Department of Energy
Washington, DC 20585

June 2, 2011

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Sandra A. Bourgeois
U.S. Environmental Protection Agency
Region 8, EPR-F
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: *Monticello Mill Tailings Site Operable Unit III: Biomonitoring Program Status and Analytical Update*, March 2011

Dear Mr. Ombach and Ms. Bourgeois:

Enclosed is an electronic version of responses to comments received by the U.S. Department of Energy (DOE) from your agencies on May 13, 2011, regarding the subject report. Specific responses to the comments are prefaced by a brief summary of relevant background information that addresses the ecological context of the statistical analysis presented in the report, and possible resolutions to Operable Unit (OU) III biomonitoring. DOE appreciates your careful review of the document and is confident that final resolution of the comments will lead to the appropriate course of action for OU III biomonitoring.

Please call me at (970) 248-6016 if you have any questions. Please send any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

Jalena Dayvault
Site Manager

Enclosures

Printed with soy ink on recycled paper

cc w/enclosure:
R. Blackburn, EPA (e)
C. Cline, FWS (e)
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File: MNT 402.02 (A) (rc-grand junction)

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DOE Responses to April 13, 2011 BTAG Technical Review Comments on Monticello Mill Tailings Site, Operable Unit III, Biomonitoring Program Status and Analytical Update, March 2011

May 2011

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Preface

The following documents the U.S. Department of Energy (DOE), Office of Legacy Management (LM) responses to joint comments received from the U.S. Environmental Protection Agency (EPA), the Utah Department of Environmental Quality (UDEQ), and the U.S. Fish and Wildlife Service (FWS) on the *Monticello Mill Tailings Site* (MMTS) *Operable Unit* (OU) *III Biomonitoring Program Status and Analytical Update*, March 2011. EPA, UDEQ, and FWS review comments on this report were received by DOE on May 13, 2011. Representatives of these agencies and DOE comprise the Biological Technical Assistance Group (BTAG) for OU III biomonitoring. The report was scoped during the Federal Facilities Agreement (FFA) meeting on September 14, 2011. At that time, EPA and UDEQ agreed to research internal sources for preferred methods of data analysis; however, no information was subsequently provided to DOE.

The joint EPA, UDEQ, and FWS review of the report concluded that additional data are needed to satisfy the biomonitoring requirements of the OU III Record of Decision (ROD). DOE generally disagrees with this conclusion. DOE's response to EPA, UDEQ, and FWS comments begins with a broad examination of the key issues, reiterating the important historical and ecological context, with the goal of guiding future discussions and achieving BTAG consensus on the future scope of the biomonitoring program. This is followed by responses to general and specific comments regarding the March 2011 report.

Background Information

- Three backwater wetlands were created along Montezuma Creek as a post-remediation mitigation action to improve wildlife habitat at MMTS—these actions were required by and concurred upon by EPA and UDEQ. Wetland 3 (1.5 acres) is the primary backwater wetland of interest in this study (see Figure 1 for a recent view of Wetland 3).
- A pond was constructed along Montezuma Creek to retain sediment during surface remedial actions (sediment pond). The sediment pond (1 acre) provides wildlife habitat and is also of primary interest in this study (see Figure 2 for a recent view of the sediment pond).
- There are a limited number of receptor species (no fish) and no known endangered or threatened species that could be exposed to the macroinvertebrates in the wetlands or sediment pond. It is likely that macroinvertebrates constitute only a small portion of the total diet for avian species. Furthermore, this food source is only available for a limited time during the year.
- The area upgradient of the wetlands underwent extensive remediation to remove contaminated soil, sediment, and debris. Selenium concentrations in onsite groundwater and surface seeps are generally decreasing over time—i.e., sources of selenium to the wetlands, although variable, are decreasing.
- MMTS is not an area with industrial (e.g., wastewater or mining-related) source inputs that can be curtailed. If BTAG were to ultimately conclude that an unacceptable risk existed, the only mitigation option would be draining and filling the wetlands (essentially mitigating the former mitigation action).
- High selenium concentrations occur in surface water and seeps throughout the Colorado Plateau, including several locations in Utah, from the natural leaching of Mancos Shale (i.e., where there is no anthropogenic source such as uranium milling). In a recent

study conducted by DOE LM[1], selenium concentrations in seeps and surface water were commonly much higher (often by over an order of magnitude) than those in the wetlands at Monticello.

- Statistical analysis demonstrates that mean selenium concentrations in biota have remained below the trigger levels for 3 consecutive sampling years at the Sediment Pond (March 2011 report, page 24, Figure 15).
- Statistical analysis cannot demonstrate that mean selenium concentrations in biota have remained below trigger levels at Wetland 3, but it can also not demonstrate that they are above trigger levels (March 2011 report, page 23, Figure 14)—i.e., mean selenium concentrations are essentially at, but not significantly exceeding the toxicity threshold. Excluding the single (4.7 mg/kg) datum for Wetland 3 in 2010, mean selenium concentrations in biota in this area were generally stable between 2005 and 2008 (ranging from 6 to 7 mg/kg).
- The small sample sizes analyzed in this study are largely due to field constraints (limited water much of the year at Wetland 3) and also reflect the limited habitat conditions—i.e., the limited food source availability in the study area for potential receptors at risk. Mostly because of the small sample sizes, DOE acknowledges that the statistical power associated with the macroinvetebrate data set is not optimal (see the responses to General Comment 1).
- The primary avian receptor at Wetland 3 is the red-winged blackbird (a species known to be selenium tolerant[2]). Selection of the 7 mg/kg toxicity threshold may have assumed waterfowl as a primary receptor at OU III. Some flexibility may therefore be warranted when interpreting the 7 mg/kg value cited in the ROD because the dietary composition may differ between these receptors.

In light of these factors, it is reasonable to conclude that:

- Additional data will not substantially improve the ability to evaluate the ecological risks associated with selenium at MMTS, and
- The benefit of the wetlands in providing wildlife habitat may exceed the minor risk to individual receptors (primarily red-winged blackbirds) potentially posed by the current selenium distributions (see page 29 of the March 2011 report).

DOE encourages BTAG to re-examine the potential outcomes of the decision-making process. For example:

> Will *nominal* exceedances of trigger levels (a possibility given the variability in the data set) trigger a mitigation action?

DOE also encourages BTAG to assess the overall objectives of the biomonitoring program and to evaluate the findings of the March 2011 study under the broader umbrella of risk—limited habitat, the paucity of macroinvertebrates available as a food source from the study area, and composition of food sources for the target receptors—and the other major issues listed above

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[1] DOE (U.S. Department of Energy), 2011. *Natural Contamination in the Mancos Shale Evaluation of the Shiprock Remediation*, LMS/S07480, ESL-RPT-2011-01, Office of Legacy Management, Grand Junction, Colorado, March.

[2] Harding LE. Non-linear uptake and hormesis effects of selenium in red-winged blackbirds (*Agelaius phoeniceus*). Sci Total Environ. 389(2008):350-66.

(e.g., lack of mitigation options, no threatened or endangered species as receptors, and decreasing selenium concentrations on the millsite). These issues overshadow any minor reductions in uncertainty gained by additional sampling and suggest that the flexibility inherent under CERCLA can be used to help address outstanding concerns (e.g., modify the language in the ROD).

Figure 1. Photograph of Wetland 3 taken in April 2011
(Montezuma Creek in foreground)

Figure 2. Photograph of Sediment Pond taken in April 2011

Comment Responses

DOE's responses to agency comments are indented below (in blue font); to facilitate review, they are provided largely in bulleted format. In cases where comments include multiple distinct points, responses are broken out accordingly (i.e., embedded within the comments).

General Comments

1. As indicated in recent discussions with BTAG members, it was agreed that background macroinvertebrate tissue concentrations should be considered in evaluating the on-site concentrations and comparison to thresholds specified in the ROD. However, invertebrate tissue concentration data sets from the mid-90's and from 2010 have been pooled in an approach to calculate the mean background tissue concentration.

- The "pooling" of the 1995–1996 data was only a minor component of the data presentation, and a very small component of the data analysis. This pooled data set was never used as the basis for conclusions drawn in the report. Rather, as stated in Section 5.2 of the report, the primary purpose of presenting these data was to demonstrate the temporal variation in tissue selenium concentrations for background (reference) areas, and provide a context for interpreting the variability in biomonitoring results.
- The only portions of the report where these data are pooled are Figure 17 and the t-test comparisons to the toxicity threshold provided in Appendix B (in the latter case, such "pooling" results in both reference areas being significantly below the 7 mg/kg threshold). Figure 17 was provided for summary purposes—to plot all data for all areas and to illustrate differences between the two expressions of variability (standard errors vs. confidence intervals). In this figure, data from different years are distinctly labeled and differences between the 1996 and 2010 data are clearly apparent. [DOE acknowledges that the reference to the 1995-1996 data in Table 2 (page 27) could be misinterpreted; however, these data were never statistically compared to more recent data.]

The data from 1995/1996 seem to be outliers which are sometimes twice the mean of the 2010 background tissue concentrations. This may be due to many factors such as differences in location-specific conditions, differences in methods and detection limits that may have been used between the two time periods, seasonal differences, etc. The length of time between these two collection periods (1997-1996 =1 year, and 1997-2010=13 years) warrants a consideration of whether or not these background data are "the same" and can be pooled. For example, a test was performed for the years 1996 and 2010 for Upper Montezuma Creek (Background). The test statistic is 3.2 and the p-value is 0.024. Therefore, it is unlikely that the mean values for these two years are equal.

- This statement (regarding the significant differences between 1996 and 2010 data) is true—we never contended otherwise. In fact, this comment underscores the very point DOE was attempting to make regarding the variability of selenium concentrations in background areas. DOE acknowledges that the variability may be related to location differences and/or seasonal differences as suggested. Regarding detection limits, the samples were analyzed by a commercial laboratory, validated, and results published in a peer-reviewed journal. Although detection limits were higher in the 1990's (about 4 mg/kg, so 1995 results could have been lower), all 1996 results were well above these limits and are considered valid.

The approach to pool concentrations from 1996-1997 with 2010 does not appear to be supported. Rather than pooling the background tissue concentrations, it is recommended that standard statistical testing be used to demonstrate differences between 2010 background tissue concentrations as compared with on-site tissue concentrations. If it can be shown that there is no significant difference between Wetland 3 and Sediment Pond concentrations and background concentrations, this would support that the site is behaving "like background", and that risks, while perhaps "elevated" with regard to benchmarks, are not

elevated compared to "background." Due to the high variability of tissue concentrations between 1990's and 2010, it would be prudent to collect a second set of macroinvertebrate tissue from background locations during the 2011 field season. The BTAG should convene in order to conduct additional discussions related to this approach.

- The comment regarding data pooling is addressed above. Due to time constraints, it may be difficult to conduct adequate monitoring in 2011. In 2010, only one sample could be collected at Wetland 3 because of low water levels. This constraint was explained in the report. If conducted, future field work is recommended in late May or early June (rather than mid- or late June) to maximize the possibility of obtaining adequate sample numbers at all wetland and background locations. Moreover, the approach for any additional sampling would need to be discussed with the BTAG before proceeding.

2. Sampling in 2011: The requirements needed to support discontinuing biomonitoring have not been achieved, either 1) three continuous years of data below the threshold, or 2) demonstration of a downward trend. For example, as shown in Figure 10, there was only one macroinvertebrate sample collected at Wetland 3 in 2010, and while the Se concentration for that sample was lower than the means for the generally more data-rich years of 2005-2008, that one point does not comprise a "downward trend" in Se concentrations in Wetland 3.

At the sediment pond, (Figure 10), 2010 appears to be holding steady compared to 2007-2008, but it's not clear if the outlier shown in 2010 was included in the calculation of the mean. Due to the high level of variability, the Information supporting a downward trend is not evident. For example, time line graphs show that there are upward trends demonstrated for the example data sets that were tested (see attachment).

- The ROD states the following: "If no consistent increases in selenium are observed in water or sediment and if biota concentrations remain below trigger levels (if biota sampling is required) for 3 consecutive years, biomonitoring can be discontinued."
- The demonstration of a downward trend is not necessary to satisfy the ROD requirements; instead, no consistent increases must be demonstrated. This has been shown for Wetland 3 (page 12, Figure 5 and page 14, Figure 8) and for sediment at the pond (page 12, Figure 6). Although an upward trend is apparent for surface water at the pond (page 15, Figure 9), the means have remained below the threshold value for all monitoring years. To evaluate these results under the broader context of the ecological setting (and associated risks), the latter points should be viewed In light of the issues and questions discussed in the preface to this response submittal.
- A downward trend for macroinvertebrates at Wetland 3 was neither stated nor implied (see page 27, Table 2). It is acknowledged that it was only possible to collect one sample in 2010 because the sampling occurred in June, when water levels dropped. The seasonal stagnation of Wetland 3 in the early summer indicates that macroinvertebrates in the diets of avian species at Wetland 3 must also be harvested from other areas (terrestrial, Montezuma Creek, or Wetlands 1 and 2).
- Given the limited number of samples available, and for the purposes of thoroughness (and statistical validity), outliers were not excluded from the evaluation (see pages 9-10, Section 3.0, General Technical Approach).
- The graphs in the attachment (provided to DOE in pdf form) are neither annotated nor explained, although it appears that the graphs plot the reported mean annual selenium concentrations in macroinvertebrate tissue samples.[1] Similar to BTAG's comment/critique regarding the trend lines in Figures 5–6, the trend lines plotted in this attachment are misleading in that they imply

[1] If this is the case, there appear to be some errors (for Wetland 3, means are 6.0 mg/kg and 6.7 for 2006 and 2007, respectively—values plotted in the attachments appear to be lower).

correlations that are, in fact, generally rather weak. For example, the r2 associated with the Wetland 3 exhibits including and excluding the 2010 datum are 0.32 and 0.03, respectively. Although the initial pdf suggests a downward trend in Wetland 3 selenium concentrations, DOE has never made such a claim.

It is recommended that another year of sampling be conducted using a similar sampling plan as in 2010. In order to establish a significant difference in mean values between the background and onsite data sets, it is recommended that the number of samples should be increased, This would yield several objectives: 1) the ability to compare between site and background concentrations in UMC and Verdure Creek, 2) Two continuous years of data AFTER the missed year of 2009, and 3) a more robust dataset to evaluate trends (would overcome issues with missed samples in 2009, and only one sample in Wetland 3.

- It is difficult, if not impossible, to increase sample sizes, particularly if Wetland 3 is sampled in late June. The population of macroinvertebrates in the Monticello wetlands is not large. All possible areas within all of the wetlands and reference areas (shorelines and regions with water deep enough to support aquatic macroinvertebrates) were sampled in 2010. Similar conditions would be expected in future sampling years, although sample sizes are expected to increase at Wetland 3 and some background areas by resuming sampling in mid-May instead of June. Note: the difficulty in obtaining large samples of macroinvertebrates indicates that avian receptors must be also harvesting macroinvertebrates from other areas (e.g., terrestrial), thereby reducing their exposure to Wetland 3 and Sediment Pond organisms. *Regarding item 2 in the comment above, what is the significance of two consecutive years?*

3. **Lines of Evidence:** An additional line of evidence that may help explain some of the variance in concentrations in background sites would be to look at how Se concentrations in macroinvertebrate tissue vary with regional climate factors on a yearly basis (e.g., precipitation and temperature trends). Since 1996, the site has experienced everything from extreme drought years to very wet years. It is known that Se is oxidized in sediments that are dry (i.e., not inundated), and this oxidized Se is then more available when the sediments are re-wetted, so perhaps there is some relationship such that Se concentrations are higher in a wet year that follows a dry year. This hypothesis could be evaluated at the background sites and could be a line of evidence that may help to explain the differences in Se concentrations between 1996-1997 and 2010.

In addition, the variations in Se in macroinvertebrates at Wetland 3 and the Sediment pond could be evaluated to determine if there is a correlation between Se in groundwater from monitoring wells near the site, and/or whether alternating dry and wet years have any "rinsing" action on the aquifer. The hypothesis to be evaluated for the first possibility is whether increases in Se in groundwater are responsible for increases in Se in macroinvertebrates. Because the shallow aquifer underlying Wetland 3 and the Sediment pond is relatively thin and appears to have a fairly high transmissivity (groundwater velocity), it could be possible that Se in the groundwater is transferred to surface water, but is then rapidly taken up by macroinvertebrates (and plants) which would explain why Se concentrations in contemporaneous surface water samples are low. We have seen this phenomenon occur in other Se-contaminated wetlands in Utah.. Regarding the second possibility, surface water and groundwater monitoring data should be evaluated to see if Se concentrations in GW vary with precipitation amounts, either immediately or after a lag that is explainable by groundwater velocities (e.g., the time expected for water that falls on the surface of the remediated area to travel down into the aquifer, laterally across the floodplain, and then into the ponds. These lines of evidence may help explain some of the observed variability in Se concentrations in the site biota, and would be useful for supporting decisions related to the need for continued biomonitoring at the site.

- The complex chemistry and behavior of selenium in aquatic ecosystems is acknowledged. It is presumed to be the primary reason for the large sample variability and apparent lack of correlation between surface water, sediment, and macroinvertebrate Se levels. However, it is unclear how an analysis of the climatic and hydrogeochemical factors influencing Se variability would be germane to the biomonitoring program—i.e., in what way would such an analysis help in determining if

selenium presents significant ecological risk and/or the need for future biomonitoring? Although this would admittedly be an interesting research project, such an investigation would be extremely costly, require years of investigation, and yet it would do little to reduce uncertainty. *Even if such endpoints could be quantified, how would these findings influence the decision-making process?* DOE LM currently spends approximately $800,000 annually on various aspects of the MMTS project—on groundwater and surface water monitoring, groundwater remediation, and maintenance and monitoring of the disposal cell. As is the case with all governmental agencies (especially in the current economic climate), DOE funds are limited. As we are not a research organization, such an endeavor is beyond the scope of the overall MMTS monitoring and remediation efforts and not aligned with our primary objectives.

Specific Comments

4. **Page 12, Figures 5 and 6.** The linear (mean) lines shown on these graphs are misleading since there is no linear correlation between selenium concentrations and time. The purpose of these graphs is to show selenium concentrations with respect to toxicity thresholds over time. Due to the high variability in these data, concentrations are rather reflected by the lines connecting concentration data from each year.

- The referenced lines do not represent correlations; rather, they were provided to represent the trends in mean concentrations. This data presentation is generally similar to those presented in other submittals (in 2010, BTAG was given an opportunity to comment on statistical and data presentation approaches but did not provide input).

5. **Page 18 Figures 10-17:** The graphs include an invertebrate tissue threshold of 7 mg/kg which reflects the level at which acute toxic effects may occur. There has been no discussion or agreements to change the invertebrate toxicity threshold of 4 mg/kg as indicted in the ROD. As indicated in the General Comments, there is support for comparing relative background concentrations to on-site concentrations to determine protectiveness, but this does not involve changing the toxicity threshold. The report should be revised to present thresholds established in the ROD in all discussions and on any graphs that discuss threshold comparisons.

- Threshold criteria as stated in the ROD for surface water and sediment (Page C-4) are:
  "If the average total recoverable surface water concentration of selenium for a given stratum exceeds 5 micrograms per liter (µg/L) or average selenium sediment concentrations exceeds 4 milligrams per kilogram (mg/kg), macroinvertebrate sampling of that stratum will be required, as described in Section 3.0. Because recent analytical results of surface water samples have exceeded the 5 µg/L threshold, macroinvertebrate sampling will be conducted during the second year of biomonitoring (see schedule in Section 6.0)."
- The threshold criterion as stated in the ROD for benthic macroinvertebrates (Page C-7) is:
  "If concentrations of selenium in macroinvertebrate tissue for any stratum exceed 7 mg/kg (http://sacramento.fws.gov/ec/GBP/Table1.htm), the Biological Technical Assistance Group will be consulted to determine the need for sampling of avian eggs. If egg sampling is required, the sampling and analysis approach will be determined at that time."

6. Page 29, Table 3. Summary of Findings. For Wetland 3 and Invertebrates, the table states "Since biomonitoring began, Se concentrations have remained stable at or near the 7 mg/kg threshold but have never exceeded it." However, Figure 2 for the year 2008 macroinvertebrate data shows the following concentrations; 13.0, 5.1, and 3.7. These three values give a mean concentration of 7.3 mg/kg which exceeds the 7 mg/kg threshold. Also, the mean values for the 2005 data show a mean value of 7.2 mg/kg.

- Regarding the referenced language, the intent was that the mean selenium concentrations have remained stable. FWS guidelines list a toxicity threshold of "> 7" mg/kg for animal food chain

(invertebrate) residues, not 7.0 mg/kg (http://www.fws.gov/sacramento/ec/GBP/table1.htm). The choice of assigning only one significant figure is done, in part, to better align the numerical value with the uncertainties associated with defining ecological toxicity. In light of this, and given traditional approaches to rounding and handling of significant figures/decimals, DOE does not concur with BTAG's assertion that selenium concentrations of 7.2–7.3 mg/kg constitute exceedances of the 7 mg/kg threshold. This conclusion is corroborated by the statistical analysis presented in the report.