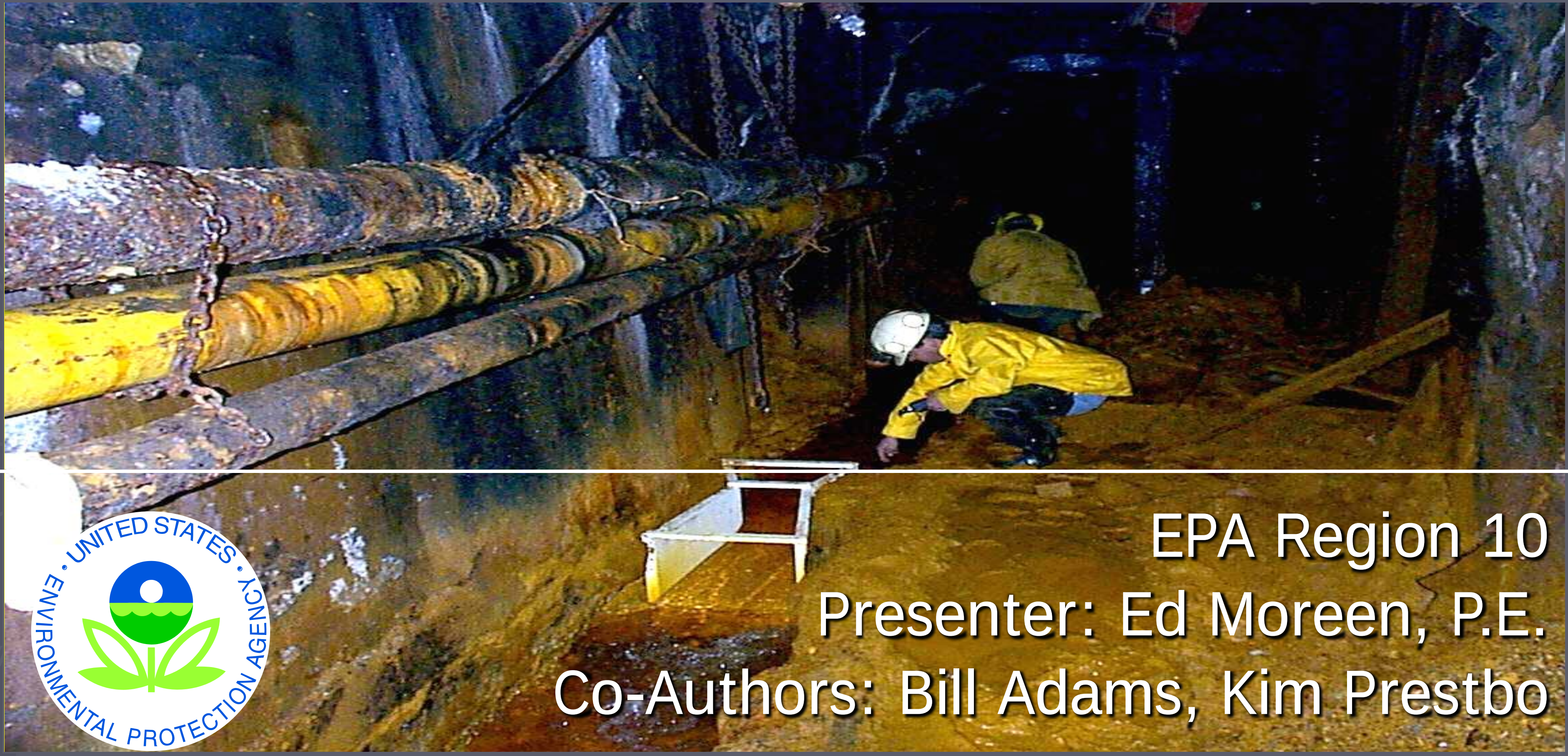
National Conference on Mining-Influenced Waters

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

August 13, 2014



EPA Region 10

Presenter: Ed Moreen, P.E.

Co-Authors: Bill Adams, Kim Prestbo

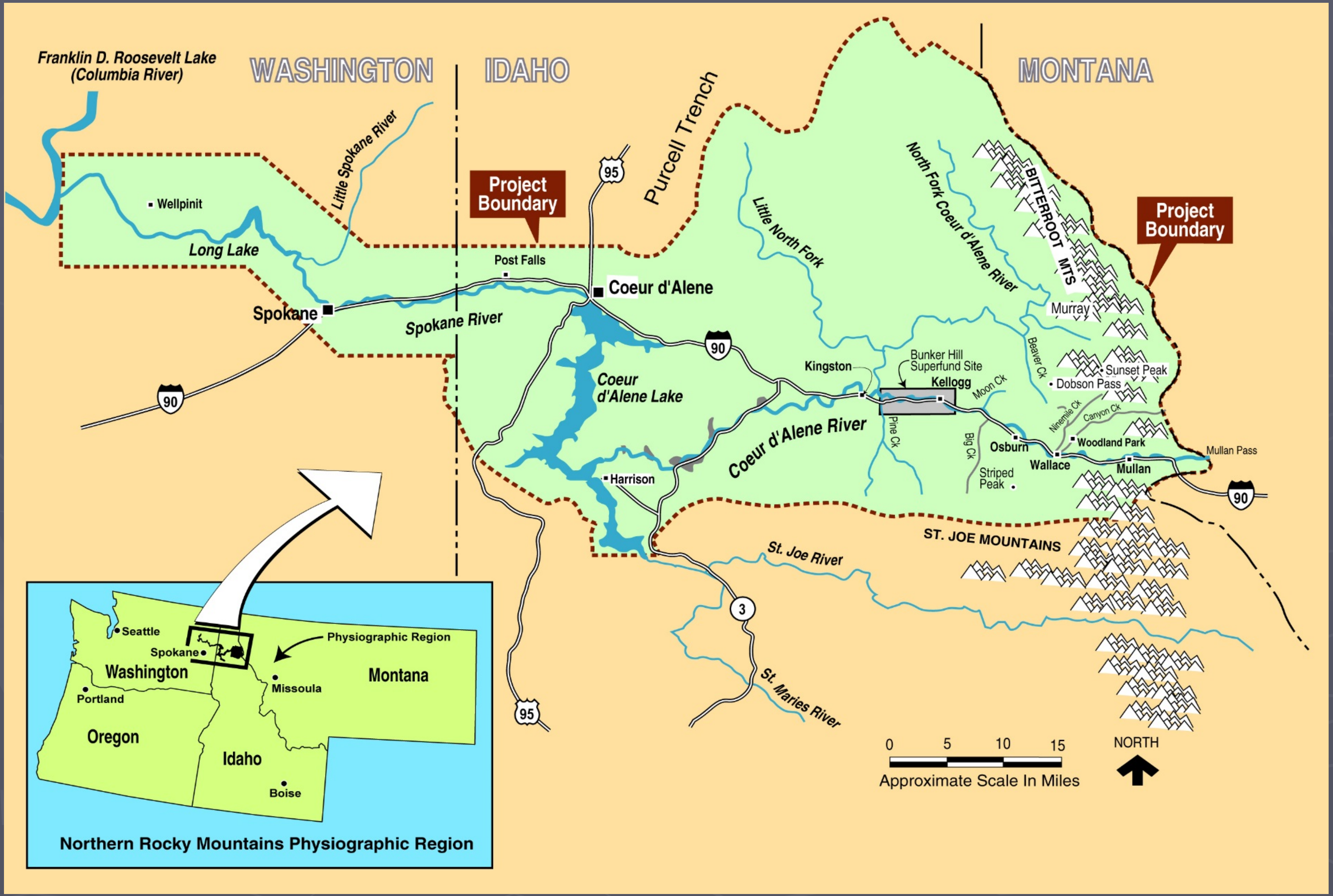
Discussion Scope

- 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

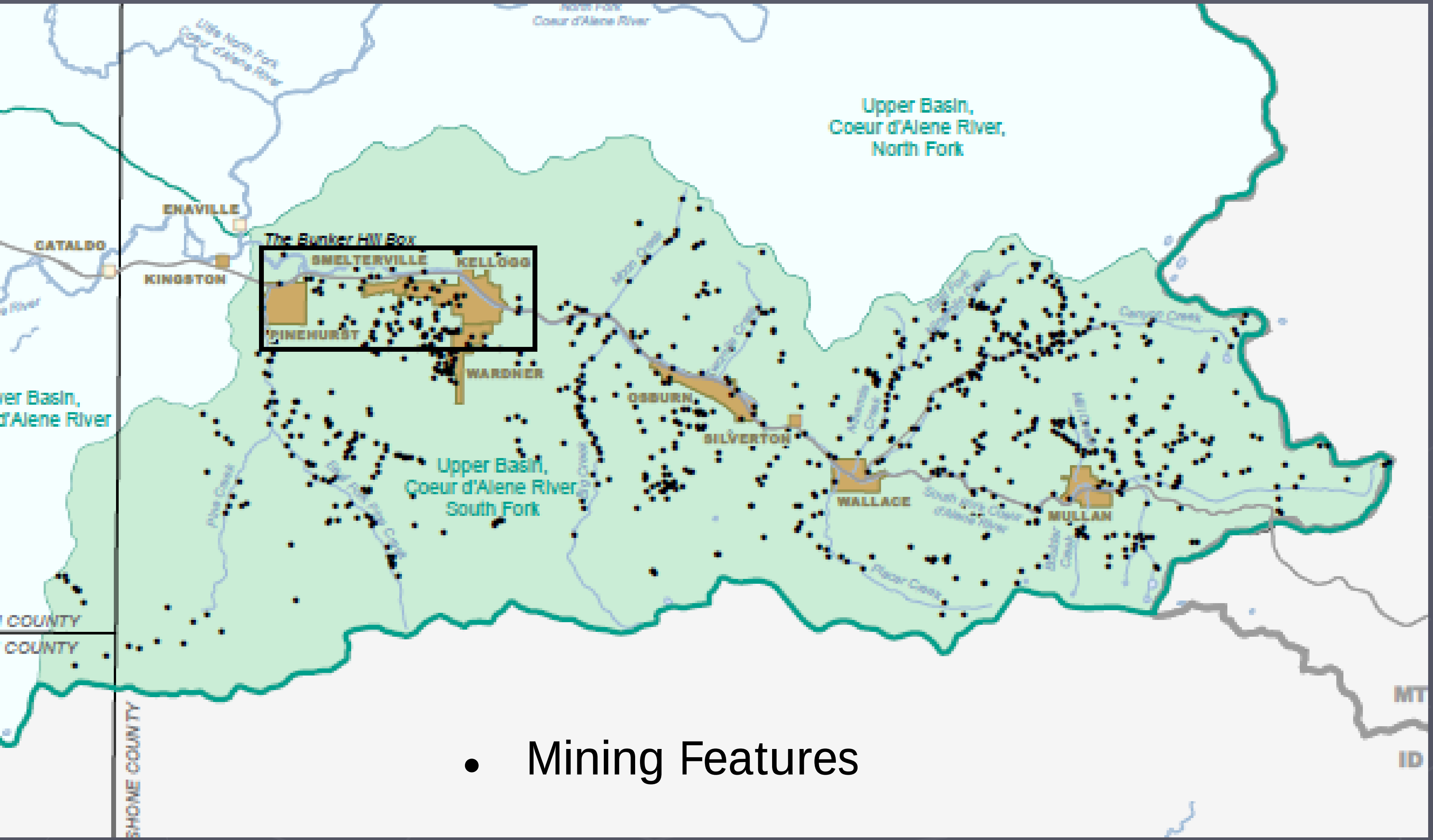
Bunker Hill Mining and Metallurgical Complex Superfund Site (Bunker Hill)

- 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

Basin Geography



Mining Activity in Upper Basin

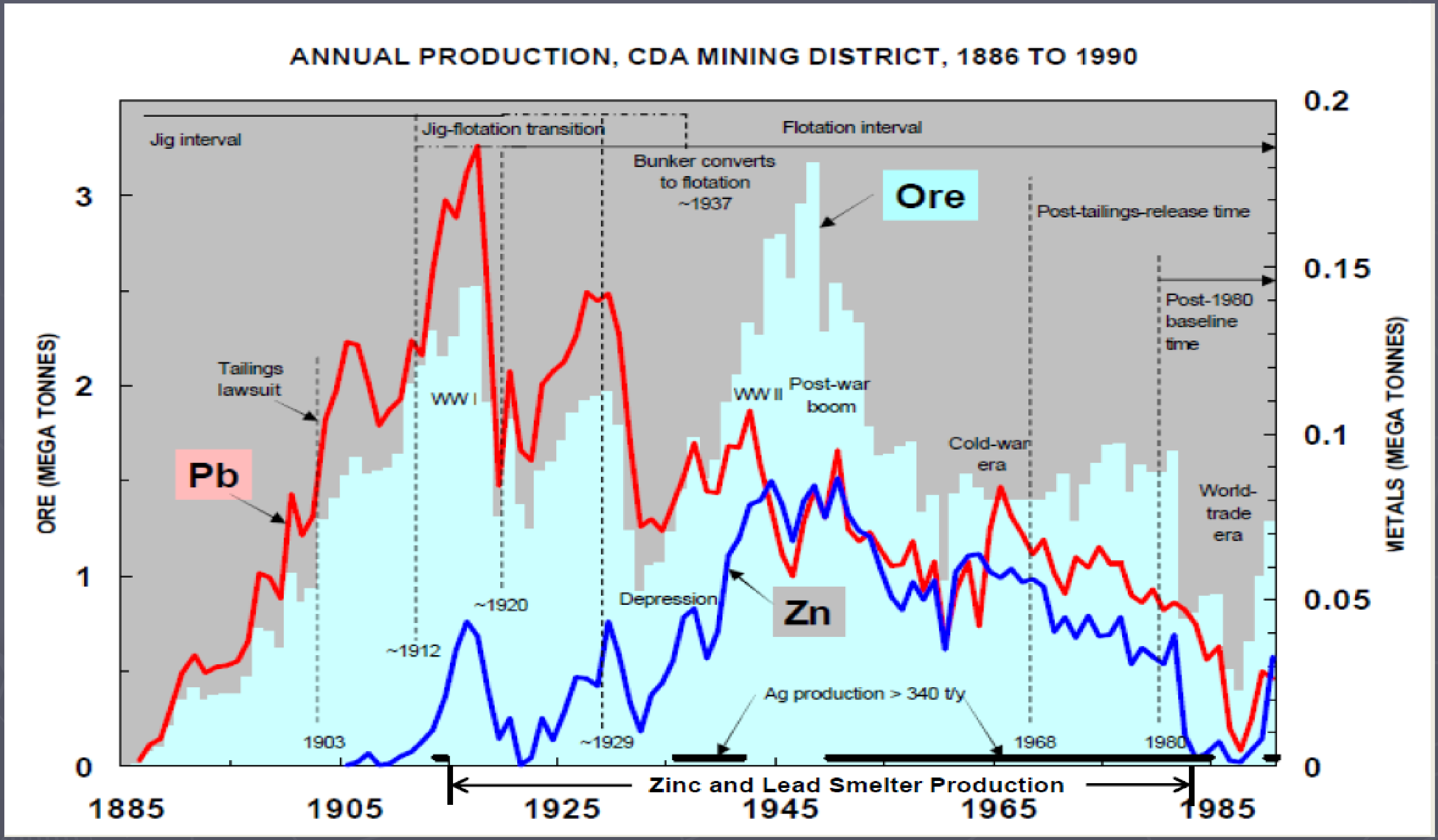


- Mining Features

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



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

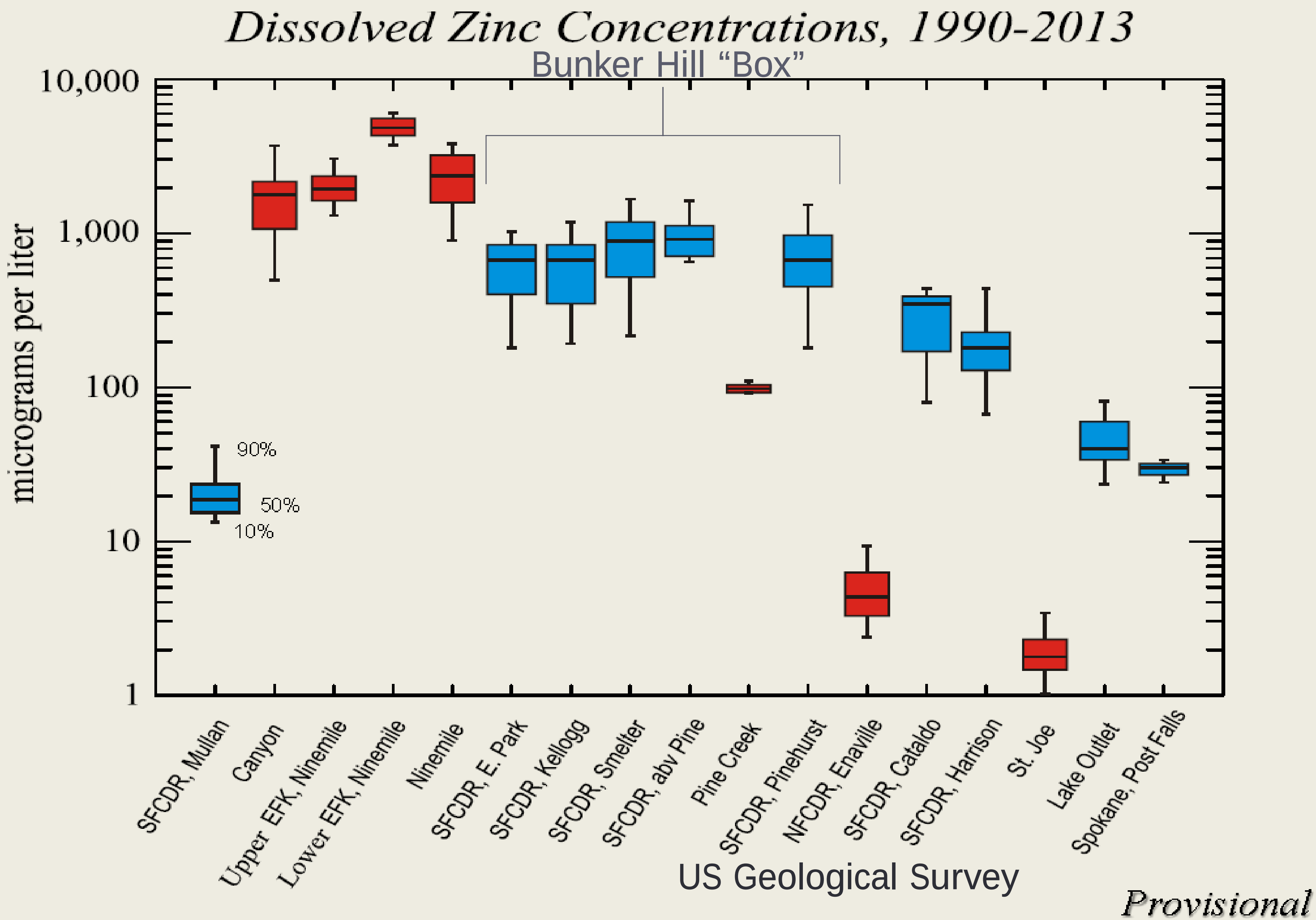
- 2012 Upper Basin RODA
  - Selected capture of G/W near CIA and treatment at CTP.
  - Selected upgrades to the CTP
  - Also called for collection of g/w in areas of OU3 & treatment at CTP. (Future Actions)
- 2002 OU2 RODA
  - Selected CTP upgrades to more effectively treat BH Mine Water

Selected Remedy Targets

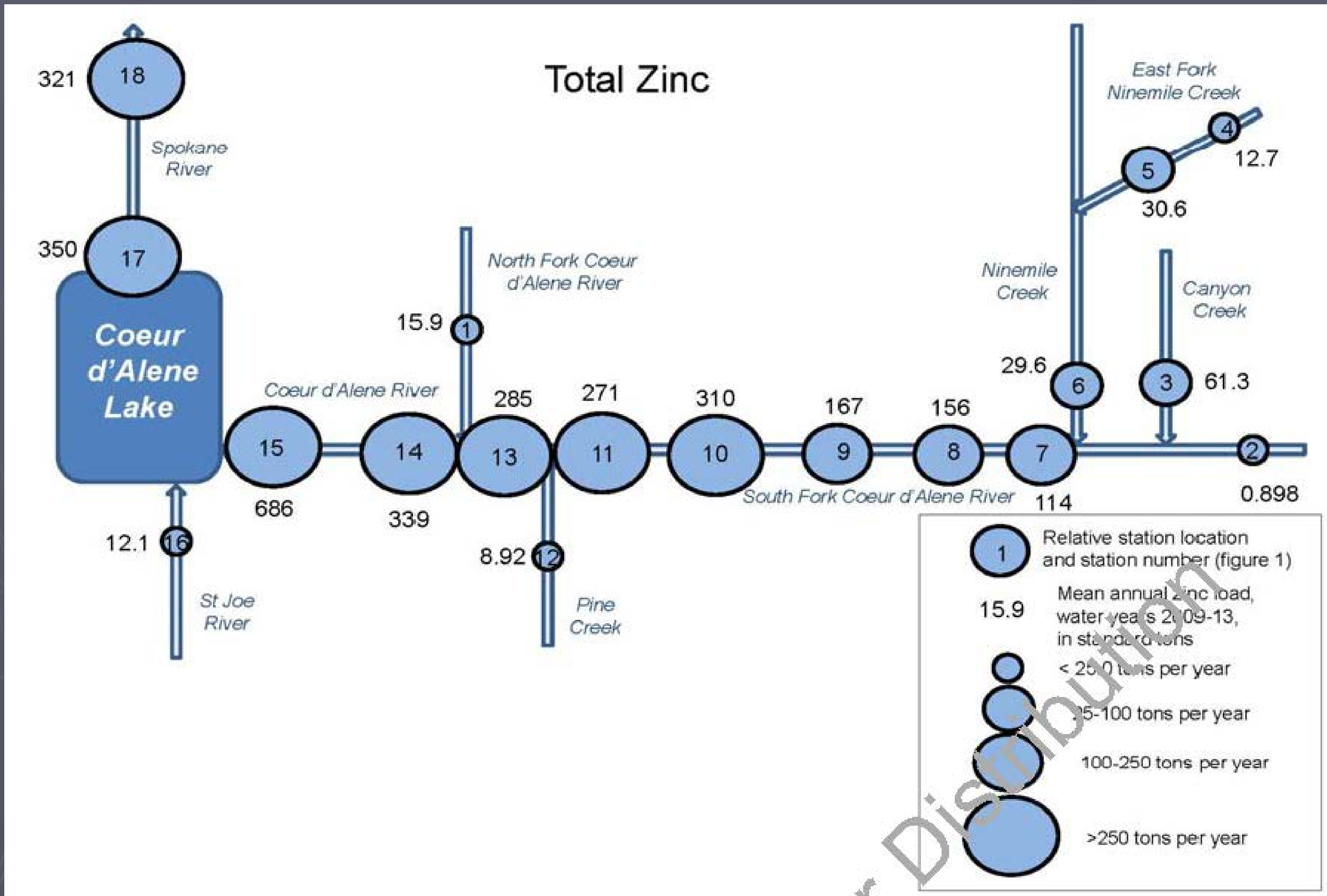
- AMD

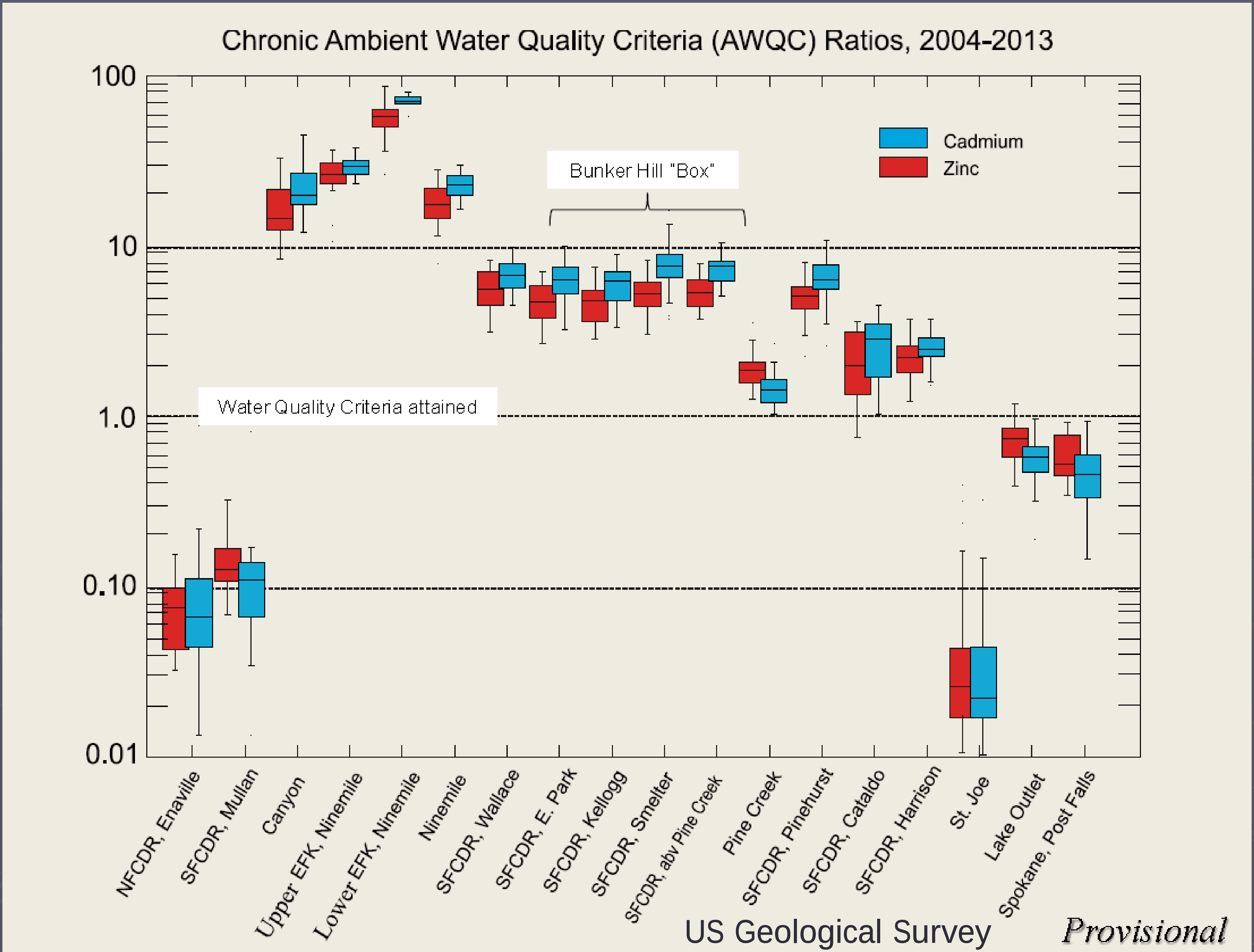
- Mining Impacted Groundwater

Receiving Waters –S. Fork CDAR



Dissolved Zinc Concentrations, 1990-2013
Bunker Hill "Box"
micrograms per liter
10,000
1,000
100
10
1
90%
50%
10%
SFCDR, Mullan
Canyon
Upper EFK, Ninemile
Lower EFK, Ninemile
Ninemile
SFCDR, E. Park
SFCDR, Kellogg
SFCDR, Smelter
SFCDR, abv Pine
Pine Creek
SFCDR, Pinehurst
NFCDR, Enaville
SFCDR, Cataldo
SFCDR, Harrison
St. Joe
Lake Outlet
Spokane, Post Falls
US Geological Survey
Provisional


Total Zinc
321
18
Spokane River
350
17
Coeur d'Alene Lake
12.1
16
St Joe River
15
686
Coeur d'Alene River
14
339
15.9
1
North Fork Coeur d'Alene River
285
13
8.92
12
Pine Creek
271
11
310
10
167
9
156
8
South Fork Coeur d'Alene River
7
114
29.6
6
Ninemile Creek
East Fork Ninemile Creek
4
12.7
5
30.6
3
61.3
Canyon Creek
2
0.898
Relative station location and station number (figure 1)
15.9
100-250 tons per year
>250 tons per year



Chronic Ambient Water Quality Criteria (AWQC) Ratios, 2004-2013
100
10
1.0
0.10
0.01
Cadmium
Zinc
Bunker Hill "Box"
Water Quality Criteria attained
NFCDR, Enaville
SFCDR, Mullan
Canyon
Upper EFK, Ninemile
Lower EFK, Ninemile
Ninemile
SFCDR, Wallace
SFCDR, E. Park
SFCDR, Kellogg
SFCDR, Smelter
SFCDR, abv Pine Creek
Pine Creek
SFCDR, Pinehurst
SFCDR, Cataldo
SFCDR, Harrison
St. Joe
Lake Outlet
Spokane, Post Falls
US Geological Survey
Provisional

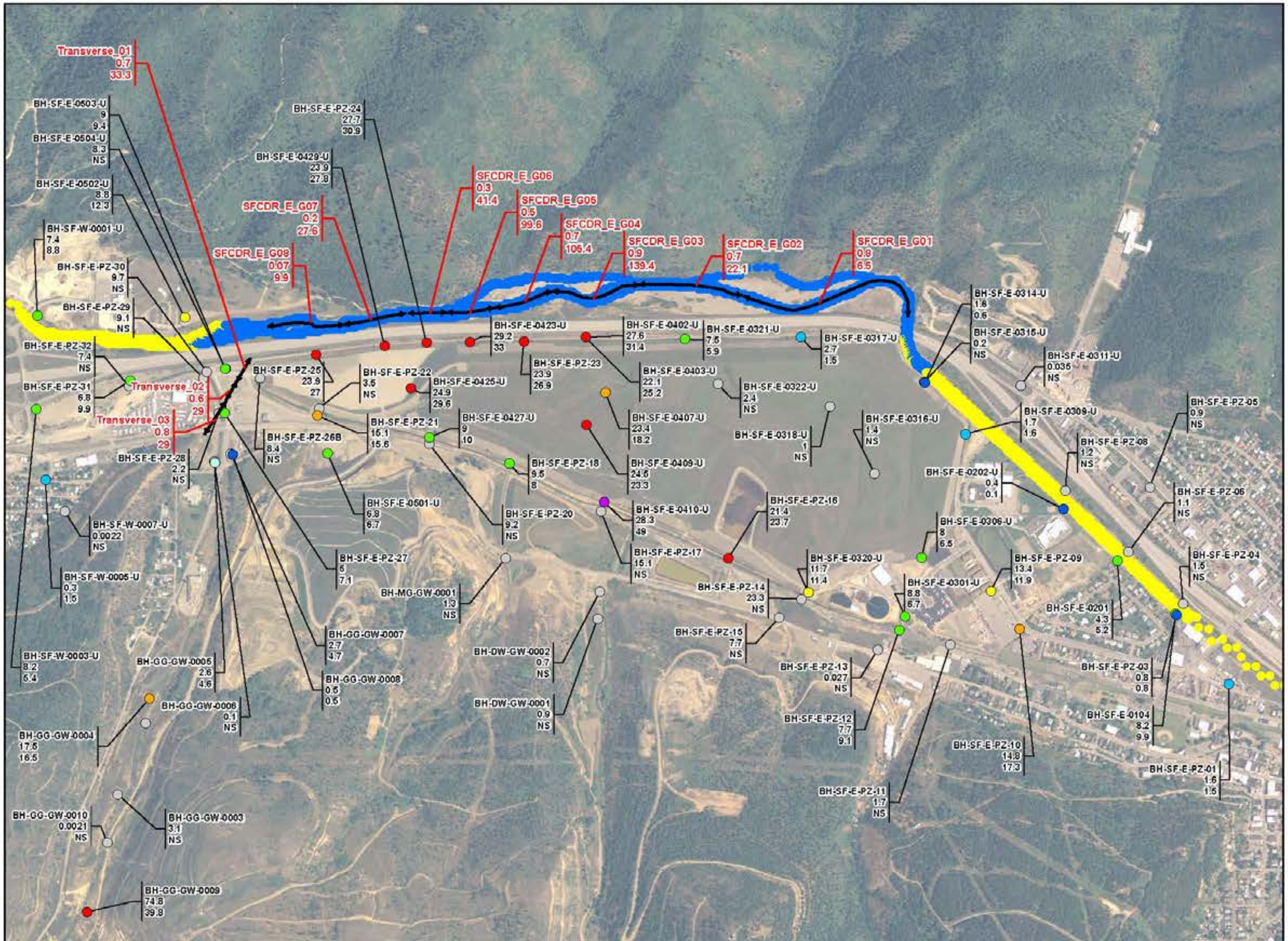
The G/W Problem

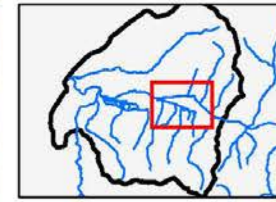
- Water moving through mine tailings and beneath the CIA releases dissolved Cd & Zn from the mine waste

- 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





LEGEND

- Mass Balance Transect
- Simulated Gaining Reach
- Simulated Losing Reach

Fall 2011 Dissolved Zinc Concentration (mg/L)

- <= 1.0
- 1.1 – 2.0
- 2.1 – 5.0
- 5.1 – 10.0
- 10.1 – 15.0
- 15.1 – 20.0
- 20.1 – 40.0
- 40.1 – 105.0
- Not Sampled

Dissolved Zinc Sample Label:

BH-SF-E-0423-U – Well Name
29.2 – 4Q08 Concentration
33 – 4Q11Concentration

Mass Balance Transect Sample Label:

SFCDR_E_G01 – Transect Name
0.8 – Simulated Stream Gain (cfs)
6.6 – 4Q11 Net Dissolved Zinc Load (lb/d)

Notes:
1. mg/L = milligrams per liter
2. NS = not sampled
3. cfs = cubic feet per second
4. lb/d = pounds per day

N 0 500 1,000 2,000 Feet

Figure 3-64
Distribution of Dissolved Zinc in Groundwater – Fall Conditions
Draft CIA Groundwater Collection System – Design Definition Report
BUNKER HILL SUPERFUND SITE

CH2MHILL

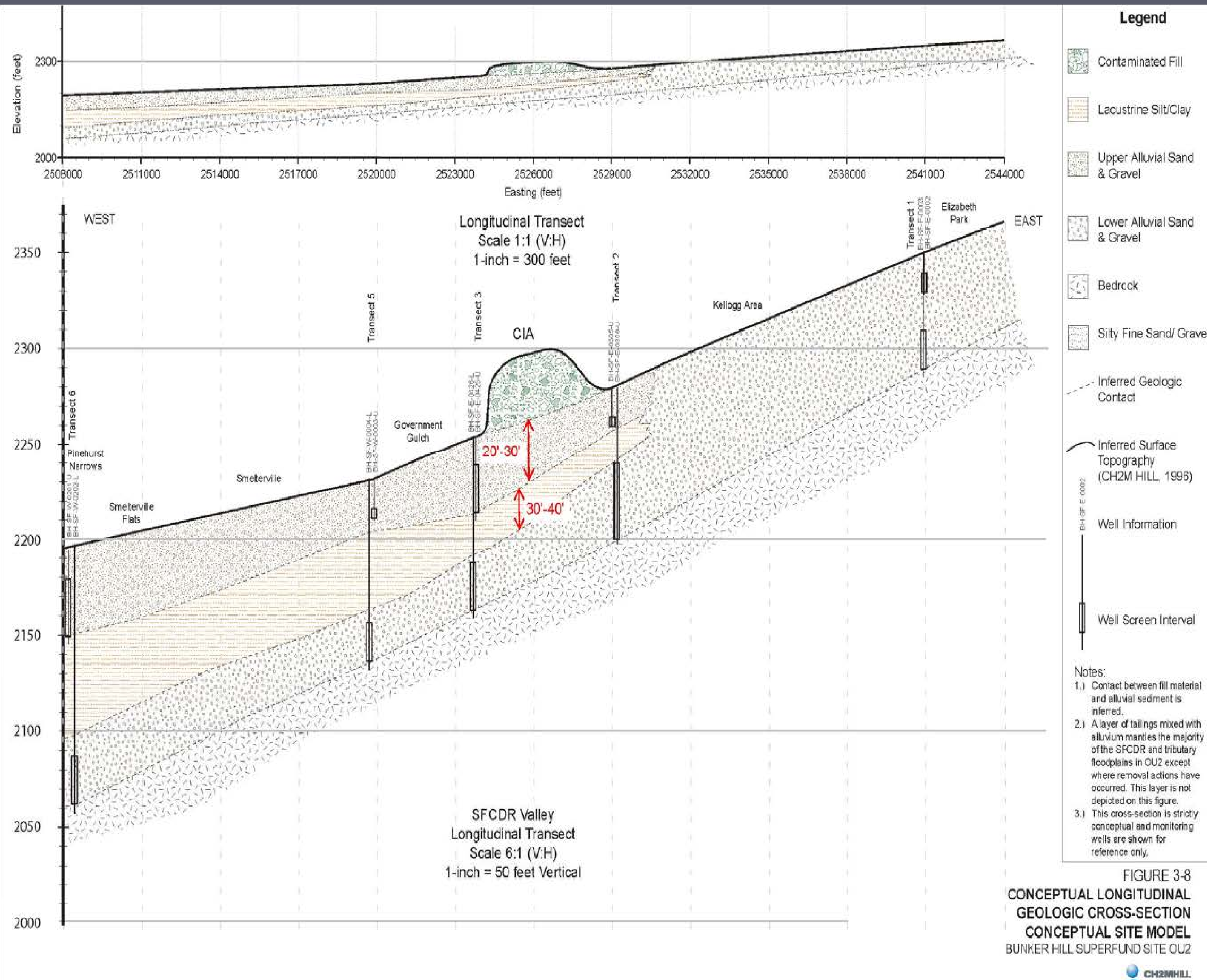


FIGURE 3-8
CONCEPTUAL LONGITUDINAL GEOLOGIC CROSS-SECTION
CONCEPTUAL SITE MODEL
BUNKER HILL SUPERFUND SITE OU2

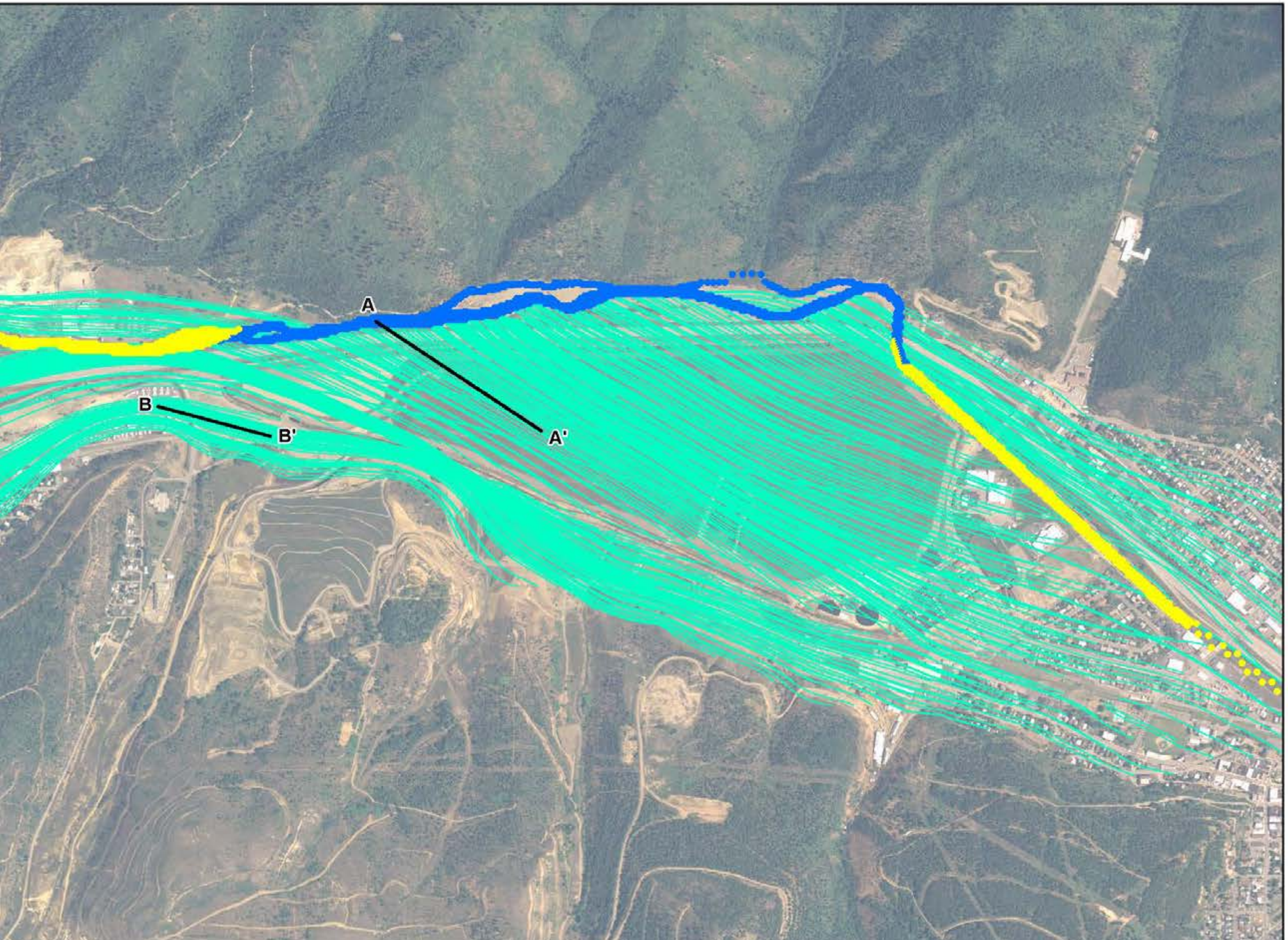


Figure 3-24
Simulated Upper Aquifer
Groundwater Flowpaths,
No Action Baseflow Cond
Draft CIA Groundwater Collectio
System – Design Definition Rep
BUNKER HILL SUPERFUND SI

CH2M

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


INTERSTATE ROUTE 90
MATCHLINE SEE 350-CP104
CIA
IDEQ PROPERTY AVAILABLE FOR STAGING AND WASTE STORAGE
SPA "WEDGE" WASTE STORAGE AREA
EXTRACTION WELL (TYP)
MONITORING WELL (LMW ****, TYP)
CONTROL WELL (LCW ****, TYP)
BEGIN COLLECTION HEADER STA 163+81
BEGIN CUTOFF WALL STA 15+00
BUNKER CREEK
EXISTING BIKE PATH
MCKINLEY AVE
Scale In Feet
0 150 300 450
THE INFORMATION ON THIS DRAWING SHOWS A GENERAL CONCEPT. THE USER IS RESPONSIBLE FOR THE CONFIRMATION, VERIFICATION, AND DUE DILIGENCE ON THE USE OF INFORMATION FROM THIS DRAWING INCLUDING ITS APPLICABILITY TO THE OVERALL PROJECT. ANY REPLICATION OR USE OF INFORMATION ON THE DRAWINGS IS AT THE SOLE RISK OF THE USER AND CONFERS NO LIABILITY TO CH2MHILL, EITHER EXPRESSED OR IMPLIED.
CH2MHILL.
CTP REMEDIAL DESIGN PROJECT
BUNKER HILL SUERFUND SITE
USEPA REGION 10
BUNKER HILL, SUPERFUND SITE, KELLOGG ID
CIA GROUNDWATER COLLECTION SYSTEM
EXTRACTION WELL PLAN EAST
DSGN B THOMPSON
DR J PRETS
CHK MW REIMBOLD
1"=150'
VERIFY SCALE
DATE JULY 2014
PROJ 382081
DWG 350-CP-103
CONCEPT DRAWING NOT FOR CONSTRUCTION
FILENAME: 350-CP103_382081.dgn
PLOT DATE: 7/11/2014
PLOT TIME: 10:31:33 AM

INTERSTATE ROUTE 90
Scale In Feet
0 150 300 450
EXTRACTION WELL (TYP)
CONTROL WELL (LCW ****, TYP)
END COLLECTION HEADER STA 217+46 END FORCE MAIN STA 51+48
MONITORING WELL (LMW ****, TYP)
END CUTOFF WALL STA 93+25
MATCHLINE SEE 350-CP103
THE INFORMATION ON THIS DRAWING SHOWS A GENERAL CONCEPT. THE USER IS RESPONSIBLE FOR THE CONFIRMATION, VERIFICATION, AND DUE DILIGENCE ON THE USE OF INFORMATION FROM THIS DRAWING INCLUDING ITS APPLICABILITY TO THE OVERALL PROJECT. ANY REPLICATION OR USE OF INFORMATION ON THE DRAWINGS IS AT THE SOLE RISK OF THE USER AND CONFERS NO LIABILITY TO CH2MHILL, EITHER EXPRESSED OR IMPLIED.
CIA
SLUDGE POND
BUNKER CREEK
EXISTING BIKE PATH
BUNKER AVE
WILDCAT WAY
VANDALS CT
CH2MHILL.
CIA GROUNDWATER COLLECTION SYSTEM
EXTRACTION WELL PLAN WEST
CTP REMEDIAL DESIGN PROJECT
BUNKER HILL SUERFUND SITE
USEPA REGION 10
BUNKER HILL, SUPERFUND SITE, KELLOGG ID
NO. DATE REVISION BY APVD
DSGN B THOMPSON DR J PRETS CHK MW REIMBOLD APVD
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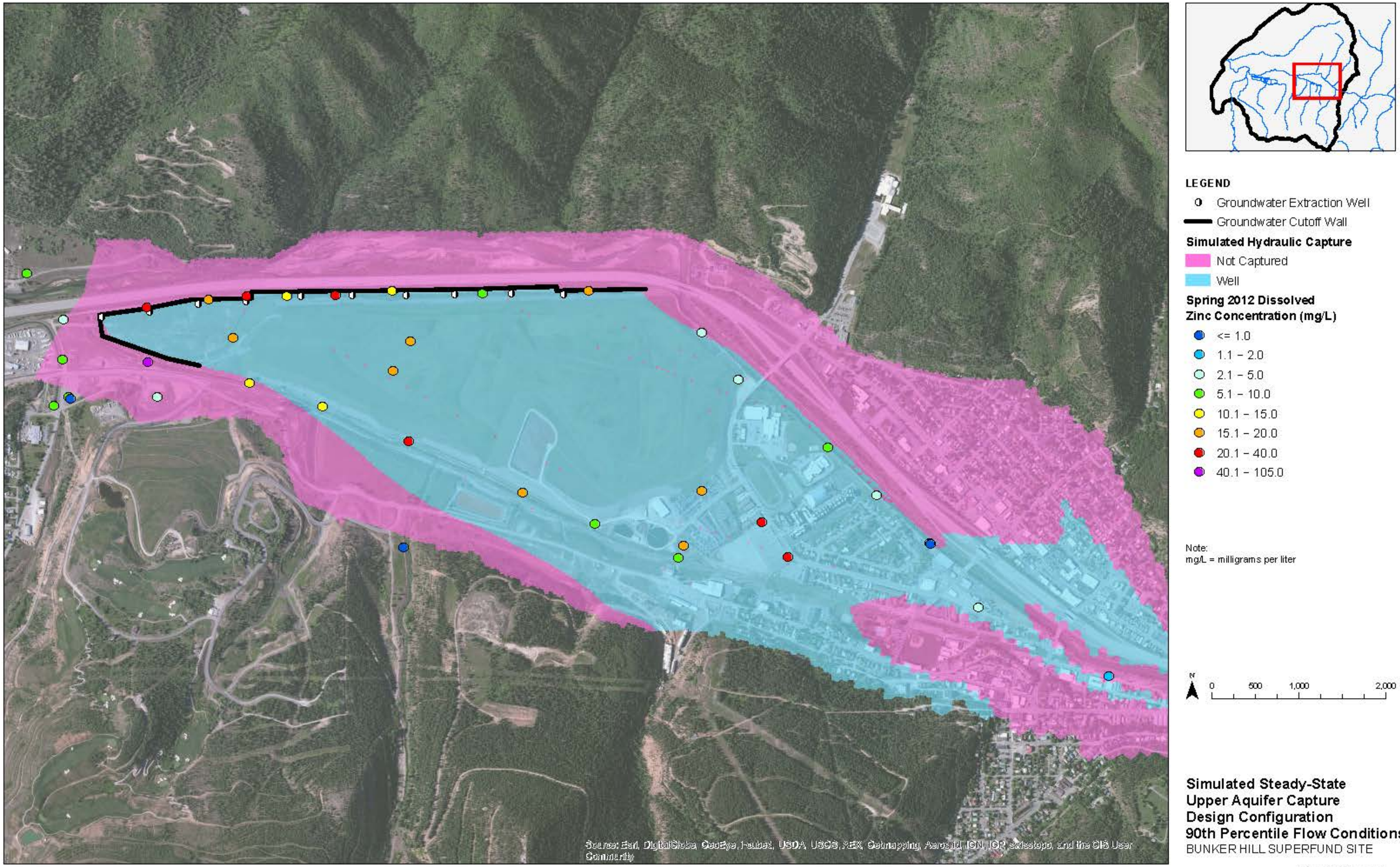
1"=150'
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
DATE JULY 2014
PROJ 382081
DWG 350-CP-104
SHEET
CONCEPT DRAWING NOT FOR CONSTRUCTION
FILENAME: 350-CP104_382081.dgn PLOT DATE: 7/11/2014 PLOT TIME: 10:31:25 AM

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



Simulated Steady-State
Upper Aquifer Capture
Design Configuration
90th Percentile Flow Conditions
BUNKER HILL SUPERFUND SITE

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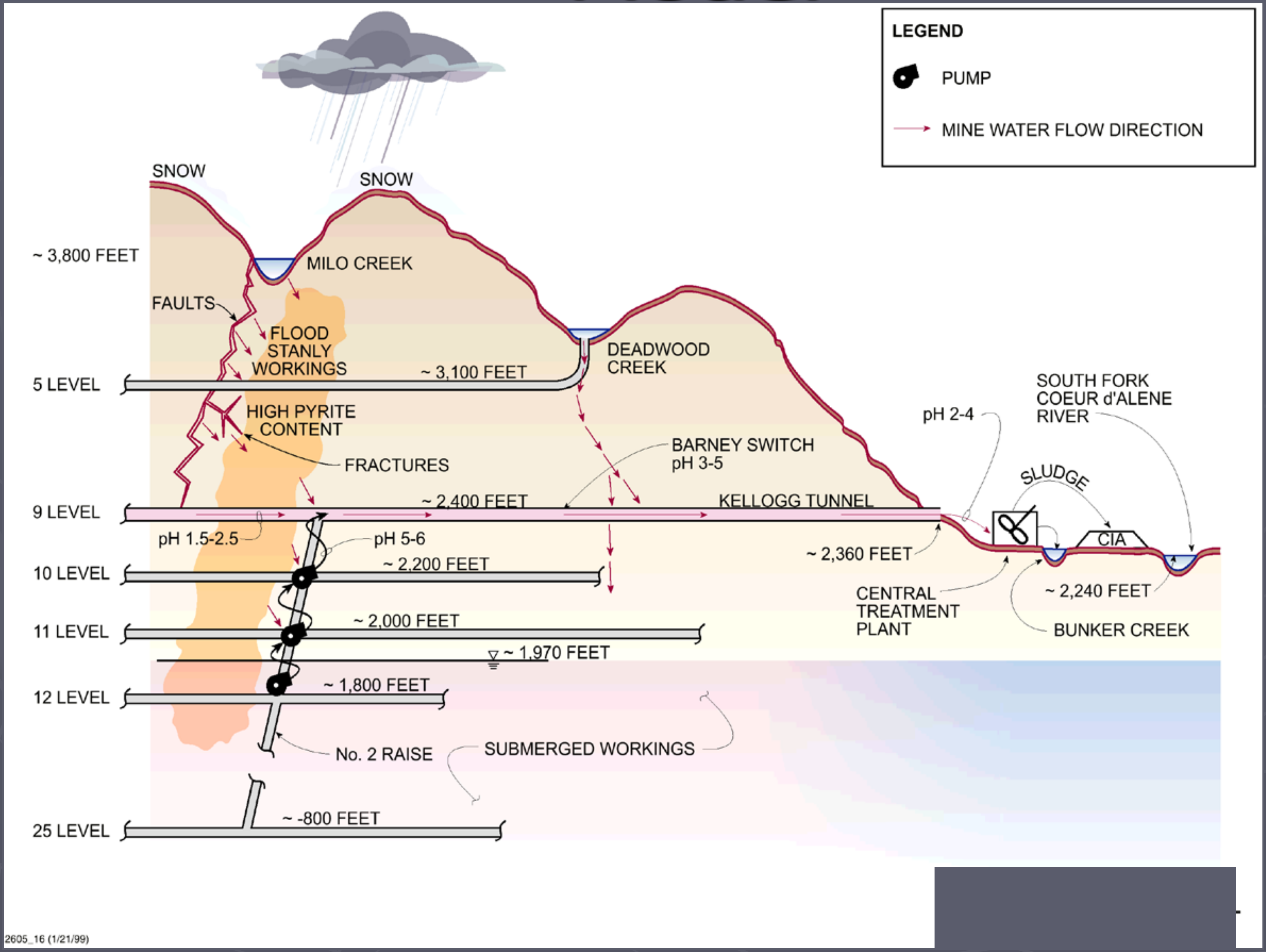
CH2MHILL.

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

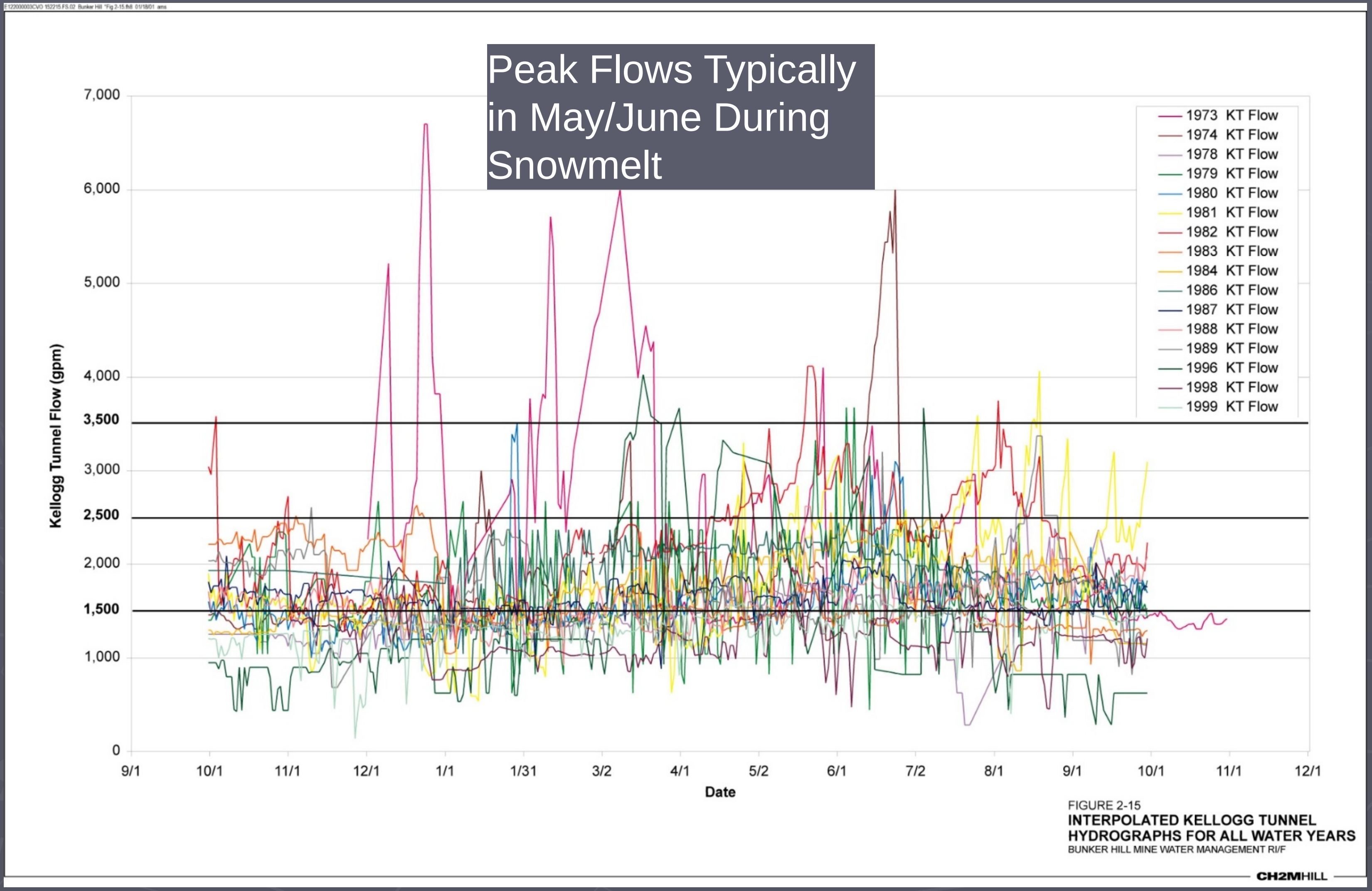
Generalized Mine Water Flow Model

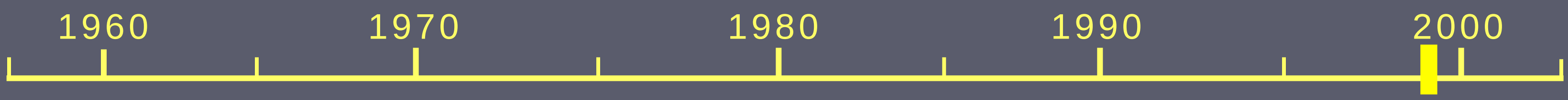


The AMD Problem

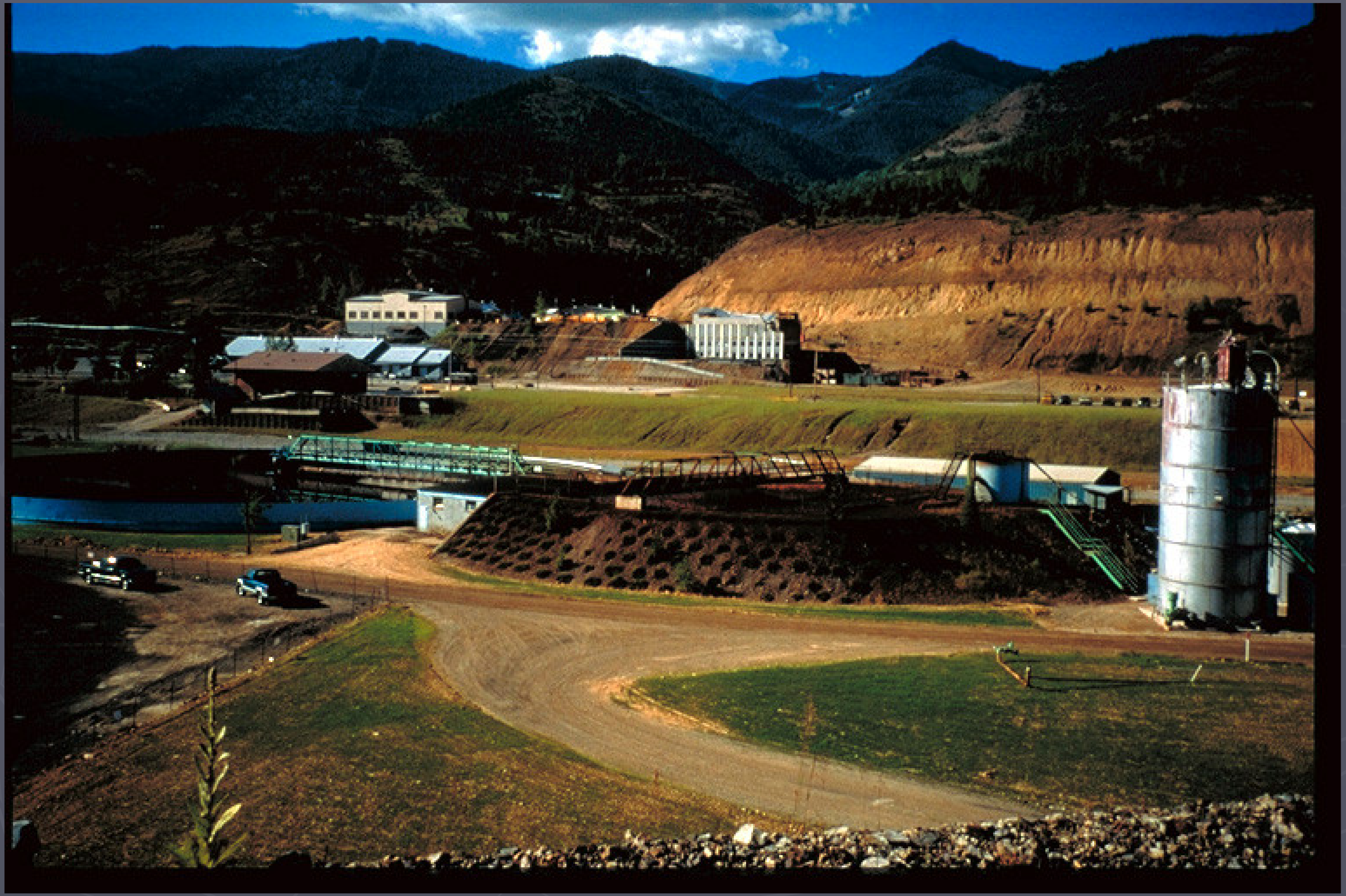
Flow:	800 - 6,700 gpm
pH:	2.0 - 4.0
Cadmium:	0.4 - 2.5 mg/L
Lead:	0.8 - 3.0 mg/L
Zinc:	200 - 1,400 mg/L
Iron:	80 - 900 mg/L
Manganese:	30 - 230 mg/L
Lime Demand:	4 - 40 lb/1000 gal
Solids Formed:	4 - 40 lb/1000 gal

Historical Mine Water Flow Rates



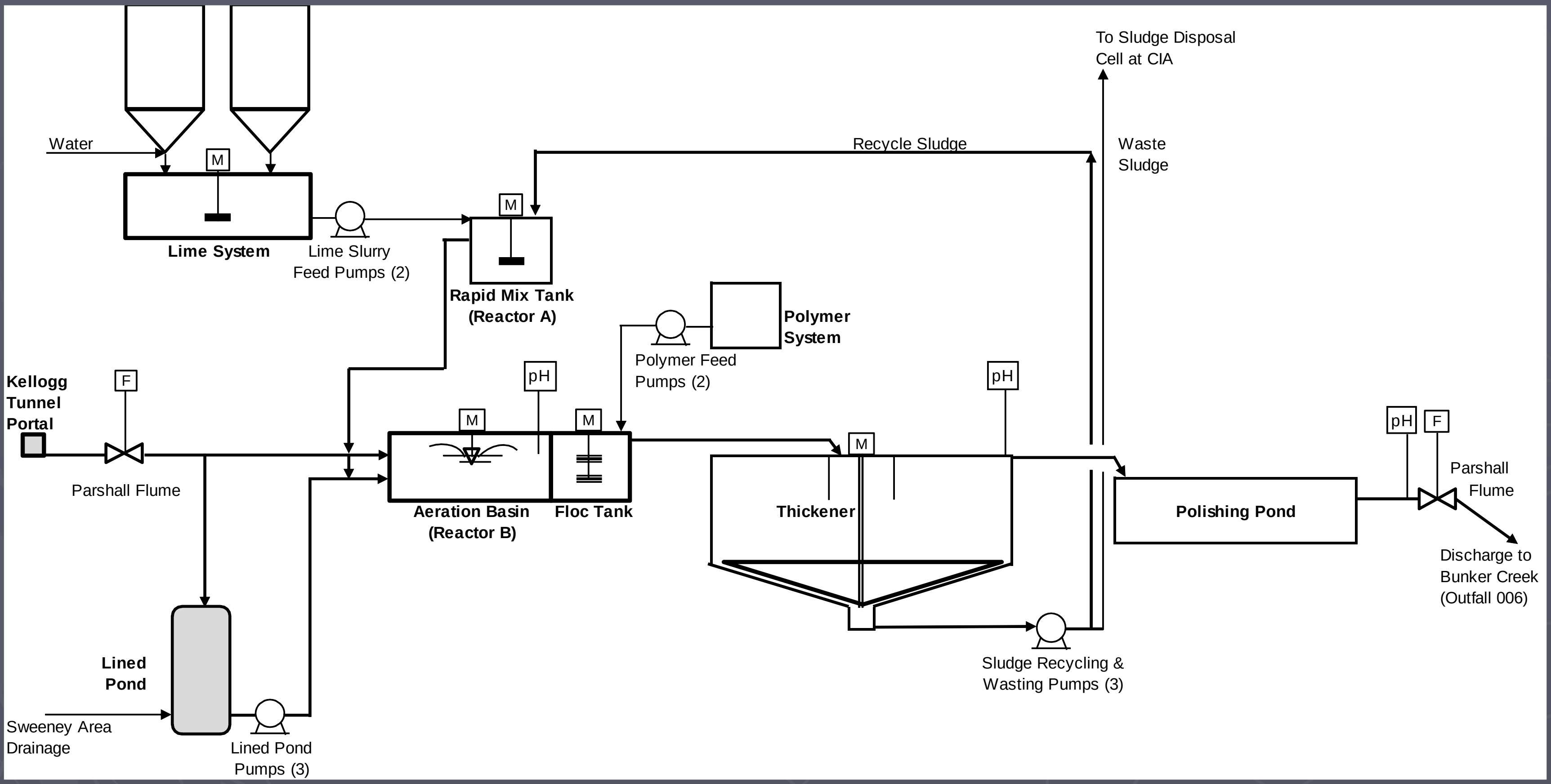


Central Treatment Plant as it appeared in 1999



Existing CTP and Related Systems Overview

CTP Existing Process Schematic



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

CTP Effluent Performance Requirements

TABLE 4-3
Current and Expected Future CTP Effluent Limits (not considering a mixing zone allowance) [a]

Parameter	Units	Current Limits [b]		Expected Future Limits [c]	
		Daily Maximum	Daily Average	Daily Maximum	Monthly Average
Aluminum	µg/L	--	--	143	71.2
Arsenic	µg/L	--	--	101	50
Cadmium	µg/L	100	50	5.6	2.8
Copper	µg/L	300	150	63.5	31.7
Iron	µg/L	--	--	1,643	819
Lead	µg/L	600	300	171	85.2
Mercury	µg/L	2	1	0.020	0.010
Selenium	µg/L	--	--	8.2	4.1
Silver	µg/L	--	--	43.9	21.9
Thallium	µg/L	--	--	0.94	0.47
Zinc	µg/L	1,480	730	489	244
pH	std units	6.0 to 10.0		6.5 to 9.0	
TSS	mg/L	30	20	30	20
Dissolved Oxygen	mg/L	--	--	> 6	
Temperature	°C	--	--	≤22	≤19
Whole Effluent Toxicity	TUc	--	--	≤1.0	

Notes:
[a] Future limits, including a mixing zone, are currently being reevaluated (see Appendix E), so values for expected future limits could change.
[b] Metals limits are as total metal. Monitoring of copper and mercury is not required by the existing (expired) NPDES permit.
[c] All metals are expressed in terms of total recoverable metal except for mercury, which is in terms of total metal.
Sources: Current limits – CH2M HILL, 2002 (from NPDES Permit No. ID 000007-8, expired October 1991); expected future limits – CH2M HILL, 2007.

°C	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?