Molycorp Assessment
Summary of efforts

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Where we have been

- Reasonable worse case scenario approach to cooperative assessment
- Habitat (resource) equivalency Restoration analysis approach
- First focus on debit side
  - Surface water
  - Terrestrial
  - Groundwater
- Next focus on restoration options

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Surface Water

Service losses to be assigned based on biological approach

- **Not strongly sensitive to species endpoint**

Based on "wedge" approach

Overview of Approach to Service Loss

- Based on May 11, 2004 meeting with Molycorp Tech Representatives
- Developed a tiered approach to estimate service loss
  - First – Evaluate biological (resident trout, invertebrates) data
  - Second – Evaluate toxicity data to confirm biology
  - If toxicity suggest greater impacts than biology, average biology and toxicity service loss
  - No explicit agreements re “combining” trout, invertebrates

Overview of Approach to Service Loss (cont'd)

Agreed-upon conceptual model:

- **Hansen Cr./scar influences degrade river**
- **Absent mine contributions, recovery should begin at Columbine Cr.**
- **Evaluate service loss as integrated difference in current conditions v. assumed recovery trajectory downstream of Hansen Cr. (AKA, the "wedge")**

Technical Approach

- **"Primary" service loss calculation based on biological data**
  - **Resident trout population density**
  - **Invertebrate density (all taxa); other invertebrate metrics?**
- **Consider water chemistry as "check" on biological approach: "joint toxicity approach"**
- **How to calculate service loss?**
  - **The "wedge"**
- **Calculating service loss**
  - ***Percent* population reduction = % service loss**
  - ***Difference* in toxicity = % service loss**
  - **Calculated as differential in area under curves**

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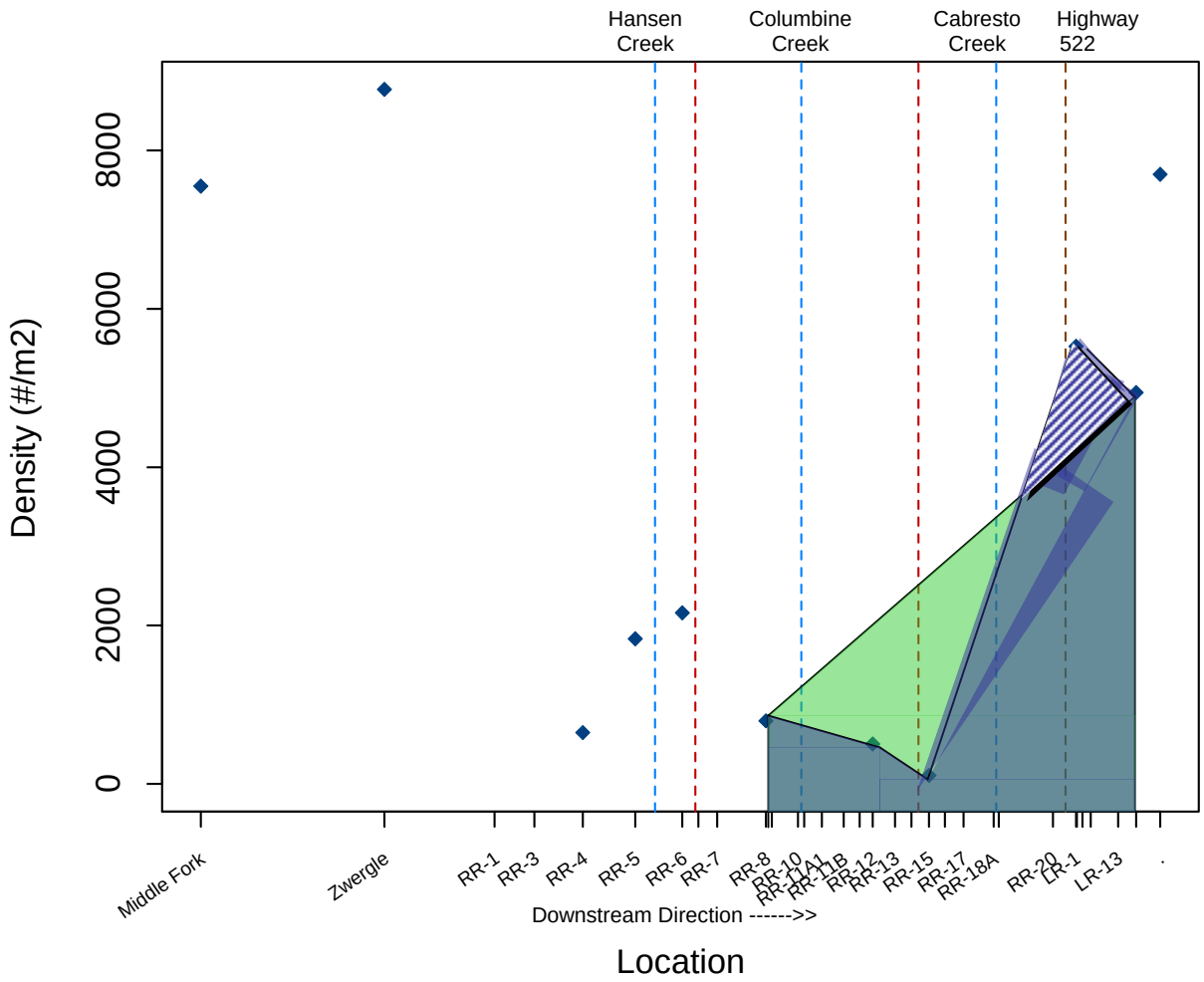
Invertebrate Density (#/m2) in spring of 2002



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Surface Water Summary

Service losses to be assigned based on biological approach

- **Not strongly sensitive to species endpoint**

Magnitude of service loss dependent on:

- **Analytical approach**
  - **Ranges from approx. 35% - 75% service loss**
  - **"midpoint" = approx. 50% service loss?**
- **Assumption re pre-1997 conditions**
  - **Constant model in absence of data?**
    - Conservative
    - May enable selection of less "conservative" service loss value?

Implications for HEA

Assumptions for HEA calculations:

- River never recovers
- Constant injury loss between 1981 and 2010
- Restoration begins in 2010
- Restoration fully functional in 5 years

Two alternative scenarios of length of river impacts evaluated: 6.47 or 9.21 river miles.

Each alternative evaluated for a range of percent service losses and gains

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Preliminary HEA results

Scenario 1

6.47 river miles injured

Percent Service Gain	Percent Service Loss: 35%	50%	75%
25%	14.25	20.25	30.5
50%	7	10	15.25
75%	4.75	6.75	10

Scenario 2

9.21 river miles injured

Percent Service Gain	Percent Service Loss: 35%	50%	75%
25%	20.25	29	69.7
50%	*16.28*	*23.26*	*34.9*
75%	6.75	9.75	14.5

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Terrestrial Data Included in Analysis

Soil metals concentrations from mine, tailings, and riparian areas from Molycorp database

- **Excluding scars, industrial dev't, roads**
- **Including riparian tailings spill data, all surface soils data in the database**

Vegetation metals data

- **Used to calculate BAFs**

Metals Driving Service Loss

- **Initial screening of 10 metals, comparing soil concentrations to toxicological endpoints**
  - **B, Cd, Cr, Co, Cu, Pb, Mn, Mo, V, Zn**
- **Mo exceeded toxicity thresholds by far more than other metals**
  - **Pb is also a driver of service loss at certain areas within the mine**

Soil [Mo] → Service Loss

RBSL = 2 mg/kg

0% SL below 63 mg/kg

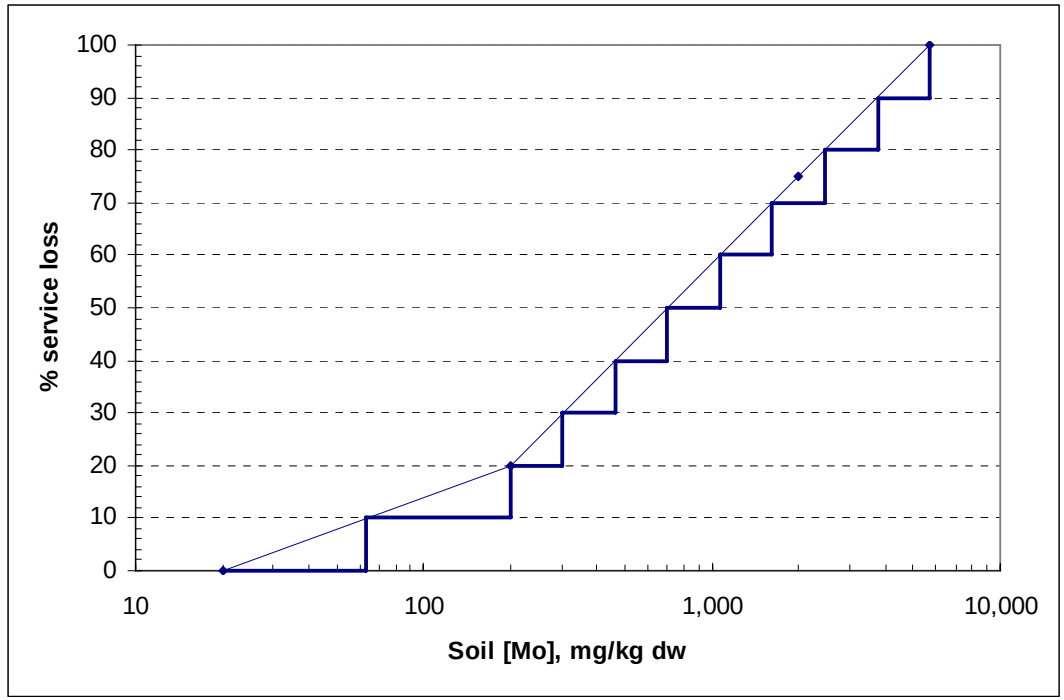
20% SL at 200 mg/kg

50% SL at 700 mg/kg

100% SL at >5700 mg/kg

Partitioned soil concentrations into SL bins

Using these thresholds, there are no service losses in the reference areas



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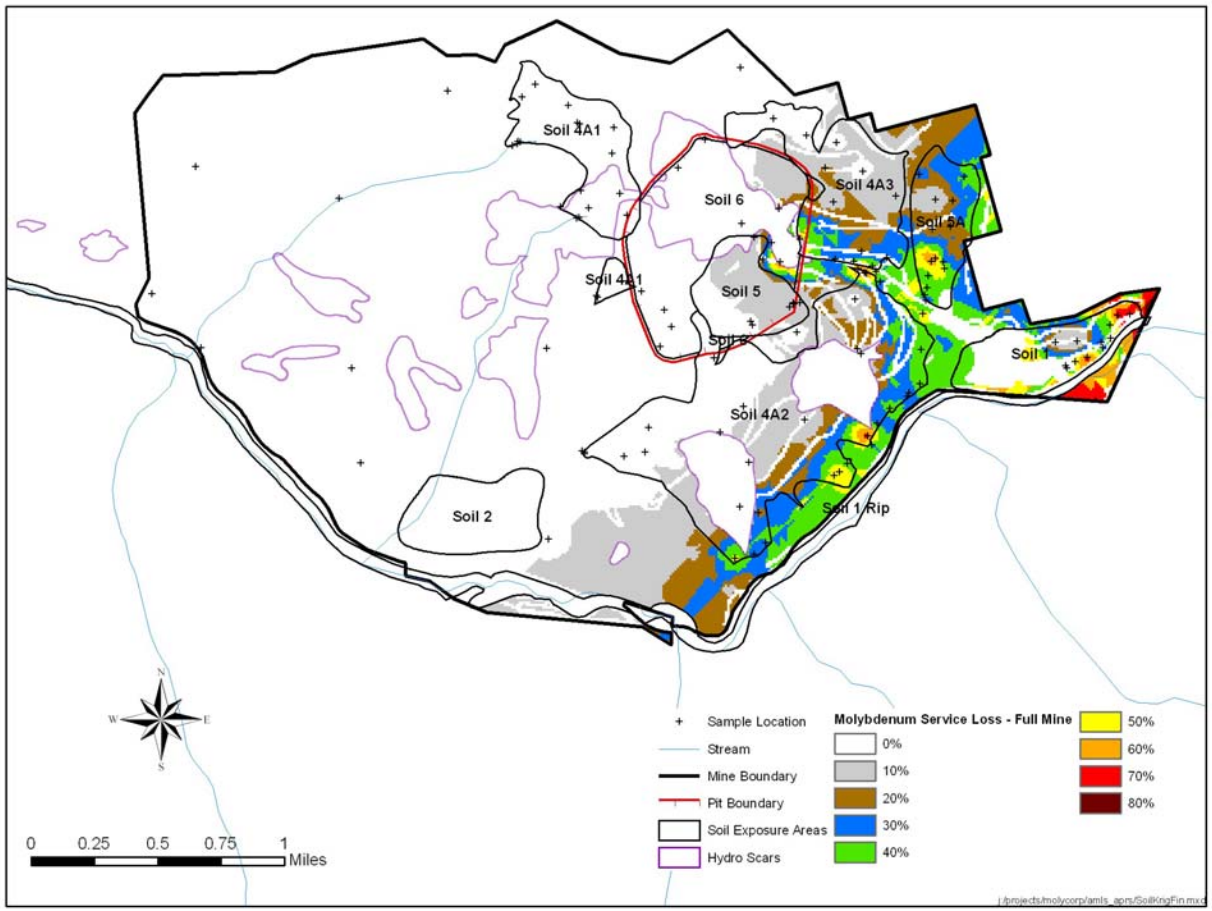
Mo & Pb Areal Coverage at Mine

Kriging used to estimate areal distribution of metals in soils

- **Excluded SS2, SS7, SS8, roads, scars**
- **Excluded mill site, but included habitat areas within SS1**
- **Low estimate = excludes western side of the mine not included in soil polygons**
- **High estimate = includes all areas within the mine site boundary, except the exclusions listed above**

Mine SL: Mo, entire site



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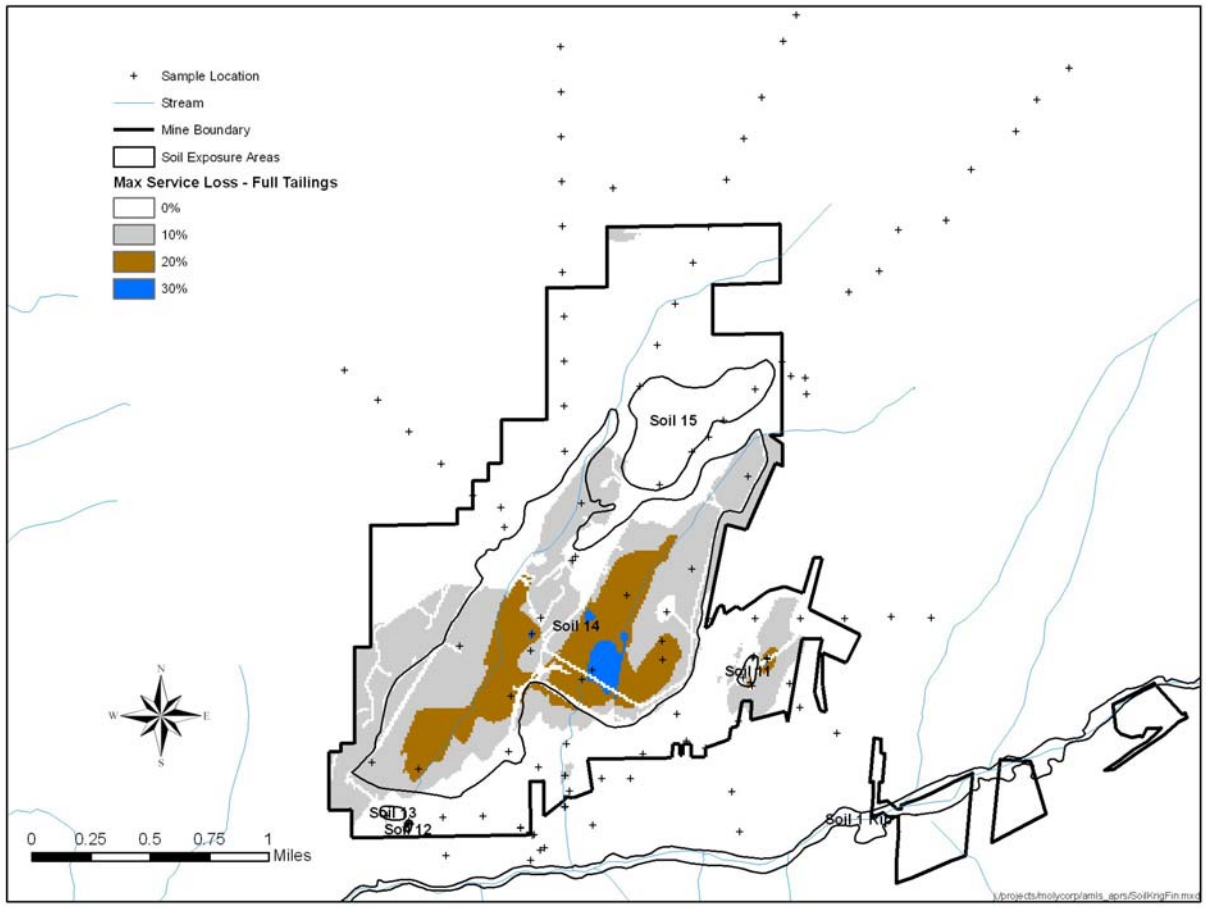
Tailings SL: Mo, Entire Tailings Area



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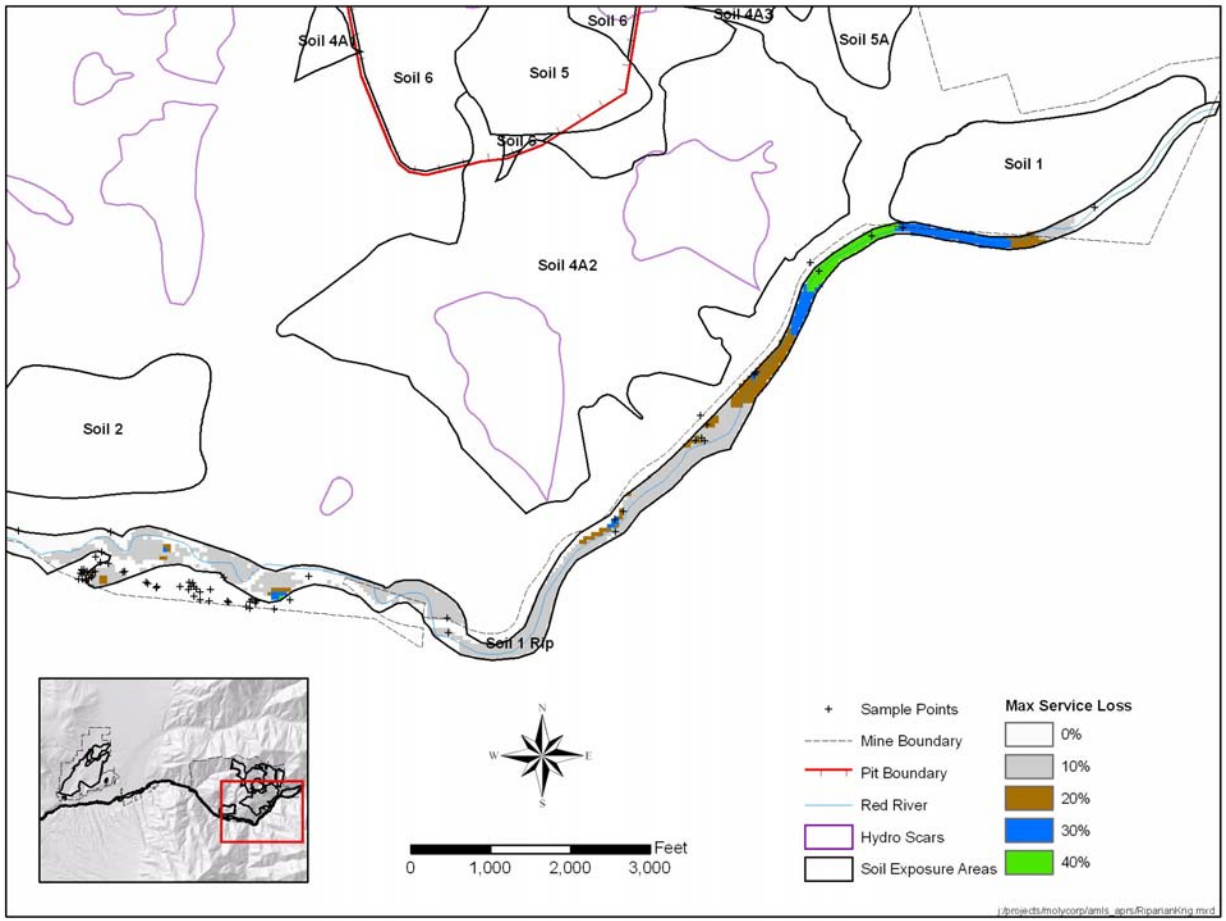
Areal Coverage of Mo: Riparian

IDW used to estimate areal extent of Mo concentrations in the riparian area

- **Included all soils data from within the riparian (not based on exposure area)**
- **Included only areal coverage in riparian soils polygon (URS' GIS) for injury quantification**
- **Low estimate = uses all soil samples in the IDW analysis**
- **High estimate = uses $[Mo]_{max}$ where there are multiple samples in one location**

Riparian SL: Mo, Upper Reach



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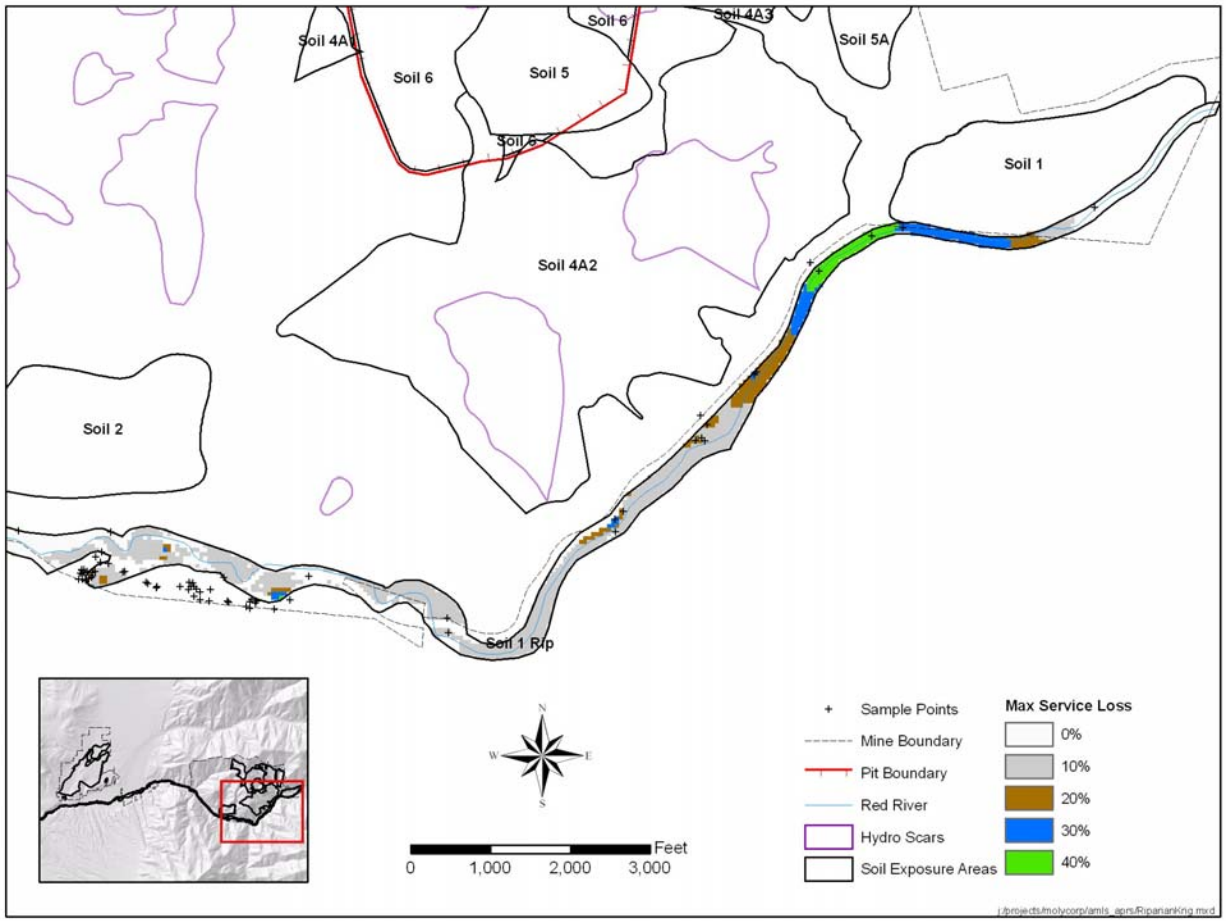
Riparian SL: Mo, Upper Reach



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HEA Debit Parameters

Units = discounted riparian service acre-years

- **Tailings and mine habitats converted to "riparian equivalents"**
  - **1 Tailings acre = 0.2 Riparian acres**
  - **1 Mine Site acre = 0.02 Riparian acres**

Discount rate = 3%

Levels of service loss remain constant through 2100

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HEA Debit Parameters (con't)

- **Assumes riparian Mo concentrations have been constant since 1980**
  - **i.e., 100% of pipeline spills had already occurred and most of the tailings were scoured out by 1980, leaving only the existing residues.**
- **Assumes tailings areal coverage has not changed since 1980**
  - **1982 and 2001 tailings pond maps appear to be identical**

HEA Debit (DRSAYs)

	Service Loss Acres		Riparian Scale Factor	Riparian Service Loss Acres	
	Low	High	Riparian Equiv wgt	Adj Low	Adj High
Tailings	50	100	0.2	10	20
Mine	170	220	0.02	3.4	4.4
Riparian	10	20	1	10	20
			Total:	**23.4**	**44.4**
			Discounted Riparian Service Acre Years (1981 - 2100)		
			Total:	**1,586**	**3,010**

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Groundwater Injury

Tailings Impoundment Area

Mine Site Area

Evaluate:

Groundwater Volume

Groundwater Flux

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Calculations

Volume = surface area of plume x depth x effective porosity

Flux = hydraulic conductivity x gradient x thickness x width of plume

Tailings Area Groundwater Injury Quantification- Method

- Focus on sulfate
- Focus on upper alluvium (basal aquifer potentially contaminated but data insufficient to draw contours)
- Focus on groundwater downgradient of tailings impoundments only (not beneath)
- Determine spatial area where groundwater sulfate concentrations exceed 600 mg/L (using existing well data)

Tailings Impoundment Area Calculations - Volume

Volume = surface area of plume x depth x effective porosity

Volume = 236 acres x 60 ft x 0.25

Volume = 3,540 acre-ft

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Tailings Impoundment Area Calculations - Flux

Flux = hydraulic conductivity x gradient x thickness x width of plume

= 15.7 ft/day x 0.14 ft/ft x 60 ft x 4000 ft

= 6.1 ft^3/sec

= 4,420 acre-ft/yr

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Mine Site Groundwater Injury Quantification- Method

Focus on sulfate

Focus on Red River alluvium

- **Mine site bedrock analysis outstanding**
  - **Bedrock contamination pre/post pumping**

Determine spatial area where groundwater sulfate concentrations exceed 600 mg/L (using existing well data)

Compare to reference area Red River Alluvium concentrations

Evaluate effects of pumping

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Mine Site Alluvium Calculations - Volume

Volume = surface area of plume x depth x effective porosity

Volume = 113 acres x 75 ft x 0.25

Volume = 2,100 acre-ft

Mine Site Alluvium Calculations Flux

Flux = hydraulic conductivity x gradient x thickness x width of plume

= 800 ft/day x 0.02 ft/ft x 75 ft x 226 ft

= 271,200 ft3/day

= 3 ft^3/sec

= 2,300 acre-ft/yr

Consistent with Vail 2000 = 6-7 ft3/sec (4,300-5,000 acre-ft/yr) through entire alluvial section at Mill Area and Columbine Park

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Effects of Pumping on Alluvial Aquifer

- Mine water supply wells in the alluvial aquifer include: Mill 1 and 1A, Columbine Nos. 1 and 2, GWW-1, GWW-2, GWW-3, Spring 13 and 39 pumps.
- In recent years majority of pumping comes from mill wells (pumped during mill runs).
- Columbine Nos. 1 and 2 also significant source (also during mill runs)

Effects of Pumping on Alluvial Aquifer – Mill Area

- Largest effect on alluvial aquifer is in mill area observation wells (MMW-43A, MMW-28A, MMW-17A)
- This area is upstream of the sulfate plume

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Effects of Pumping on Alluvial Aquifer – Other Areas

Some effect (drawdown) on the aquifer is observed

Comparison of groundwater elevation data to pumping data indicates

- Influence is localized
- Elevation data following heavy pumping falls near average

Not possible to determine make-up of pumped water

- Combination of contaminated alluvium, clean alluvium, river water

Aquifer is recharged downstream of pumping

Groundwater Summary

Tailings Alluvium

- Volume = 3,540 af
- Flux = 4,420 af/y

Mine Site – Red River Alluvium

- Volume = 2,100 af
- Flux = 2,300 af/y

Total - Alluvium

- Volume = 5,640 af
- Flux = 6,720 af/y
- Mine site bedrock = TBD

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All Resource Summary

Surface Water -	**10 – 15 river miles of 50% improvement**
Terrestrial –	**50 – 100 acres of 50% riparian improvement**
Groundwater -	**Volume = 5,640 af**
	Flux = 6,720 af/y

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Restoration

Review of potential restoration options

Site Visit Summary

Outstanding issues

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Restoration Options

Riverine

Terrestrial

Groundwater

Recreation

Project No.	Project Title	Surface Water	Terrestrial	Groundwater	recreation
Habitat Improvements to ponds and lakes					
6	Hunts pond improvements	1	1		1
8	Eagle Rock Lake habitat improvements	1			1
12	Construction of second pond at Eagle Rock lake	1			1
13	Establishment of permanent water right at Eagle Rock lake	1			
17	Goathill Pond - Diversion and constructed wetland	1	1	1	1
18	Columbine Park Pond Complex - Gravel Pit Lake development	1			
22	Potato Patch Spring Pond - Diversion, Constructed wetland, day-use facilities upgrade, access bridge	1			1
27	Fawn Lakes -- habitat improvements		1		
46	Cabresto Park Pond Complex - Lake development	1	1		1
61	Shuree Ponds spillway repair	1			1
Riparian habitat improvements					
4	Riparian corridor improvements in Questa	1	1		
15	Mainstem Red River Embeddedness Treatment/Study	1			
23	Riparian habitat enhancement near Fawn Lakes	1	1		
33	Rio Costilla Riparian Habitat Improvement	1	1		
31	Red River habitat improvements in the town of Red River	1	1		
Projects to benefit surface water quality for streams and rivers					
14	Service Road Reconstruction	1			
32	Mitigation of off-road vehicle impacts to the watershed	1	1		
39	Creek	1			
40	Obliterate Road and Return to Natural Contours -- Gold Creek	1			
41	Stream Crossing #1 – Comanche Creek	1			
42	Stream Crossing #2 – Comanche Creek	1			
43	Stream Crossing #3 – Comanche Creek	1			
44	Stream Crossing #4 – Comanche Creek	1			
45	Stream Crossing #5 – North Ponil Creek.	1			
47	General Road improvements in the watershed (relocation away from stream, culvert replacement/modification), etc.	1	1		
48	Bitter Creek Drainage Improvements	1			
49	Construction of acid drainage capture systems for natural scars draining to the Red River	1			
64	Cebolla Mesa trail improvement	1			1

Project No.	Project Title	Surface Water	Terrestrial	Groundwater	recreation
Projects to benefit surface water habitat and biota for streams and rivers					
34	Rio Costilla Instream Habitat Improvement				
38	Fish Habitat Enhancement, Large Boulder Placement	1			
36	Protect Rio Grande cutthroat trout	1			
37	Restore Rio Grande cutthroat trout	1			
2	Red River Fish Ladder	1			
Projects to conserve water use					
58	Development of Water Conservation Ordinances	1		1	
5	Irrigation diversion upgrade in Questa	1		1	
35	McCrystal creek headgate	1			
63	Rio Grande box recreational facilities	1			1
Projects to improve or protect terrestrial or wetland habitat					
24	Alluvial fan habitat enhancement on south side of Red River		1		
59	Sunshine Canyon wetland restoration	1	1		
62	Improve winter range for bighorn sheep		1		
70	Land acquisition of LaBelle property		1		
Projects to benefit groundwater quality (WWTP and septic improvements)					
53	Questa WWTP Replacement/ Improvement			1	
54	Questa WWTP Monitoring well replacement			1	
55	Red River WWTP sludge-drying basin lining			1	
56	Red River underground storage tank remediation			1	
57	Septic system concerns in Red River Watershed	1		1	
69	Septic system concerns in Lama or San Cristobal			1	
Projects to develop or improve groundwater resources for human use					
51	Public education about beavers and restoration	1	1	1	1
60	Construction of small retention dams for groundwater storage	1		1	
65	Clower Spring water quality improvement			1	
66	Clower Spring water users well development			1	
67	Lama domestic water supply augmentation			1	
68	San Cristobal groundwater development			1	
Projects primarily related to recreation or tourism					
52	Funding for promotion of outdoor activity related tourism				1
29	Fawn Lakes -- recreation enhancement				1
30	Upper Fawn Lake --- Recreation enhancements				1
11	Eagle Rock Lake recreational improvements				1
3	Additional Hatchery Pipeline	1			1

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Outstanding Restoration Issues

- Project Issues
  - Anderson Ranch
  - Groundwater options
- Scaling
  - Combination of projects
    - e.g. river restoration and riparian
  - Habitat trade-offs