SOIL AND VEGETATION SAMPLING OF IRRIGATED MEADOWS IN THE UPPER ARKANSAS RIVER VALLEY[1]

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Abstract. The California Gulch site (Site) in Leadville, Colorado, is a historic mining site located in the northern half of the upper Arkansas River valley in the Southern Rocky Mountains, approximately 100 miles southwest of Denver, Colorado. Mine waste has impacted soil and surface water in and around California Gulch and downstream to the Arkansas River and adjacent irrigated and riparian lands. The USEPA placed the Site on the National Priorities List (NPL) in 1983 to initiate clean-up of mine wastes contributing to contamination of the Arkansas River watershed. Remedial action in, and around the town of Leadville and California Gulch continues to date, but little work in either assessment, or remedial action has taken place in impacted flood plain soils along an 11 mile stretch along the upper Arkansas River downstream of the confluence with California Gulch. This 11-mile reach was the focus of this investigation. Significant portions of the 11-mile reach have been, and continue to be, used by private landowners for hay production and livestock grazing. Irrigation water for these areas has largely come from the Arkansas River and thus the soils have become contaminated from contamination in the river water. Previous investigations about the health of the riparian plant community have led to the following conclusions: 1) Zinc induced iron deficiency/chlorosis has been reported; 2) Plant tissue concentrations of zinc exceed literature threshold concentrations for healthy vegetation; 3) Existing data are inadequate to determine the spatial extent of potential zinc toxicity to vegetation; 4) No quantitative analytical data were available for vegetation in lower reaches. The current investigation proceeded in two phases: 1) the objective of Phase I was to characterize the nature and extent of metal contamination, pH and total organic matter in riparian soils outside of visible fluvial tailings deposits, and in upland meadows; 2). Phase II stations were then selected to bracket a range of metals concentration, soil pH and organic carbon, allowing the development of site-specific exposure-response relationship(s). Phase I sample locations were placed on a triangular grid over the defined study area. One hundred twenty unbiased stations were placed on grid nodes, and nine biased samples were placed

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manually to fill in small features that did not contain grid nodes. Phase 1 results demonstrated a wide range of metals concentrations concurrently with high variations in pH and total organic carbon. Twenty stations were selected to bracket the Phase I soil parameters and additional Phase II analyses were undertaken: 1) metals concentration in soils and plants; 2) plant available metals in soils; 3) phytotoxicity studies with alfalfa, wheat grass and yarrow; 4) vegetation demographics. Positive correlations with phytotoxicity, bulk metals; plant available metals; and bioaccumulation of metals in the plants were demonstrated. These relationships were then extrapolated to the entire 11-mile reach to identify areas of decreased productivity of the vegetative community in the flood plain.

Additional Key Words: Plant, Metals, Soil, Toxicity, and Bioavailability