Tackling AMD, Mining Impacted G/W & Private Ownership - Bunker Hill Mine, ID Panhandle

August 13, 2014
Discussion Scope

- Geographical Orientation - Bunker Hill Site
- Process History
- CTP & GCS
- EPA Ownership and Ops of CTP
- Water Qualities and Quantities
- G/W Collection System & CTP Upgrades
- Procurement Status
- Summary
Bunker Hill Mining and Metallurgical Complex Superfund Site (Bunker Hill)

- Site listed on NPL in 1983
- Record of Decision Documents:
  - OU1 – Box Pop. Areas/ROD - 1991
  - OU2 – Box Non-Pop. Areas/ROD - 1992
  - OU 3 – CDA Basin/ROD – 2002
  - Upper Basin ROD Amendment - Aug 2012
Mining Activity in Upper Basin

- Mining Features
Coeur d’Alene Mining District
Production - Process History

► Silver Valley

- Most Prolific Silver Producer in the World.
  - 130 M Tonnes of Ore
    - 1 Billion oz – Ag ~ 18% of all U.S. Silver
    - 17% of all Pb
    - 16% of all Zn
Mining Production

ANNUAL PRODUCTION, CDA MINING DISTRICT, 1886 TO 1990

ISPE June 06 2013

USGS modified Bookstrom, etal
History High Points

- Mining and milling began in the 1880s
- Until 1968, mine waste discharged directly to creeks and rivers
- Most tailings piles located adjacent to streams
- Estimated over 100 million tons discharged
  - 2.4 billion pounds of lead
  - Dispersed over 10,000’s Ac
Mine Waste Disposal History
Bunker Hill Box

- Major industrial complex (mining, milling, smelting)
- CIA Construction displaced S.Fork
- Contaminants in Air, soil and water pathways
- Some of highest blood leads measured in the world
Remedy Selection

► 2012 Upper Basin RODA
- Selected capture of G/W near CIA and treatment at CTP.
- Selected upgrades to the CTP
- Also called for collection of g/w in areas of OU3 & treatment at CTP. (Future Actions)

► 2002 OU2 RODA
- Selected CTP upgrades to more effectively treat BH Mine Water
Selected Remedy Targets

- AMD
- Mining Impacted Groundwater
Receiving Waters – S. Fork CDAR
Dissolved Zinc Concentrations, 1990-2013

Bunker Hill “Box”

US Geological Survey

Provisional
The G/W Problem

- Water moving through mine tailings and beneath the CIA releases dissolved Cd & Zn from the mine waste

- No-action dissolved Zn loading to SFCDR estimated to be ~540 lb/day

- Zn loading under CIA ~ 450 lb/day

- Zn loading moving through g/w system ➔ Smelterville Flats ~ 90 lb/day
Conceptual G/W Solution

- 8,500-foot-long cutoff wall, 2-3 foot wide
- Keyed into aquitard at depth ranging from 14-32 feet bgs
- Series of 10-12 extraction wells
- Flow rate is controlled by wells at ~2,000 – 2,500 gpm
- Flow from SFCDR and lower Bunker Creek isolated from wells by cutoff wall
- Amount of groundwater rise inside wall is minor, controlled by wells
- Force main conveyance along north and east side of CIA to CTP
GCS Implementation Objectives

► Optimize configuration:
  ▪ Isolate groundwater from SFCDR and Lower BC
  ▪ Minimize groundwater extraction
  ▪ Maximize hydraulic capture
  ▪ Drawdown/recharge of groundwater levels
    ▶ Minimize risk/mitigate impact of groundwater overflowing wall
    ▶ Reduce fouling/precipitation due to geochemical effects
  ▪ Provide Continuous Operation
Bunker Hill Mine History

- 1885--Discovered
- At Peak--Largest Pb/Zn/Ag Mine
- 1974—CTP Built
- 1982—Listed on NPL
- 1991—Closed/Reopened
- 1996 – EPA began running CTP
- Current- Private Ownership O&M
Workings Accessed Via ~10,000-Foot Kellogg Tunnel
Generalized Mine Water Flow Model

Legend:
- PUMP
- MINE WATER FLOW DIRECTION

Key Points:
- MILO CREEK
- DEADWOOD CREEK
- SOUTH FORK COEUR D'ALENE RIVER
- KELLOGG TUNNEL
- BARNEY SWITCH pH 3-5
- pH 2-4
- FRACTIONS
- HIGH PYRITE CONTENT
- FLOOD STANLY WORKINGS
- FAULTS
- SOUTH FORK COEUR D'ALENE RIVER
- BUNKER CREEK
- CENTRAL TREATMENT PLANT
- SLUDGE
- CTP
- COLLECTION CHANNEL
- OUTFALL TO BUNKER CREEK
- BURIED SLUDGE PIPE
- BURIED MINE WATER PIPELINES
- ~3,800 FEET
- ~3,100 FEET
- ~2,400 FEET
- ~2,200 FEET
- ~2,360 FEET
- ~2,240 FEET
- ~1,970 FEET
- ~1,800 FEET
- ~800 FEET
- ~1,970 FEET
- No. 2 RAISE
- SUBMERGED WORKINGS
# The AMD Problem

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Flow:</td>
<td>800 - 6,700 gpm</td>
</tr>
<tr>
<td>pH:</td>
<td>2.0 - 4.0</td>
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<tr>
<td>Cadmium:</td>
<td>0.4 - 2.5 mg/L</td>
</tr>
<tr>
<td>Lead:</td>
<td>0.8 - 3.0 mg/L</td>
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<tr>
<td>Zinc:</td>
<td>200 - 1,400 mg/L</td>
</tr>
<tr>
<td>Iron:</td>
<td>80 - 900 mg/L</td>
</tr>
<tr>
<td>Manganese:</td>
<td>30 - 230 mg/L</td>
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<tr>
<td>Lime Demand:</td>
<td>4 - 40 lb/1000 gal</td>
</tr>
<tr>
<td>Solids Formed:</td>
<td>4 - 40 lb/1000 gal</td>
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</tbody>
</table>
Historical Mine Water Flow Rates

Peak Flows Typically in May/June During Snowmelt
Central Treatment Plant as it appeared in 1999
Existing CTP and Related Systems Overview

- Sludge Pond
- Buried Sludge Pipe
- Outfall to Bunker Creek
- Buried Mine Water Pipelines
- Mine Workings ~2 miles
- Portal Collection Channel
- CTP
Configured as “HDS” process but operates in “LDS” mode due to lack of filters.
CTP Upgrade Objectives

► Provide Continuous Ops
► Produce Acceptable Effluent Qual-Discharge
► Minimize Sludge Production
► Maximize system reliability
► Incur acceptable capital and O&M Costs
► Optimize operation by commercial sector
TABLE 4-3
Current and Expected Future CTP Effluent Limits (not considering a mixing zone allowance) a

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Current Limits b</th>
<th>Expected Future Limits c</th>
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<tbody>
<tr>
<td></td>
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<td>Daily Maximum</td>
<td>Daily Average</td>
</tr>
<tr>
<td>Aluminum</td>
<td>µg/L</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Arsenic</td>
<td>µg/L</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cadmium</td>
<td>µg/L</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Copper</td>
<td>µg/L</td>
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<td>150</td>
</tr>
<tr>
<td>Iron</td>
<td>µg/L</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Lead</td>
<td>µg/L</td>
<td>600</td>
<td>300</td>
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<tr>
<td>Mercury</td>
<td>µg/L</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Selenium</td>
<td>µg/L</td>
<td>--</td>
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</tr>
<tr>
<td>Silver</td>
<td>µg/L</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Thallium</td>
<td>µg/L</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Zinc</td>
<td>µg/L</td>
<td>1,480</td>
<td>730</td>
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<tr>
<td>pH</td>
<td>std units</td>
<td>6.0 to 10.0</td>
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<tr>
<td>TSS</td>
<td>mg/L</td>
<td>30</td>
<td>20</td>
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<tr>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
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<tr>
<td>Temperature</td>
<td>ºC</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Whole Effluent Toxicity</td>
<td>TUc</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes:
- Future limits, including a mixing zone, are currently being reevaluated (see Appendix E), so values for expected future limits could change.
- Metals limits are as total metal. Monitoring of copper and mercury is not required by the existing (expired) NPDES permit.
- All metals are expressed in terms of total recoverable metal except for mercury, which is in terms of total metal.
- ºC = degrees Celsius
- µg/L = micrograms per liter
- mg/L = milligrams per liter
- TSS = total suspended solids
- TUc = toxic units, chronic
Optimization Study Recs

- Conducted Prior to Initiation of Design

- Recommended:
  - View as Watershed - Weigh Plant Capital Costs vs. implementing Source Control Elsewhere in Watershed – Policy and Funding
  - Delay Installation of Filters – Analyzed during pilot studies & during initial design
  - Delay Infiltration RA due to long break even t
Key VE Study Recommendations

► Control flows to the CTP to a maximum of 5000 gpm (original dsn flow)
  - Requires controlling g/w flows that are collected (model predicts peak flows ~ 2500)
  - Requires controlling flows from Bunker Hill Mine
    - Base flows 1300 gpm
    - Peak flows since 1996 have, on occasion, > 4000 gpm

► Mitigate infiltration into mine

► Encircle CIA with wall – creates ponding
Path Forward Procurement
Strategy CTP/GCS

► Design/Build hybrid - performance/prescriptive work statement
► ODBO – includes operations before & after design/construct
► COE - issue and manage solicitation and be responsible for ODBO contract admin
► Ch2MHill – EPA Design Assistance Consultant
ODBO Contract Milestone Dates
- COE lead tasks

- Industry Day – conducted June 5-6
- Market Survey - complete early Aug
- Ph I solicitation - issue Aug 17
- Selection of Qualified Contracting Pool – December
- Ph II solicitation – Dec 2014
- Contract award – early Jun 2015
- Fast Track design – Aug - Dec 2015
- Initiate Fast Track Construction – Dec 2015
- Design Typical Track - Jun thru Nov 2015 ➔ Constr Follow
- Anticipated construction completion Fall 2017
O&M Responsibility

- EPA requires states to take on O&M following RA implementation
- Idaho DEQ unwilling to sign SSC that includes operations of CTP
- Some Critical Upgrades were conducted in 2005 under Removal Action authority
- Settlement Agreement with Hecla Mining set aside a portion of funds to pay for l/t O&M
We’ve Accomplished Much, Much Remains

► More than 6000 residential and recreational properties remediated

► More than 2 million cubic yards of contaminated soil and sediments consolidated capped on-site

► Revegetated approximately 3,200 acres of denuded hillsides

► 72 miles of contaminated railroad right-of-way cleaned up and converted to popular recreational rail trail

► More than 50% reduction in local children’s blood lead levels

► More than 1,800 acres of property transferred to State of Idaho for economic development projects in OU1 and OU2

► 400 acres of waterfowl habitat cleaned up and converted

► Select Abandoned Mine Sites remediated

► .....
Bunker Hill Summary

► Grand Scales – Temporal, Spatial, Complexity

► Remedy implementation over long t / large $

► Prioritized remedy implementation approach

► Currently addressing the 2 highest loading reaches of dissolved metals (CIA G/W & EFNM)

► Implementation of GCS + CTP Upgrades expected to significantly reduce dissolved metals loading to SFCDR
Questions?

Pb Smelter - 15 Years after