilitated objective-focused, strategic planning effort
  - Identified >350 action items during two meetings and one prior meeting
- Developed Excel database matrix as collaborative management tool
  - Strategic-, programmatic- and project-level activity planning and tracking
- Proposed use of an integrated strategy for key site activities
  - Enabled immediate planning for taking action on obvious site concerns
  - Requires additional evaluation for regulatory process and funding

Bonita Peak Mining District, CO

Lava Cap Mine Superfund Site

Site Information

Location

- Sierra Nevada foothills; western Nevada County, CA
- Approximately 33 acres in semi-rural, residential area

Mine Type

- Gold and silver from underground workings
- Initiated in 1861 and continued sporadically until 1943
- Mine-related arsenic contamination in nearby drinking water wells

Cleanup Status

- Remedial design stage; Record of Decision (ROD) signed Sept. 2008
- Interim remedy for Groundwater Operable Unit (OU)
- Construction of public water supply line to affected residences
- Further study required to assess interactions between fractured bedrock aquifer and surface water

Two Optimization Reviews: Impoundment Focus; MIW Focus

Lava Cap Mine Superfund Site
Key Optimization Review Findings

Dam Safety
- Unregulated earth-rock embankment dam
- Holds tailings and other wastes
- Spillway inadequate for minimum flood flow and has deteriorated concrete components

Dam Characterization
- Approximately eight decades of operation and modifications
- Dam stability and composition not well-defined or documented

Seepage from Dam
- Active seepage from former mine workings
- Source of surface water contamination

Lava Cap Mine Superfund Site

Key Review Recommendations

Embankment Plan

- Conduct further investigations to support development of more realistic embankment model of dam stability
- Perform stability analysis

Prevent Seepage

- Identify seepage outlet
- Quantify conditions to design mitigation
- Install conduit plug to reduce seepage

Reduce Construction Activity

- Use stability analysis as basis for developing closure alternatives that more efficiently satisfy dam safety requirements

Estimated 30 Year Cost Savings: $5.6M

Summitville Mine Superfund Site

Site Information

Location

- San Juan Mountains south of Del Norte, CO
- 11,500 feet above sea level; ~2 miles east of the Continental Divide

Mine Type

- Gold, copper and silver mining from underground workings and open pit
- Initiated ~1870 and continued into the 1990s

Cleanup Status

- Remedial Action stage
- Several actions implemented to reduce MIW discharge
  - ➢ Detoxifying, capping and revegetating a cyanide heap leach pad
  - ➢ Removing waste rock piles and filling the mine pits
  - ➢ Plugging adits and underground mine entrances
  - ➢ Expanding water runoff holding ponds and operating on-site WTP
- In preparation stages for transfer to State of Colorado

Two Optimization Reviews: Whole Site Focus; State Transfer Focus

Summitville Mine Superfund Site

Site Information

Summitville Mine Superfund Site
Key Optimization Review Findings

Mine Pool

- Elevated MIW pool water level
- Hydraulic potential may affect migration of impacted groundwater through bedrock and subsequent discharge to surface water

Pump & Treat Capture Zone

- High seasonal variability in groundwater flow
- Uncaptured seeps and groundwater discharges impacting river

Remedy Operation

- Remedy operating costs significantly high compared to similar sites

WTP

- Current and planned remedies anticipated to require operation in perpetuity
- Will result in high total costs

Summitville Mine Superfund Site
Key Review Recommendations

Lower Mine Pool Elevation

- Evaluate options for maintaining lower water level in mine pool
- Reduce effects of hydraulic potential on groundwater migration and discharge

Conduct Comprehensive Hydrogeologic Evaluation

- Determine if planned interceptor trench along the northern boundary of the site will provide the expected capture of impacted groundwater and surface water

Reduce Monitoring Program

- Evaluate need for continued extensive surface water sampling and analysis

Reduce Snow Removal

- Eliminate potentially unnecessary seasonal maintenance snow removal

Address Perpetual WTP Operation

- Consider remedial approaches that will not require perpetual water treatment

Estimated 30 Year Cost Savings: $13.8M

Central City/Clear Creek Site

Site Information

Location

- Gilpin and Clear Creek Counties, CO
- Consists of 400 mile^2 watershed

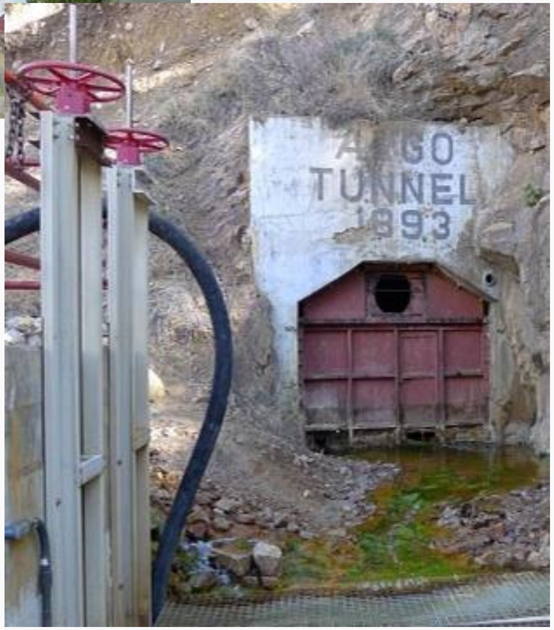
Mine Type

- Gold and silver
- Initiated in the mid-1800s and continued until the 1940's
- Most mines in watershed were underground mines
- Site's Argo Tunnel is major source of MIW discharge

Cleanup Status

- Remedial Action stage
- Remedies at the site's four operable units (OUs) focus on water treatment and source control
  - Simultaneous design, construction and operation activities

Central City/Clear Creek Site
Site Information



Central City/Clear Creek Site

Key Optimization Review Findings

Collection System and Treatment/Capacity

- MIW collection system and 180 gpm WTP overwhelmed during high flows of groundwater and surface water
- Untreated water discharged to Clear Creek

WTP Performance

- Poor lime quality causes blockages and system failures
- Results in discharge standards not being met

Weather

- Weather conditions impact system performance and worker safety

Operations

- WTP is attended less than half the day; operated remotely via laptop

Effluent Filters

- Post-clarifier gravity filters commonly become clogged as WTP backwash systems do not function properly; this requires filters to be bypassed

Central City/Clear Creek Site

Key Review Recommendations

Contain Groundwater

- Determine need for complete contaminated groundwater collection and treatment as well as blowout prevention to avoid untreated discharges

New Filter System

- Install new automated filter presses to replace existing presses that require manual sludge movement

Improve Lime Delivery

- Improve the lime delivery system to prevent blockages

Compressed Air Reliability

- Provide additional compressed air capacity to improve system functionality
- Essential for filter presses, waste evacuation pumps and other equipment

Consider Developing On-site Repository

- To avoid the costs of disposing filter press solids at off-site landfill

Estimated 30 Year Cost Savings: $7.7M

Gilt Edge Mine Superfund Site

Site Information

Location

- 360-acre mining disturbed area near Lead, SD
- Headwaters of cold-water fisheries and municipal water supplies of the northern Black Hills

Mine Type

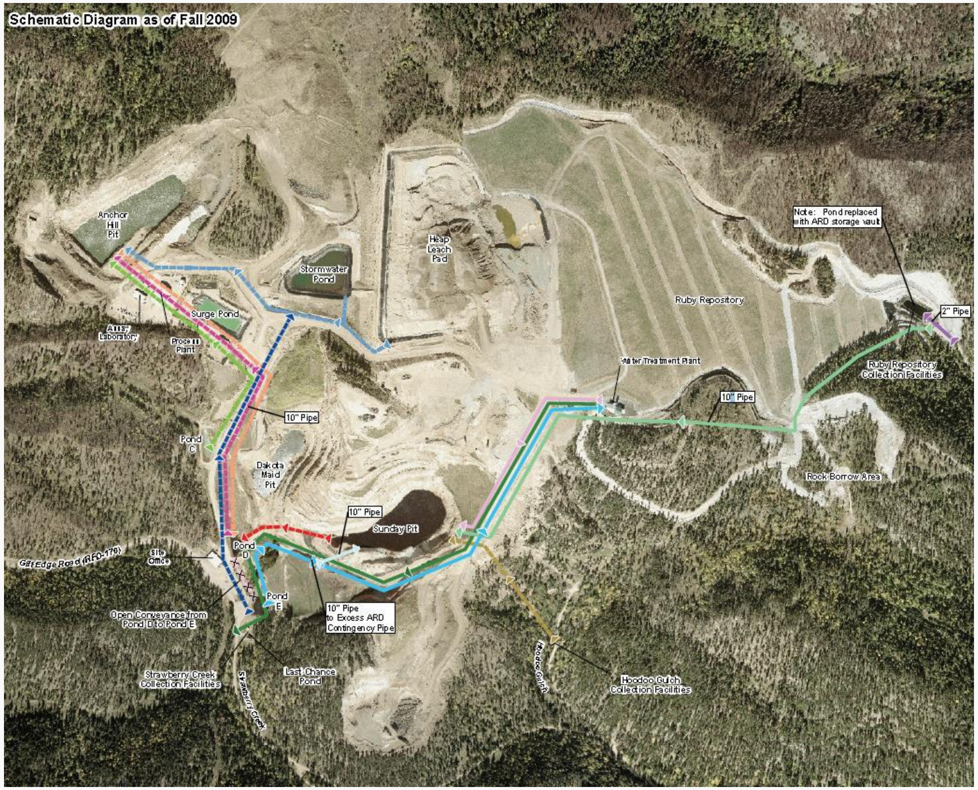
- Gold, copper and tungsten
- initiated in 1876 and continued until late 1990s
- Open pit mining and cyanide heap-leach operations
- Prior mine exploration activities from various mining companies

Cleanup Status

- Remedial Action stage
- Interim remedies being undertaken at all three OUs while further study and final remedies are selected
- WTP being operated as an interim remedy while a permanent water treatment remedy is evaluated and selected

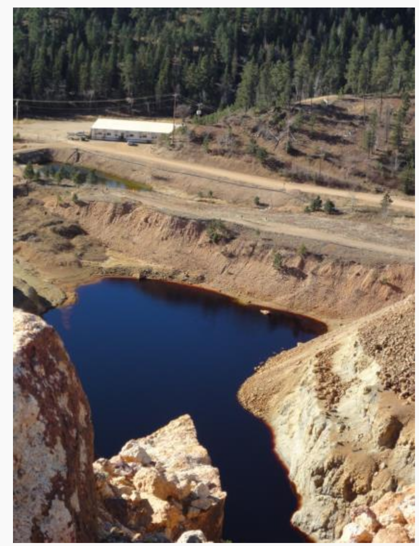
Gilt Edge Mine Superfund Site

Site Information



Extensive MIW Collection & Conveyance System

Anchor Hill Pit



Gilt Edge Mine Superfund Site

Key Optimization Review Findings

WTP

- Three collection facilities capture and treat a significant portion of MIW
- Continued MIW releases to surface water from un-captured seeps
- WTP treats up to 325 gpm MIW to near S. Dakota surface water quality standards (SDSWQS)

Effluent Exceedances

- Waiver allows selenium and total dissolved solids (TDS) discharge above SDSWQS
- Cadmium exceeds SDSWQS chronic standard in creek and periodically exceeds effluent discharge limitations at WTP
- Effluent periodically exceeds SDSWQS 30-day average conductivity standard

WTP Operations

- WTP staffed 7 days per week, 24 hours per day with a total of 10 full-time staff
- Plans exist to modify or replace WTP

Power and Fuel Costs

- Electricity costs approximately $151,000 per year, for ~434 kilowatt electrical power demand
- Fuel costs of $79,000 per year and propane heating costs of about $24,000 per year

Sampling and Analytical Cost

- Approximately $125,000 per year for 352 samples and laboratory and reporting costs

Gilt Edge Mine Superfund Site

Key Review Recommendations

Pretreatment

- Implement pretreatment for remaining high-sulfate MIW in pits

MIW Collection

- Upgrade Hoodoo Gulch collection facility

Reduce Staffing Levels

- Eliminate overnight staffing, reduce labor force and operate in batch mode
- Reduce vehicle leases for snow removal

Reduce Sampling Frequency

- Evaluate current monitoring requirements to identify savings that can be achieved by removing unnecessary or outdated monitoring requirements

Keep Existing WTP

- Do not change existing WTP
- Regularly evaluate collection system pumping requirements

Estimated 30 Year Cost Savings: $23.7M

Gilt Edge Mine Superfund Site
Implemented Recommendations

- Installed SCADA*/Automation system; completed in the spring of 2016
  - Cost approximately $950,000
  - Remote operation and monitoring of MIW collection facilities and WTP
  - Labor required for full time monitoring of collection facilities reduced

- Overall site operations costs reduced
  - From between $2M to $2.2M per year to approximately $1.5M per year
  - Payback for investment will be approximately 2 years

- Additional reductions from changes in contractor and contract mechanism
  - Large to small business contractor
  - Cost reimbursable to fixed price contract
  - Outsourced oversight to U.S. Army Corps of Engineers

*SCADA = supervisory control and data acquisition

Summary

- Optimization program standard EPA business practice
- Standard process provides consistent review outcomes
- Reviews improving performance of mine sites nationwide
  - ➢ Improved effectiveness / protectiveness
  - ➢ Solutions to complex site problems
  - ➢ Increased stakeholder collaboration
  - ➢ Advance progress toward closure
  - ➢ Reduced costs
- Lessons learned driving innovation in best practices for mine site characterization and remediation

Shasta Lakes Mining District, CA

Questions

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