

Surface Reclamation of the Captain Jack Mill Superfund Site

May 8, 2019



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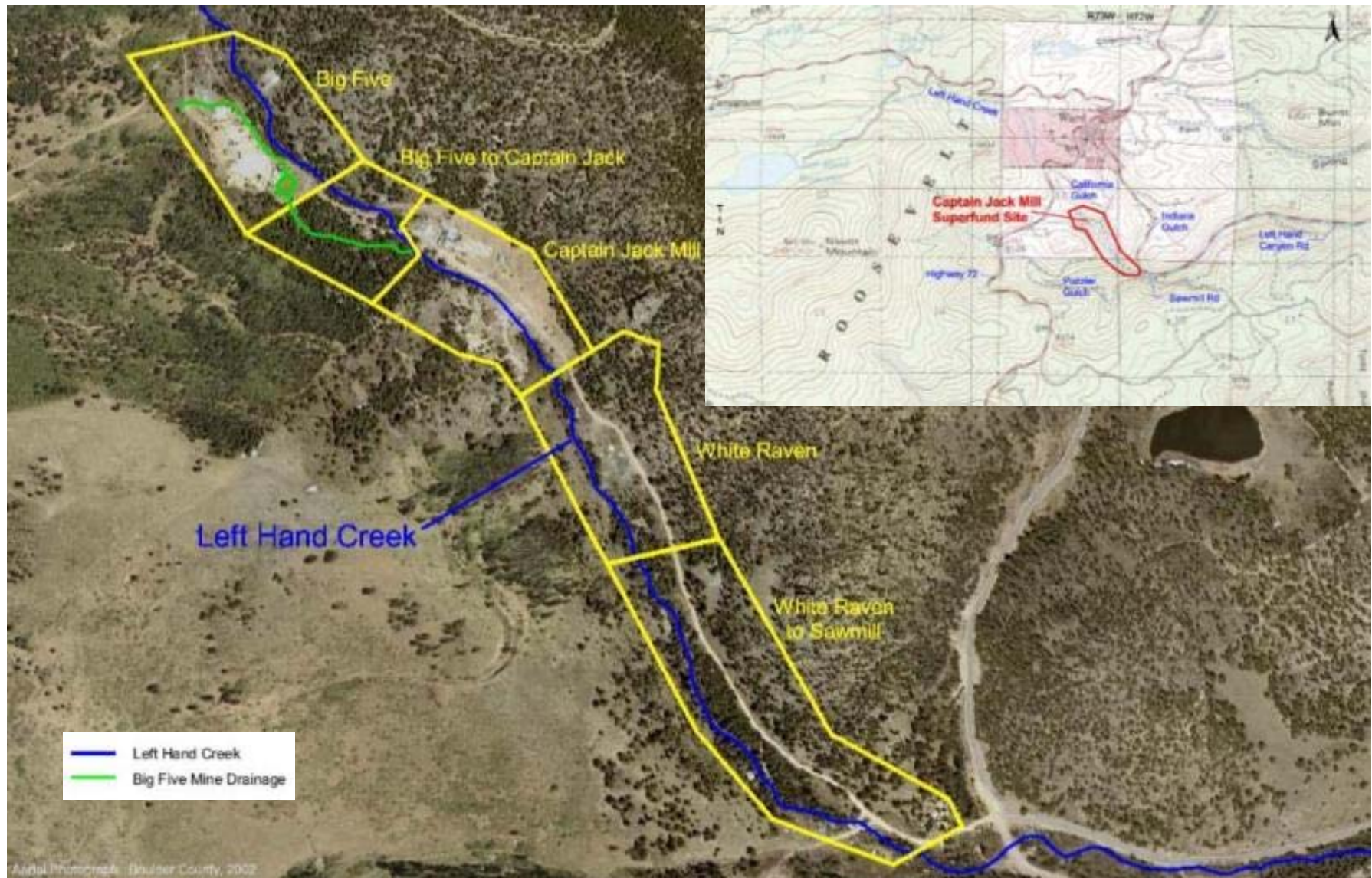
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Introduction – Captain Jack Mill Superfund Site

- Site Conditions
- Remedial Design Approach and Criteria
- Remedial Action Construction Activities
- Post Construction Vegetation Inspections
- Pre-and-Post Remediation Comparisons

Site Location & Layout



- Boulder County, Colorado - located near town of Ward

Introduction – Captain Jack Mill Superfund Site

- Ward Mining District began ~ 1861
- Silver and Gold mining
 - Pyrite and galena-containing wastes
- Periodic operations in early 1900s to 1940
- Captain Jack Mine Area
 - Mining/milling resumed from 1981-1986 and in 1992 at Capt. Jack
 - Predominately EPA emergency removal actions in 2004 and 2007
 - RI/FS/ROD in 2008
 - Pre-Design Investigation 2010 – 2011
 - Remedial Design in 2011 and Remedial Action Construction in 2012

Site Conditions - Big Five Mine Dump



Erosion (Head-cutting), Stormwater & Adit Discharge (Infiltration), Direct Exposure

Site Conditions - Black Jack Adit & Captain Jack Mill



Former Mill & Tailings Ponds & Adit, Direct Exposure, Boulder County Borrow Area

Site Conditions - Residential Property & Philadelphia Mine



Erosion, Direct Exposure

Site Conditions – White Raven Mine



Erosion, Direct Exposure

Remedial Action Overview

- Remedial Action Objectives
 - Reduce Exposure to Metals in Soil (Arsenic, Lead, and Thallium)
 - Reduce Metals Loading to Groundwater from Surface Sources
 - Reduce In-stream Surface Water Metals Concentrations
 - Remedial Goal: Lead in Soil < 380 to 860 mg/kg (Area Specific)
- Surface Selected Remedy (2008 Record of Decision)
 - Adit Water Diversion
 - Removal of Mine Wastes from Various Site Sources
 - Consolidate and Cover Mine Waste at the Captain Jack Repository
 - Regrade and Cover Mine Waste at Big Five Mine Dump
- Subsurface (groundwater) remedy implemented separately

Pre-Design Investigations

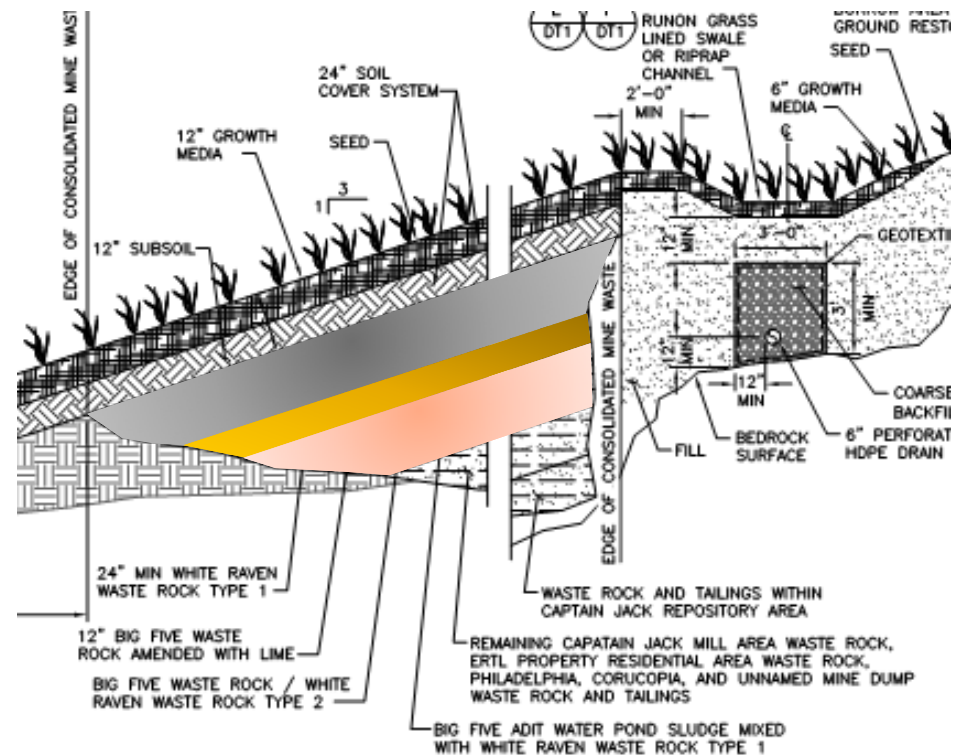
- Mine wastes
 - Mine dump extent delineation
 - Geotechnical properties
 - XRF field-based lead remedial action level development
- Borrow material
 - Geotechnical/agronomic properties
 - Volumes
- Structural/features assessment
- Cultural resources assessment
- Flood plain mapping

Design and Construction Approaches

- Onsite Reclamation Materials
 - >30,000 CY of borrow fill and rock mined onsite and processed
 - Growth media (topsoil)
 - 2-inch minus screen
 - Organic compost, sugar-beet lime, fertilizer
 - Subsoil
 - 4-inch minus screen
 - No amendments
 - General Fill
 - As excavated or screened to minus 12-inch
 - Oversized material/riprap
 - 4-inch plus
 - Gravel
 - 2-4 inch screened

Design and Construction Approaches

- Steep slope reclamation
 - Mine dump removal
 - Parent ground amendment and seeding
 - Erosion controls and habitat
- Acid-generating waste stabilization
 - Lime amendment
 - Repository layering
 - Galena-containing coarse waste rock placed over lime-amended wastes
 - High-neutralizing capacity (NP)
 - Coarse rock provides capillary break



Design and Construction Approaches

- Repository covers – 12” subsoil and 12” growth media
- Revegetation
 - 6-12” growth media in non-repository areas
 - Hand broadcast seeding and hydromulch
 - Erosion controls
- Creek restoration
 - Waste removals
 - Embankment stabilization
 - Willow planting
 - Riprap
- Adit water diversion from cover areas

Design and Construction Approaches

Seed Mix				
Common Name	Latin name	Variety	% of mix	PLS/Acre
Fringed Brome	Bromus ciliatus	VNS	7	1.94
Tufted Hairgrass	Deschampsia caespitosa	VNS or Nortran	8	0.21
Canada Wild Rye	Elymus canadensis	VNS	12	6.82
Squirrel Tail	Elymus elymoides	Wapiti	15	5.10
Thickspike Wheatgrass	Elymus lanceolatus	Critana	14	5.94
Slender Wheatgrass	Elymus trachycaulus	San Luis	10	4.11
Rocky Mountain Fescue	Festuca saximontana	VNS	5	0.25
Thurber's Fescue	Festuca thurberi	VNS	5	0.33
Junegrass	Koeleria macrantha	Native	8	0.23
Spike Trisetum	Trisetum spicatum var. montanum	VNS	5	0.19
Yarrow ¹	Achillea lanulosa	Occidentalis	3	0.07
Fringed Sage	Artemesia frigida	VNS	3	0.04
Sulphur Flower	Eriogonum umbellatum	VNS	3	0.79
Northern Sweetvetch	Hedysarum boreale	Timp	2	3.89
Totals			100.00	29.91

Remedial Action – Big Five Mine Dump



- 18,500 CY excavation and consolidation at Captain Jack Repository
- 12,600 CY regrade in place
- 2-ft soil cover
 - 12" subsoil and 12" growth media

Remedial Action – Big Five Mine Dump



- Adit drainage sedimentation ponds and diversion piping

Remedial Action – Big Five Mine Dump



- Runon controls and cultural resources protection

Remedial Action – Big Five Mine Dump



- Access and runoff controls



Remedial Action – Captain Jack Repository



- Adit portal extension and mill demolition

Remedial Action – Captain Jack Repository



- Lime amendment of top 1-foot of Big Five acid generating mine waste

- Minimum 2-foot lift of non-acid generating White Raven mine waste over lime-amended Big Five waste

Remedial Action – Captain Jack Repository



- Borrow material excavation and processing
 - Fill, subsoil, growth media, riprap, gravel

Remedial Action – Captain Jack Repository



- 51,000 CY consolidated mine waste
- 2-ft soil cover
 - 12" subsoil and 12" growth media

Remedial Action – Captain Jack Repository



- Run-on controls

- Riprap and grass-lined channels
- Subsurface interceptor drain

- Runoff controls

- Grass-lined channel at toe

Remedial Action – Captain Jack Repository



- Erosion controls and seeding

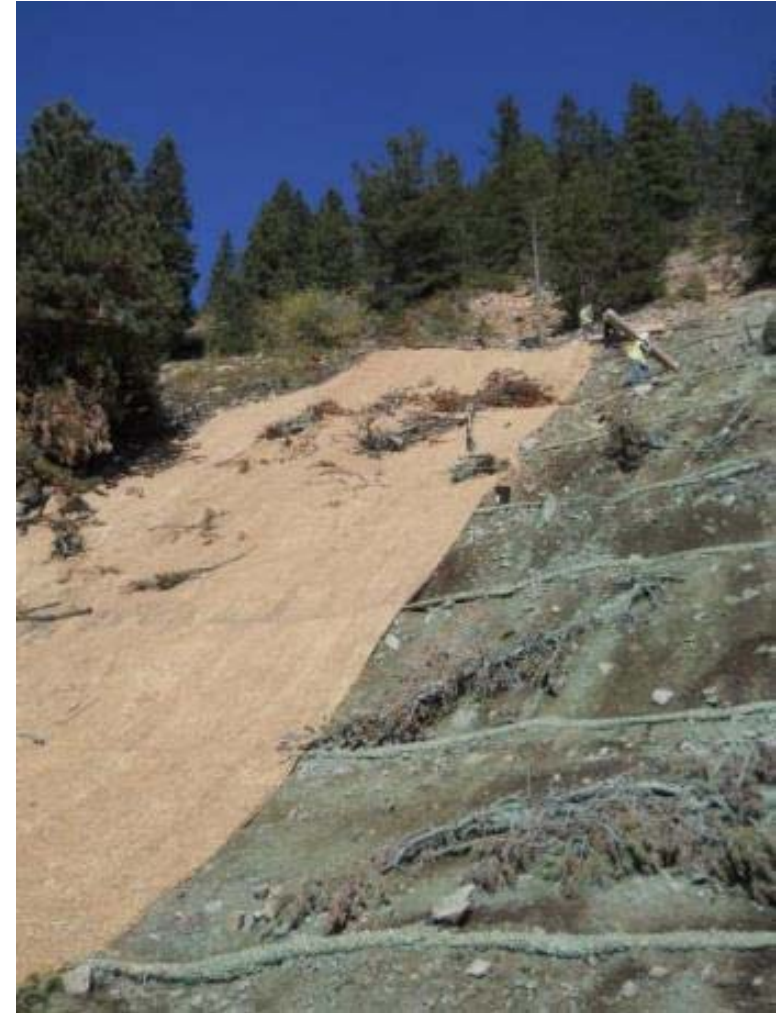
Remedial Action –Philadelphia Mine Dump



- Mine waste excavation, parent ground amendment, slash placement



Remedial Action –Philadelphia Mine Dump



- Erosion control and seeding

Remedial Action – White Raven Mine



- 18,300 CY excavation and consolidation at Captain Jack Repository



Remedial Action – White Raven Mine

- Restoration – Fill and rock placement, erosion controls, seeding

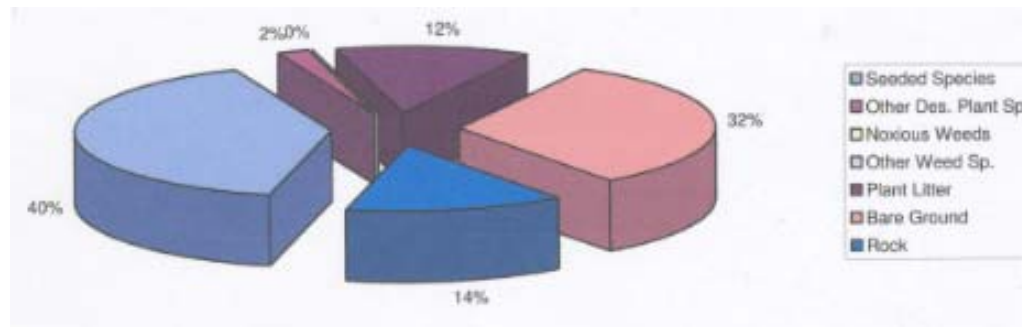


Warranty, Inspections, and Maintenance

- Construction complete November 2012
- 1-year general warranty on construction
- 3-year special warranty on seeded areas
- Seed success/failure inspection, May 2013
 - Some problem areas identified: reseeded, fertilized, extra watering
- Peak growth inspection Year 1, August 2013
 - Frame and grid inspection approach
 - ~50 frames per acre frequency with 20X50 cm frame
 - >300 frames evaluated for 5-acre site
 - Estimated percent cover of seeded and other desirable species, noxious and other weedy species, plant litter, bare ground, and rock
 - General inspection for rilling and other erosion issues

Warrantee, Inspections, and Maintenance

- Peak growth inspection Year 1, August 2013
 - Overall average perennial non-weedy plant canopy was 42%
 - Exceeds 30% warrantee criteria
 - Dominated by Elymus grass species
 - Many other minor species including fescues, Canada bluegrass, sage, brome, sweetvech, and yarrow
 - Average perennial non-weedy plant canopy breakdown:
 - Captain Jack Repository: 57%
 - Big Five Repository: 43%
 - Residential property: 23%



Warrantee, Inspections, and Maintenance

- Final 1-year warrantee inspection in October 2013
 - Further improvements to residential property seed success due to addition of topsoil, fertilizer, water, and re-seeding
- Peak growth inspection 2, August 2014
 - Used a frame and grid inspection approach only on residential property area
 - Other areas visually similar or more dense than previous year
 - Improved average perennial non-weedy plant canopy at residential property to 38%
- 2015 season - limited inspection
 - Met or exceeded previous years



Pre and Post Reclamation – Captain Jack Mine



Pre-Reclamation



August 2014 – 2nd Year Peak Growth Inspection



Summer
2017

Pre and Post Reclamation – Captain Jack Mine



Summer 2018



Pre-Reclamation

Pre and Post Reclamation – Philadelphia Mine



Pre-Reclamation



Summer 2017



Summer 2018

Pre and Post Reclamation – Big Five Mine



Pre-Reclamation



August 2014

Pre and Post Reclamation – Big Five Mine



Summer 2017



Summer 2018



Pre and Post Reclamation – White Raven Mine



Pre-Reclamation



August 2014

Pre and Post Reclamation – White Raven Mine



Summer 2017



Summer 2018



Pre-Reclamation

Questions

