Department of Energy, Office of Legacy Management
Monticello Mill Tailings Site Operable Unit III (MMTS OU III)

Summary of Program Directive #: MSG-04-01

Subject: Post-Record of Decision biomonitoring – collect baseline sediment and surface water samples from wetland areas for evaluating ecological risk from sediment accumulation.

Directive/Task Changes: Attachment A to Program Directive MSG-04-01 specifies the plan for the collection and laboratory analysis of sediment samples and surface water samples that will establish baseline concentrations of selenium in the constructed wetlands on the Millsite and in the sediment retention pond constructed on Montezuma Creek approximately one mile east of the Millsite.

Affected Program Documents: Monticello Mill Tailings Operable Unit III Post-Record of Decision Monitoring Plan

Justification: Selenium concentration data collected under Program Directive MNT-04-01 will support the biomonitoring task as required by the ROD of OU III, signed June 2004.

Effective Date: October 1, 2004

Expiration Date: September 30, 2005

Attachment A

Monticello Mill Tailings Site Operable Unit (OU) III Post-Record of Decision Biomonitoring: Sampling and Analysis Plan for Baseline Sediment and Surface Water in Constructed Wetlands and Pond

I. Purpose

Sediment and surface water sampling will be conducted in accordance with the specifications provided in this plan in order to establish baseline concentrations of selenium in the constructed wetlands on the Millsite and in the sediment retention pond constructed on Montezuma Creek approximately one-mile east of the Millsite. The location of the wetlands and sediment pond are depicted in Figure 1.

Sediment and surface water sample collection under this Program Directive (MSG-04-01) will occur in October 2004 as the first phase of post-Record of Decision (ROD) biomonitoring activities for OU III. The ROD for OU III, signed in June 2004, specified DOE to conduct biomonitoring in order to evaluate the effects on biological receptors to recent increases in selenium concentrations in ground water and surface water in OU III. The conceptual design and complete work-scope of the biomonitoring task, to be implemented in phases as new information is acquired, is presented in *Monticello Mill Tailings Site Operable Unit III Post-ROD Monitoring Plan, August 2004* (Monitoring Plan). Separate Program Directives will be prepared to address other scheduled biomonitoring tasks, including follow-up sediment and surface water sampling in October 2005 and 2006, a wildlife survey in spring 2005, and the collection of benthic macro-invertebrates from the wetlands and pond in 2005.

II. Summary of Selenium Contamination at OU III

Selenium concentrations in surface water and ground water were observed to increase significantly by April 1999 at many OU III monitoring locations while remediation of contaminated mill tailings, soil, and sediment on the Millsite was underway. The localized effect on ground water encompasses the eastern-most portion of the Millsite and a short distance downgradient, where selenium concentrations now range between about 50 and 80 micrograms per liter (μg/L), or 10-times greater than before the Millsite was remediated. Prior to those remedial actions, which began in June 1997, selenium concentrations in Montezuma Creek downstream of the Millsite averaged approximately 2.7 μg/L, with maximum concentrations occasionally approaching 20 μg/L, and did not pose significant risk to human health or ecological receptors. Since that time, the average concentration of selenium in the downstream reach has increased to about 7 μg/L raising concern regarding potential ecological risk. Background concentrations persist on the western half of the Millsite and farther upstream.

Figure 2 illustrates the extent of selenium contamination in surface water and ground water in October 2003. Figure 3 provides a reference map identifying the October 2003 monitoring locations. Recent maximum concentrations of selenium (up to about 125 μg/L) are associated with a ground water seep (Seep 2) that discharges to Wetland 3 along its north bank and to a second seep at the northeast corner of the Millsite (Seep 3). (Seep 2 was dry in October 2003 and is not shown in Figure 2). It is the local discharge of selenium-contaminated ground water to Wetland 3, and to Montezuma Creek on the east half of the Millsite that accounts for elevated selenium at the remaining affected surface water locations. The recently-developed selenium ground water plume has migrated a short distance off-site. No other site-related contaminants accompanied the apparent release of selenium to surface water or ground water.

The recent concentration increases are attributed to the mobilization of naturally occurring selenium abundant in Cretaceous marine shale that is common to OU III. Millsite remediation resulted in fresh exposures of such deposits in most of the eastern half of the Millsite, over which the alluvial aquifer was subsequently reconstructed. Selenium enters the aqueous phase by geochemical weathering of the bedrock by ground water. Concentrations of selenium appear to have peaked in year 2001, but a stable trend has yet to establish. Over time, the weathering profile is expected to deepen and isolate the host rock from further release of selenium. Similar bedrock is exposed along much of the north hillside of the Millsite. The selenium content of Seep 3, which emanates from such an outcrop, is attributed to the leaching of bedrock and bedrock-derived soil, by municipal water or irrigation water applied seasonally to crops on the mesa north of the Millsite. Diffuse subsurface flow of this water, in addition to overland flow of Seep 3 water, then contributes to the observed selenium contamination in surface water and ground water in the eastern area of the Millsite.

III. Hydrology of Constructed Wetlands and Sediment Pond

The Monticello Mill Tailings Site is located in the valley of Montezuma Creek. A shallow, thin, unconfined alluvial aquifer, in hydraulic connection with the creek, underlies the central portion of the valley. Montezuma Creek forms at the confluence of North and South Creeks about 0.5 mile upstream (west) of the Millsite. Its watershed includes portions of the 11,000-foot (ft) Abajo Mountains, 4 miles farther west. Baseflow in Montezuma Creek and the aquifer is supported in part by leakage through an earth dam 1.5 miles upstream of the Millsite that impounds South Creek in Loyd's Lake reservoir. North Creek joins Montezuma Creek about 0.5 mile below the dam. Operation of a municipal water treatment plant and irrigation diversions interrupt natural flow in North Creek. Prior to recent drought, flow in Montezuma Creek typically ranged between about 0.2 and 0.4 cubic feet/second (90 and 180 gallons/minute) at any given location in OU III. Surface flows are now less than half of normal and many reaches are seasonally dry.

Reconstruction of Montezuma Creek on the Millsite and in the area of the permeable reactive barrier occurred during September 1999 to August 2001, when remediation and restoration actions were completed, respectively. On the Millsite, the creek was constructed in a narrow corridor that occupies the topographical axis of the bedrock valley. In some areas, a trough was cut into the bedrock to accept the new channel. A 3-ft layer of coarse granular alluvial fill placed on the bedrock forms the creek bed, although this layer is absent in some locations. The reach entering the Millsite has been dry or nearly dry (less than 10–20 gallons per minute [gpm]) for several years, in part due to drought but also to modification of the creek gradient. Steady creek flow generally occurs only below the outlet of Wetland 2. As constructed, Montezuma Creek is a hydrological boundary that captures ground water in its reach on the Millsite. Most of the surface water and ground water baseflow on Millsite originates from sources to the north of the alluvial valley. During 1999 through 2001, the creek flow at the east boundary of the Millsite, sustained wholly by ground water capture in the Millsite reach, was about 100 to150 gpm. This amount of stream gain has decreased significantly in recent years.

During site restoration, three basins identified as Wetland 1, 2, and 3 in the attached figures, were constructed adjacent to the creek on the Millsite to allow establishment of wetland habitat. The wetlands were constructed by excavating up to several feet into the bedrock, placing a 2-ft layer of coarse fill at the base of the excavation to transmit water, followed by a 1-ft layer of fine-textured soil for plant rooting. Water enters the wetland from Montezuma Creek through a boulder and cobble infiltration gallery on the upstream side of each wetland. Because the wetlands intercept the full thickness of the aquifer, significant inflow also occurs as perennial ground water seepage from the north and northwest banks of Wetlands 2 and 3. Water exits each wetland via a downstream outlet (weir) to Montezuma Creek. These inlet and outlet features are indicated in Plate 1. The maximum water depth of the wetlands is 2 ft. The design area of Wetlands 1, 2, and 3 are 1.0, 1.8, and 1.5 acres, respectively.

As the creek flows through the broad, flat reach east of the Millsite, a losing-stream condition prevails, and it occasionally dries. A net gaining-stream condition resumes about 4,000 ft east of the Millsite as the canyon narrows and the creek fully penetrates the aquifer. In this reach, the Dakota Fm. aquitard is absent and upward flow of ground water from the underlying Burro Canyon aquifer contributes as much as 90 gpm of additional stream gain. The 0.2-acre sediment retention pond is located in this general reach of Montezuma Creek. Montezuma Creek directly enters the pond at its west end and exists over a rock dam spillway at its east end. Water depth of the pond is maintained by the dam at about 2 ft. The base of the pond is likely at or near the bedrock surface. Sediments, if present, are likely to consist of alluvial sand and gravel overlain by muck and decaying vegetation.

A losing stream condition begins where the canyon broadens about a half-mile east of the sediment pond. Some water loss in this final stream reach within OU III may occur as infiltration into the soft shales and silts of the Morrison Fm. now underlying the alluvial aquifer. A short distance downstream of the OU III boundary the alluvial aquifer pinches out entirely (is absent) in this very rugged portion of Montezuma Canyon.

IV. Sediment and Surface Water Sampling Design and Data Objectives

Co-located surface water and sediment samples for baseline characterization of selenium distribution will be collected from three distinct areas (strata) of Wetland 1, 2, and 3, and the sediment retention pond, in October 2004.

<u>Identification of Sampling Strata</u>

Individual strata identified for this baseline sampling activity in the wetlands and sediment pond are 1) the influent area, 2) the open water area, and 3) the restricted flow area. These strata were selected to account for the potential variation of selenium distribution from different sources or flow dynamics; and, because the distinct flow regimes represented will account for the physical and geochemical factors that determine the ecology and fate of selenium within each stratum.

At the Millsite wetlands, the influent area corresponds to the general area of standing water closest to the native ground water seeps that feed the wetlands and which may be considered important sources of selenium to the wetlands (particularly to Wetland 3). Seeps at the infiltration galleries contribute mainly uncontaminated water from Montezuma Creek so are not a sampling stratum. Areas of native seeps and the location of the infiltration galleries are depicted in Plate 1. The influent area of the sediment pond corresponds the standing water closest to the mouth of the creek. The second sampling stratum corresponds to the center, or open-water area of the wetland or pond, through which the bulk of through-flow occurs. This area will represent a composite of all water entering and flowing through the wetland. The final sampling stratum corresponds to a selected near-shore, shallow, vegetated zone of restricted flow in the wetland and pond.

V. Field Procedures

Sampling strata will be demarcated in the field using the preceding criteria prior to any sample collection. A marker will be placed at the center of each stratum and its location will be determined using global positioning satellite (GPS) technology. Each stratum will be identified by wetland number and stratum type following the above definitions as guidance.

The field sampling team will consist of two persons. Personnel will use hip-boots or chest waders to access the wetlands and sediment pond. Field personnel will be familiar with and retain a copy for field use of the Monitoring Plan. Applicable field practices or details not specifically addressed in this Program Directive, such as equipment decontamination, sample management, and field documentation will conform to the specifications of the Monitoring Plan.

<u>Surface Water Sample Collection</u>

Surface water samples will be collected in a given stratum before sediment samples are collected to minimize turbidity. One surface water sample will be collected in each stratum at the location of the center stake. The sample will be collected in a new and certified pre-cleaned high-density polyethylene (HDPE) bottle. The sample will be obtained by directly immersing the bottle near the center of the water column or by using a peristaltic pump with its intake suspended near the center of the water column. The surface water sample will be filtered through a 0.45 micron (μm) filter while in the field. If the bottle-immersion method is used, sample will be filtered from the original container to a fresh container. The final sample volume will be 500 milliliters (mL). Field parameters of temperature, pH, electrical conductivity and alkalinity will be determined at each surface water collection site. Field personnel will also record the approximate water depth at the center stake and the general hydrologic condition of the wetland or pond in the field logbook.

Field duplicates and equipment blanks will be collected on a frequency of one duplicate and blank per 20 surface water samples. Fictitious sample identification will be assigned to the duplicates and blanks that are similar to the actual sample identification. Surface water samples will be identified on the basis of wetland number, stratum number, and matrix type, such as "SW" for surface water. For example, W3-S1-SW will identify the surface water sample collected from stratum 1 (S1 = influent area) of Wetland 3. The sediment pond will be designated with the prefix "P".

Sediment Sample Collection

For each stratum in a given wetland or pond, a sample of sediment will be collected from three equally spaced locations around the center mark of the stratum and within about 6 feet of the center mark. Each sample will be collected from the upper 3-inches of sediment to obtain 500 mL of sediment. Sampling devices may include a hand-scoop, or pre-cleaned HDPE bottle or bucket. Excess water will be decanted from the sample and any coarse plant debris or gravel will be discarded. The three samples per stratum will be manually combined in a mixing vessel (e.g., disposable aluminum pan), again removing excess water, vegetation, or gravel as necessary, from which a single 500-mL composite sediment sample will be obtained. Personnel will record in the field log book the lithologic composition of the sediment, and the presence (and general description) or absence of aquatic organisms.

Non-dedicated sampling devices will be rinsed clean of visible sediment and vegetation prior to re-use. Field duplicates or equipment blanks are not required for sediment sampling. The composite sediment sample for each stratum will be identified according the same scheme described for surface water samples, however, an "SD" suffix will signify the sample matrix as sediment.

Surface Water and Sediment Sample Preservation

Surface water samples will be preserved in the field by adding nitric acid to reduce the pH of the sample to <2 standard pH units.

Sediment samples will be preserved by placing the bottle containers in an ice-chest and maintaining a cool temperature until received by the analytical laboratory.

VI. Laboratory Analysis

Surface water samples will be submitted to a contracted analytical laboratory for analysis of selenium by ICP-MS (inductively coupled plasma-mass spectrometry, EPA SW-846 6020). The laboratory reporting limit (0.1 μg/L) will be consistent with previous and current monitoring for selenium in OU III water samples.

Sediment samples will be prepared in the laboratory using an acid digestion procedure (EPA SW-846 050B) to extract selenium from the matrix. Sediment samples will be analyzed for selenium by ICP-MS. This method routinely provided detection limits as low as 0.2 milligrams per kilogram selenium in samples collected to characterize the content of OU III ground water contaminants of concern in the post-remediation soil of the Millsite.

Sampling personnel will refer to *Monticello Mill Tailings Site Operable Unit III Post-Record of Decision Monitoring Plan*, August 2004 (Draft Final) for specific requirements of sample packaging, shipment to the laboratory, and sample custody management.

VII. Reporting

Laboratory data reporting will conform to the applicable requirements and formats meeting the DOE-Legacy Management (DOE-LM) data deliverable specifications for subcontracted laboratory analytical services, as outlined in Section 5.1 of the Monitoring Plan. Once received at the DOE-LM in Grand Junction, Colorado, laboratory results will be managed in the project database by environmental data services personnel.

After field activities have concluded, DOE will prepare a trip report to summarize the activities that were completed. The report will identify personnel in attendance, number, location, and identity of samples, sampling methods, general site conditions, and any variances from the Program Directive and rationale.

After the laboratory results have been received and validated, a letter report will be prepared for distribution to representatives of the OU III biological technical assistance group in which the field sampling program and analytical results are summarized.