RESPONSE TO COMMENTS ON
DRAFT FINAL RI REPORT
IRON MOUNTAIN ROAD RANGES

RESPONSE TO COMMENTS

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Response to Alabama Department of Environmental Management Comments on the Draft-Final Remedial Investigation Report for Iron Mountain Road Ranges: Skeet Range, Parcel 69Q; Range 19, Parcel 75Q; Range 13, Parcel 71Q; Range 12, Parcel 70Q; Former Rifle Grenade Range at Skeet Range, Parcel 222Q-X; and Former Rifle Grande Range North of Washington Ranges, Parcel 221Q-X
Fort McClellan, Alabama

Comments from Stephen A. Cobb, Chief – Governmental Hazardous Waste Branch, Land Division, received via e-mail on January 22, 2009.

The Alabama Department of Environmental Management (ADEM or the Department) has reviewed the Army's Draft-Final RI based on the Army's Responses to ADEM Evaluations on the Draft RI Report for Iron Mountain Road (IMR) Ranges. The Department considers all comments to be resolved based on the Army's previous responses to comments except: General Comment 9 and Specific Comments 5, 45, 61, 62, 69, 74, 76, 78, 81, 82, 85, 86, 87, 88, 89, 90, 91, 92, 93, 95 and 99. The Department considers the following comments to be resolved based on the Army's recent responses to evaluations: Specific Comments 61, 62, 69, 74, 76, 82, 88, 89, 90, 91 and 92. Attached are the Department's evaluations of the Army's responses to comments that remain unresolved.

[**Editor's note:** the following comments and responses have been preserved to document the chronological sequence of events. As such, they include ADEM's original comments on the draft RI report and subsequent evaluations of Army responses, as well as the Army's initial and final responses.]

General Comments

Comment 9: **According to current Environmental Protection Agency (EPA) guidance (Role of Background in the CERCLA Cleanup Program, 2002) regarding the role of background in the CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) cleanup program, metals that are both site-related and background-related are required to be included in the risk characterization to ensure adequate representation of cumulative risks. EPA Region IV and ADEM allow the elimination of metals that are below two times the arithmetic mean background concentration. Please clarify the justification of eliminating metals from evaluation in the risk assessment that exceed such levels.**

Response 9: The reviewer's assertion that the EPA (2002) *Role of Background in the CERCLA Cleanup Program* (hereinafter call Background Document) states, "…metals that are both site-related and background-related are *required* to be included in the risk characterization to ensure adequate representation of cumulative risks" (italics added) is not entirely correct. The Background Document does state that background constituents associated with site activities *should* be included in the risk assessment, but that the Background Document "…cannot impose legally-binding requirements on…the regulated

community, and…decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance." The three-tiered background evaluation protocol for FTMC is an excellent example of the decision makers (the BCT) exercising their discretion to develop a protocol that differs somewhat from the recommendations of the Background Document.

The Background Document clarifies the phrase, "…included in the risk assessment…" as follows: "When concentrations of naturally occurring elements at a site exceed risk-based screening levels, that information should be discussed qualitatively..." That information is currently discussed in the uncertainty sections of our risk assessments. The Army believes that the three-tiered approach to evaluating background and the discussion of background in the uncertainty section constitutes full compliance with the Background Document.

Reference:
U.S. Environmental Protection Agency (EPA), 2002, *Role of Background in the CERCLA Cleanup Program*, Office of Solid Waste and Emergency Response, 26 April, OSWER 9285.6-07P.

Evaluation: *The response includes excerpts from the guidance taken out of context. The guidance states "…COPCs that have both release-related and background-related sources should be included in the risk assessment. When concentrations of naturally occurring elements at the site exceed risk-based screening levels, that information should be discussed qualitatively in the risk characterization…" Considering lead and other metals are acknowledged site contaminants, they should be included in the risk assessment, not treated as naturally occurring. Please address.*

Response to Evaluation: ADEM confirmed the use of the established 3-tiered background screening protocol at FTMC during the October 11-12 comment resolution meeting.

ADEM Comment: **During the December 11-12, 2008 meeting between the Army, ADEM, USEPA, U.S. Fish and Wildlife Services and their respective contractors, ADEM confirmed the use of the 3-tiered background screening protocol at FTMC for all media, not just soils and groundwater. Response is acceptable.**

Final Response: Comment noted.

Specific Comments

Comment 5: **Page ES-2, Paragraph 3. Please indicate the basis of the exposure point concentrations that result in risk (e.g., maximum values, 90-percent upper concentration limit).**

Response 5: This information is beyond the scope of the Executive Summary but is provided in Chapters 6.0 and 7.0 of the report.

Evaluation: *Please clarify the basis of exposure point concentrations.*

Response to Evaluation: This information is provided in Chapters 6.0 and 7.0 of the report.

ADEM Comment: **ADEM notes that the source term concentration (STC) is conservatively estimated based on the lower of the 95-percent Upper Concentration Limit (UCL) or Maximum Detected Concentration (MDC), with the exception of lead where an arithmetic average was used for a blood-lead modeling approach. Please insert a sentence with this level of detail, or refer the reader to the section discussing STC estimates.**

Final Response: Agreed. The following sentence will be added as the second sentence to the first full paragraph on Page ES-3: "Source term concentrations (STC) were conservatively estimated based on the lower of the 95-percent Upper Concentration Limit or maximum detected concentration, with the exception of lead where an arithmetic average was used for a blood-lead modeling approach."

Comment 45: **Page 4-3, Paragraph 4. Please describe in the text how arsenic samples focused on the shotgun ranges and if evidence of shotgun wading was found near sample locations.**

Response 45: The Army is unsure what the term "arsenic samples" refers to. A large number of samples were collected at the IMR Ranges and analyzed for TAL metals, including arsenic. Arsenic-specific analysis was not selectively performed at the ranges with historical shotgun usage because it was already included in the TAL metals analyses. There was no evidence of shotgun wadding – not "wading" – at the IMR Ranges.

Evaluation: *The purpose of the comment was to focus on whether the sampling strategy was targeted towards known uses and since arsenic is associated with shotgun fire it may be appropriate to conduct additional arsenic sampling in shotgun ranges. Shotgun wadding was not referenced in the text but is commonly found at shotgun ranges. Please address.*

Response to Evaluation: Please see original response.

ADEM Comment: **Arsenic in soil is a site-related COPC based on the three-tiered approach. The Army's response implies that shotgun ranges were not sampled more extensively for arsenic despite the more prevalent use of arsenic in shotgun ammunition. Please note that any remedy of the shotgun range sites will require additional confirmation sampling for arsenic.**

Final Response: Comment noted.

Comment 78: **<u>Page 5-7, Paragraph 3.</u> The text states Kd values used are the default values used by EPA. Please provide information on the pH assumed for the default Kd values, discuss the range of pH values detected for all parcels and discuss the applicability of the default Kd values to the soil pH values reported.**

Response 78: Kd values presented in the text in Table 5-2 are primarily EPA default values and based on a soil pH of 6.8. Estimated Kd values for SSL application are presented in Soil Screening Guidance: Technical Background Document (EPA, 1996a) for 14 metals at pH values of 4.9, 6.8 and 8.0. EPA conducted a separate modeling effort (MINTEQ) to develop the metal Kd values for SSL application. Kd values for lead and copper were not modeled. Estimated Kd values for antimony, cyanide, and vanadium ore only supplied for a soil pH of 6.8. The applicability and accuracy of the model results are subject to limitations; one of the limitations of the model is that the redox potential of the system is not considered because of the difficulty in obtaining reliable field measurement of Eh.

Evaluation: *Please discuss the range of pH values detected for all parcels and the applicability of the default Kd values for the site-specific soil pH values reported.*

Response to Evaluation: See original response.

ADEM Comment: **Please refer to Table C-4 of the Soil Screening Guidance: User's Guide for Kd values across a range of pH values from 4.9 to 8.0. As requested in the original comment, please include a discussion of the range of pH values detected for all parcels and discuss the applicability of the default Kd values to the soil pH values reported.**

Final Response: Discussion will be included in Sec 5.2.2 on the range of pH values of soils at the IMR Ranges. Further, in an effort to better accommodate the use of site-specific data, partition coefficient (K_d) values for metals for low pH soils,

presented in Table 46 and C-4, EPA (1996) Soil Screening Guidance documents, will be used in the calculations to evaluate contaminant fate and transport. The text and tables will be revised to reflect these changes.

Comment 81: **<u>Page 5-10, Paragraph 1.</u> Please clarify the origin of the DAF_{20} for lead of 400 mg/kg. The reference cited for the value in Table 5-4 is EPA Office of Solid Waste and Emergency Response (OSWER) Directive Number 9355.4-12 (*Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*) issued in August 1994. EPA (1994) recommends a screening level for lead in soil for residential land use of 400 mg/kg. This screening level was developed using the Integrated Exposure Uptake Biokenetic (IEUBK) model, which is based on direct exposure to lead contamination in soil. It does not address or model leaching of lead contaminants through the soil column to underlying groundwater. Please revise DAF_{20} SSL or use leaching tests instead of modeling to determine the potential mobility of lead in the soil water environment at the ranges.**

Response 81: Please note that Table 5-4 (and also Table 5-2), although placing the value of 400 mg/kg in the column for DAF 20, have indicated by footnote "c" that EPA has established a soil screening level of 400 mg/kg for lead, and similarly to the reference cited by the reviewer, cites EPA, 1994. The reference was inadvertently not included as a reference in Section 9.0, References and will be added; a more recent August 1998 clarification to the 1994 document is listed in Section 9.0. Because this value is used as the recommended screening level for lead in soil for residential land use it is considered as a conservative dilution attenuation factor to be used in place of conducting leaching tests to estimate the mobility of lead in the subsurface.

Evaluation: *This screening criteria has no relation to processes that result in migration to groundwater. For this reason, EPA has separate screening criteria for direct contact exposure and migration to groundwater, a migration pathway. Therefore, this value should not be used for screening for migration to groundwater. Please address.*

Response to Evaluation: See Responses to Evaluations of Specific Comments 61 and 74.

ADEM Comment: **A value of 400 mg/kg should not be used as a screening level for the migration to groundwater pathway for lead as stated in the original comment. Please address.**

Final Response: It is agreed that a value of 400 mg/kg should not be used for the migration to groundwater pathway for lead. DAF_1 and DAF_{20} SSLs for lead have been calculated using EPA guidance (EPA 1996) and a partition coefficient (K_d) value of 3,373 L/kg (Hazardous Substance Data Base, 2009) and are used as

the screening criteria for lead for the migration to groundwater pathway. The text and tables will be revised to reflect these changes.

Comment 85: **<u>Page 6-9, Paragraph 2.</u> Please revise the text to state that underestimating the size of the exposure unit (EU) will result in a higher source-term concentration (STC) only if the EU is centered over the source area. Please note that each area of contamination should be treated as an EU rather than combining all sources and parcels. Please provide a separate dataset to evaluate each parcel and release.**

Response 85: This comment addresses two separate issues. Regarding the first, the Army respectfully disagrees that underestimating the size of the EU will result in a higher STC only if the EU is centered over the source area (i.e., if lesser contaminated samples are not included in the data set). We agree that centering the EU over the source area will usually result in a higher STC, but also, on many occasions, will simply reducing the number of samples because the variance in the data set may be increased.

The second issue is that the reviewer requested that each parcel and source area should be evaluated as separate EUs. The request is reasonable, and the approach taken at the Bains Gap Road and Baby Bains Gap Road ranges was to evaluate each range as a separate EU. Some of the Iron Mountain Road ranges, however, are small, and few samples were taken so that it was deemed more reasonable to combine the data across the ranges. Generally, a request to reduce the size of EUs reflects concern that STCs will be diluted by data from less contaminated areas and that unacceptable risk might be overlooked. This possibility, however, is precluded because the concentration of each COPC at each sample location is compared with the maximum permissible concentration.

The foregoing is illustrated by the risk assessment for the on-site resident. COPCs in surface soil for the resident included antimony, arsenic, copper, lead, and the PAHs benzo(a)anthracene, benzo(a)pyrene and dibenz(a,h)anthracene (Table 6-12). COPCs in subsurface soil included antimony, lead and benzo(a)pyrene (Table 6-13). COPCs in total soil, therefore, included antimony, arsenic, copper, lead, benzo(a)anthracene, benzo(a)pyrene and dibenzo(a,h)anthracene (Table 6-14). COPCs in groundwater were limited to 4-amino-2,6-dinitrotoluene (4-ADNT) (Table 6-15). COPCs in surface water (Table 6-16) and sediment (Table 6-17) were limited to lead. The cumulative ILCR and HI summed across all media (limited to total soil and groundwater because lead in surface water and sediment cannot be evaluated in this manner) for the on-site resident were 1.77E-4 and 1.10E+1, respectively (Table 6-18).

The EU evaluation for the on-site resident is explained in Section 6.6.2.2, pages 6-20 and 6-21. Lead, antimony and arsenic were identified as COCs, and all the sample locations on any range in which site-related concentrations

exceeded their maximum permissible concentrations were identified. No site-related concentrations of copper exceeded the maximum permissible concentration. 4-ADNT does not share a target organ with the other noncancer-based COPCs; therefore, the HI of 1.50E-1 for this chemical is of no concern. The maximum detected concentrations of the PAHs fell below their maximum permissible concentrations.

In summary, comparing the concentration of each COPC in each sample for each receptor with their maximum permissible concentrations (or otherwise explaining that they do not represent an unacceptable health threat) permits identifying exactly where the receptor scenario would "fail" regardless of how many EUs are evaluated or how they are gerrymandered.

Evaluation: *The Army agrees that centering an EU over each source area usually results in higher EPCs. This should be done unless the Army demonstrates that data variability across sites is sufficiently similar to warrant combining datasets. Please address.*

Response to Evaluation: This comment addresses two separate issues. Regarding the first, the Army respectfully disagrees that underestimating the size of the EU will result in a higher STC *only* if the EU is centered over the source area (i.e., if lesser contaminated samples are not included in the data set). We agree that centering the EU over the source area will usually result in a higher STC, but also, on many occasions, will simply reducing the number of samples because the variance in the data set may be increased.

The second issue is that the reviewer requested that each parcel and source area should be evaluated as separate EUs. The request is reasonable, and the approach taken at the Bains Gap Road and Baby Bains Gap Road ranges was to evaluate each range as a separate EU. Some of the Iron Mountain Road ranges, however, are small, and few samples were taken so that it was deemed more reasonable to combine the data across the ranges. Generally, a request to reduce the size of EUs reflects concern that STCs will be diluted by data from less contaminated areas and that unacceptable risk might be overlooked. The consequence, that individual sample locations where the concentration of a COPC greater than its cleanup level may escape notice, is precluded because the concentration of each COPC at each sample location is compared with the cleanup level, as was explained during the presentation on the Streamlined Risk Assessment during the meeting with ADEM on 12 October 2007.

ADEM Comment: **The response to evaluation does not appear to be adequate. The EU should be centered over each source area unless the Army demonstrates that data variability across sites is sufficiently similar to warrant combining datasets. Please address.**

Final Response: It appears that the reviewer's concern reflects the possibility that selecting a large EU or failure to center the EU over the source area (highest concentrations) could lead to understating the STC and the resulting risk estimates. We would agree if the risk assessment used a typical baseline risk assessment paradigm. The streamlined risk assessment (SRA) approach used herein, however, precludes that difficulty, as explained below.

The purpose of a risk assessment in an RI report is to provide information to the risk managers to support the development of remedial alternatives and to support the ensuing risk management decisions (EPA, 1991). In a typical baseline risk assessment for the resident this is accomplished by the following:

- Identifying COPCs based on the MDC, so that no chemical that could contribute significantly to risk is overlooked.
- Calculating cumulative risk and comparing the cumulative risk estimates with the appropriate trigger levels to determine whether chemical of concern (COC) identification is necessary.
- Identifying the COCs.
- Developing remedial goal options (RGO) for the COCs.

Locating the EU for the resident over the area of highest concentration, as requested by the reviewer, is important in a typical baseline risk assessment so that the STCs and the resultant cumulative risk are not understated.

The streamlined risk assessment (SRA) approach adopted and implemented at FTMC since the mid-late 1990s operates somewhat differently to accomplish the same goals, as follows:

- Identifying COPCs for the resident in the same manner as in a typical baseline risk assessment.
- Calculating cumulative risk; however this step is unnecessary because cumulative risk estimates are not compared with trigger levels. For this reason the position of the EU and the resulting magnitude of the STC are immaterial.
- COCs are not identified; instead, cleanup levels are developed from the SSSLs for **ALL** the COPCs for the resident.
- Contaminant concentrations in each sample are compared with the cleanup levels.

The SRA approach permits identifying all areas where contaminant concentrations exceed cleanup levels regardless of how EUs are located. It is applied to the resident and construction worker, because a reasonable EU for these receptors would be somewhat smaller than the entire area represented by the data set. It is particularly useful when applied to shooting ranges where metals are the predominant contaminants, because the three-tiered background

evaluation identifies each sample location where metals are present at concentrations exceeding background.

Reference:
U.S. Environmental Protection Agency (EPA), 1991, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," Memorandum from DR Clay, Assistant Administrator, to Regional Directors, OSWER Directive 9355.0-30, 22 April.

Comment 86: **<u>Page 6-10, Paragraph 3.</u> According to the Alabama Risk-Based Corrective Action (ARBCA) guidance, the site-wide hazard index (HI) must be less than or equal to 1.0 (two significant digits), not 1. Please revise this paragraph and any calculations where a value greater than 1.0 was used or presented as 1 (i.e., any value up to 1.49 used in calculations as a target hazard quotient or target hazard index rather than 1.0).**

Response 86: Rounding to 1 is consistent with EPA (1989 and 2002) guidance, which suggests rounding risk estimates to one significant figure. Although not stated in the EPA guidance documents, the reason for rounding is so that an unrealistic level of precision is not implied in risk characterization, as would be the case if HI values were presented with two significant figures. All HI estimates include dividing an exposure term by a reference dose (RfD). (In a FTMC SRA, this is accomplished in deriving the SSSLs.) There is a great deal of uncertainty about the exposure term. Also, most RfD values incorporate an uncertainty factor ranging from 100 to 10,000. Implying that the product of two values with such great uncertainty can be expressed to the level of precision implied by two significant figures is mathematically inappropriate.

Furthermore, rounding is not only consistent with EPA guidance, it is consistent with the Installation-Wide Work Plan, which has been accepted by both EPA and ADEM. The IMR Ranges SRA was not performed under the ARBCA program, but the approved protocol qualifies as a site-specific RM-2 risk assessment under the ARBCA guidance.

Nonetheless, as requested by the reviewer, maximum permissible concentrations (cleanup levels) based on a target HI of 1.49 will be recalculated using an HI of 1.

References:
U.S. Environmental Protection Agency (EPA), 2002, ***Region 4 Human Health Risk Assessment Bulletins – Supplement to RAGS***, EPA Region 4, Atlanta, Georgia, online.

U.S. Environmental Protection Agency (EPA), 1989, ***Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual***

(Part A), Interim Final, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1-89/002.

Evaluation: *Please clarify that a value of 1.0 will be used in the recalculation of SSSLs.*

Response to Evaluation: As requested by the reviewer, maximum permissible concentrations (cleanup levels) based on a target HI of 1.49 will be recalculated using an HI of 1. All SSSLs for noncancer effects have always been calculated within EXCEL spreadsheets using a target HI of 0.1.

ADEM Comment: **Please clarify if a value of 1.0 will be used to recalculate the SSSLs. The response to evaluation only indicates a value of 1 (one significant digit) will be used. Please revise the response to show two significant digits.**

Final Response: The reviewer is confusing SSSLs with cleanup levels (see first sentence of comment). The noncancer SSSLs, used in the screening of site-related data to identify COPCs have always been based on an HI of 0.1. In order to respond to previous EPA comments on this series of documents, a typical EPA Region 4 "RGO" table will be prepared with cleanup levels (not SSSLs) based on HI values of 0.1, 1.0 and 3.0.

Comment 87: **<u>Page 6-12, Paragraph 3.</u> The text states that "the concept of EU, however, is very important to ensure that data from relatively clean areas do not dilute the data from the more heavily contaminated areas." This statement supports Specific Comment 85 which states that data across different releases and areas should not be combined together to form the data for the risk assessment. Please revise the risk assessment to reflect more appropriate EU evaluations.**

Response 87: Please see response to Specific Comment 85.

Evaluation: *Please see the Evaluation of Response to Specific Comment 85.*

Response to Evaluation: Please see Response to Evaluation of Specific Comment 85.

ADEM Comment: **Please see ADEM's Comment on Response to Evaluation of Specific Comment 85.**

Final Response: Please see response to evaluation of Specific Comment 85; additional information has been added that should clarify the matter.

Comment 93: **<u>Pages 6-18 and 6-19.</u> The SSSL of 7.60E+3 mg/kg is not protective of child recreational receptors. Furthermore, the use of an EU comprised of**

all ranges that a recreational receptor will be exposed to is unreasonable from an exposure standpoint. Please evaluate each range separately using a child receptor to calculate the SSSL or institutional controls should be implemented.

Response 93: This comment addresses two issues. Regarding the protectiveness of the SSSL for child recreational receptors, please see response to Specific Comment 88. Regarding the request to evaluate each range as a separate EU, please see response to Specific Comment 85.

Evaluation: *Please see the Evaluation of Responses to Specific Comments 85 and 88.*

Response to Evaluation: This comment addresses two issues. Regarding the protectiveness of the SSSL for child recreational receptors, please see Response to Evaluation of Specific Comment 82. Regarding the request to evaluate each range as a separate EU, please see response to Specific Comment 85.

ADEM Comment: **Regarding the protectiveness of the SSSL for child recreational receptors, the response is acceptable (per responses to Specific Comment 82). Regarding the request to evaluate each range as a separate EU, please see ADEM's Comment on Response to Evaluation of Specific Comment 85.**

Final Response: Please see response to evaluation of Specific Comment 85; additional information has been added that should clarify the matter.

Comment 95: **<u>Page 6-22, Paragraph 2.</u> The text states that a groundskeeper or recreational site user may be exposed randomly over the entire site and it is appropriate to estimate "a single STC for a given COPC from the entire data set." The sites encompass an area where the total acreage for each site is significantly larger than the area actually investigated. It is not reasonable to assume that a single groundskeeper would be conducting outdoor landscaping activities over this entire area under a future land use where site development occurs. Please evaluate a current and future commercial/industrial worker receptor separately since liberal exposure assumptions are assumed for the groundskeeper exposure scenario. If liberal assumptions are used, institutional controls should be implemented to ensure that these assumptions hold true for the future.**

Response 95: This comment addresses two related but separate issues. The first is that the site as a whole is too large to be cared for by a single groundskeeper, implying, as stated in Specific Comment 85, that each range should be evaluated as a separate EU. Please see response to Specific Comment 85. The second issue is that the exposure assumptions for a groundskeeper may

not apply to a commercial/industrial worker. Please see response to Specific Comment 89.

Evaluation: *Please see the Evaluation of Responses to Specific Comments 85 and 88.*

Response to Evaluation: Please see Responses to Evaluations of Specific Comments 85 and 89.

ADEM Comment: **Regarding the exposure assumptions for a groundskeeper, the response is acceptable (per responses to Specific Comment 89). Regarding the request to evaluate each range as a separate EU, please see ADEM's Comment on Response to Evaluation of Specific Comment 85.**

Final Response: Please see response to evaluation of Specific Comment 85; additional information has been added that should clarify the matter.

Comment 99: **<u>Page 8-6, Sections 8.2 and 8.3.</u> Please expand these sections to identify and discuss the explosive compound detections in groundwater. Page 4-8, Paragraph 5 indicates that two explosive compounds exceeded criteria at one or more sampling locations. Based on potentiometric contours presented in Figure 3-8, it appears that none of the monitoring wells may be appropriately located to intercept contaminant plumes that have migrated downgradient from the "hot spots" at each of the ranges. Please address.**

Response 99: Page 4-8, Paragraph 5 indicates that a total of two explosives were *detected* in site groundwater. Only one compound (4-amino-2,6-dinitrotoluene, 0.00047 mg/L) exceeded its very conservative SSSL (0.000094 mg/L) at one Skeet Range well location (HR-69Q-MW01). This compound was not detected in any other site wells, including adjacent bedrock well HR-69Q-MW02.

Evaluation: *The revised report should identify as a data gap that monitoring wells may not be appropriately located to intercept contaminant plumes that have migrated from the "hot spot" of each range. The revised report should also identify corrective action that considers additional well installation and groundwater sampling to fully characterize groundwater contamination. Please address.*

Response to Evaluation: Shaw attempted to re-sample existing well HR-69Q-MW01 in November 2007 based on agreements made during the ADEM comment resolution meeting. However, this well was dry and could not be sampled. It should be noted, however, that re-sampling for explosives at the BGR Ranges during this same timeframe showed no detections of explosive compounds. This finding is consistent with our previous experience re-sampling for spurious low-level detections of explosives in groundwater, namely that these

compounds are shown not to be present upon re-sampling. These observations, coupled with the fact that explosives are not present in soil at the IMR Ranges, suggest this is not a data gap.

ADEM Comment: **Since resampling at the BGR ranges was conducted and no detections of explosives were identified, then the response is considered acceptable. If later monitoring of the dry well, HR-69Q-MW01, shows water is present then a sample should be collected for analysis of explosives consistent with our agreement.**

Final Response: Comment noted.

Technical Evaluation of Summary of Inorganic Data Evaluations for Surface Soil, Subsurface Soil, Groundwater, Surface water, and Sediment (Tables 4-8 through 4-12), Iron Mountain Road Ranges Fort McClellan, Alabama

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General Comments

Comment 1: The tiered background data evaluation concepts underlying the data tables have reportedly already been agreed to by EPA and the generally methodology of using the 2 times rule and the statistical evaluation have been agreed to by ADEM and reaffirmed by ADEM during meetings at Ft McClellan. That specific agreement is consistent with ADEM guidance as it pertains to establishing and using soil background concentrations to eliminate soil COPECs. However, it was not accepted for application to sediment and surface water, since ADEM and CERCLA guidance specifies the use of data from upstream reference samples for sediment and surface water to establish "background" concentrations. Therefore, it seems reasonable to be consistent with prior commitments and agreements recognizing that the EPA has already agreed to the statistical methods for establishing soil background. However, site-specific surface water and sediment data from upstream samples should be used rather than the statistical lines of evidence, whenever possible, but only to assess incremental site risk relative to upstream/background as part of the risk characterization rather than for dismissing the contaminants prematurely at the preliminary stage of assigning COPECs even if they exceed risk-based screening values. Please address.

Response 1: It is important to understand the process of conducting ecological risk assessments at FTMC as it has evolved over the past ten years, including the agreements, compromises, and precedents that have been set and agreed upon by the BCT. Consistent with current USEPA and ADEM guidance, COPECs are initially identified in the SLERA by comparing the maximum detected constituent concentrations in each environmental medium to conservative ecological screening values (ESVs). Constituents whose maximum detected concentrations exceed their respective ESVs are identified as COPECs. In order to streamline the ecological risk assessment process, elements of step 3 of the 8-step ecological risk assessment process as outlined in USEPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (1997) have been incorporated into the SLERA process at FTMC. Namely, the process of refining the initial list of COPECs is incorporated into the SLERA process. Whether the process of refinement of the list of COPECs is conducted at the end of the SLERA (Step 2) or the beginning of the Problem Formulation (Step 3) is, in practice, inconsequential from a technical perspective. Incorporating elements of Step 3 into the SLERA provides for the presentation of additional information into the SLERA that will allow risk managers to make more informed risk management decisions at the completion of the SLERA. It is the Army's belief that providing risk managers with as much pertinent information at each risk management decision point is imperative to making informed decisions and that delaying the transfer of information to a later stage in

the ecological risk assessment process substantially reduces the efficiency and transparency of the process.

Per USEPA Region 4 guidance (*Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders*, June 23, 2000): "Problem formulation begins with the refinement of the COPCs. This step is an opportunity for facilities to present a reasoned toxicological approach for the elimination of one or more COPCs from future consideration. At this step, negotiations are undertaken to alter assumptions associated with the Screening Level ERA. These assumptions include but are not limited to area use factors (e.g. home ranges), incidental soil/sediment intakes, **background/reference location comparisons** and the nature of the contaminants." (underline and bold added for emphasis). Further justification for including a background comparison within the COPEC refinement process is found in "Step 3: Problem Formulation" of the USEPA Region 4 guidance (2000) which states: "Risk management issues such as background comparison, are introduced for discussion among stakeholders at this stage." It is clear from these passages from the USEPA Region 4 guidance (2000) that comparison to background is an accepted practice in the refinement of the list of COPECs to be carried forward into the Problem Formulation and Study Design portions of the ecological risk assessment process.

Furthermore, neither USEPA nor ADEM guidance specifies that background comparisons are solely applicable to soil or that background comparisons for surface water or sediment are invalid. In fact, the ADEM guidance cited in Specific Comment 3 below specifically states that background comparisons are appropriate and that "*[If an upstream sample is unattainable, a nearby site that has not been affected by the release should be used]," which is the case at the IMR and BGR Ranges at FTMC.* The background data set that has been approved for use by the BCT and used at FTMC over the past ten-plus years has been constructed from samples collected from nearby sites that have not been affected by operations at FTMC.

Furthermore, based on discussions between stakeholders at the December 2008 meeting at FTMC, it was agreed that background comparisons for soil, surface water, and sediment were consistent with ADEM guidance and were a valid screening tool for soil, surface water, and sediment. Based on the guidance cited above and agreements made at the December 2008 meeting, surface water and sediment constituents were not dismissed prematurely in the COPEC identification process.

Comment 2: The tabulated listing does not include all the inorganic constituents known to be associated with small arms ranges. Please address.

Response 2: It must be remembered that the IMR Ranges are inactive ranges that were used for routine small arms training from approximately 10 to 50 years ago. Based on the additional metals cited in the updated guidance document for *operating* small arms ranges mentioned by the reviewer (see Comment 2 below), it would appear

that these additional metals (e.g., cobalt, chromium, iron, nickel) are associated with more recent types of ammunition, as these metals were not identified in the 2003 ITRC guidance document for *closed* small arms ranges. These metals are not known to be associated with typical small arms ammunition such as that historically used at the IMR Ranges. This is further supported by the fact that analytical data from the IMR Ranges, as well as data from numerous other small arms ranges investigated at FTMC over the last 10 years, do not indicate the presence of elevated levels of other metals such as chromium, cobalt etc. The tables will be revised to indicate that the additional metals cited by the reviewer are not known to constituents of typical small arms ammunition such as that used at the IMR Ranges.

Specific Comments

Comment 1: According to Introduction to EPCRA Toxic Chemical Release Reporting For U.S. Army Munitions Operations, chromium is a metal potentially used in casing alloys and solid munitions components. Therefore, it seems appropriate to indicate that chromium is a known constituent in small arms ammunition. Please address.

Response 1: See response to General Comment 2 above.

Comment 2: Small arms range ammunition constituents also include iron[d] (used for bullet hardening) tin[e], chromium[e], nickel[e], cobalt[e] barium[e], potassium[e]; strontium[e,f] and magnesium[e,f] for tracer rounds potassium[e], strontium[e,f] , if training equipment such as red smoke grenades or smoke pots are used then the list of inorganic chemicals would also include mercury[g] and cadmium[g]. Please address.

Response 2: See response to General Comment 2 above.

Comment 3: The Tier 1, 2, and 3 background data/methods should not be used to eliminate COPECs in surface water and sediment during the SLERA or BERA for regulatory and scientific reasons. EPA's CERCLA guidance and national policy for ERA do not permit the use of analytical data for "background" or upstream "reference" media samples as a screening step to eliminate COPECs from further evaluation during an ERA. While ADEM guidance does allow the use of twice the average background concentration for inorganic COPEC selection in soils, it does not allow the use of background (nor reference habitat) data to eliminate surface water and sediment COPECs in an ERA. COPECs should be identified in the ERA solely by comparing the maximum detected analyte concentrations in each medium to the lowest available of their respective ESVs, such as national ambient water quality criteria (AWQC; USEPA 2006) or sediment benchmarks established by EPA and/or corresponding state criteria. Prior use of background data to eliminate sediment and surface water COPECs from the ERAs at several sites has led to inappropriate and premature elimination of COPECs that exceeded their ESVs, such as cobalt and mercury, the latter of which could pose significant risks of aquatic food web contamination and piscivorous wildlife exposure due to its high potential for biomagnification.

CERCLA guidance for ERA encourages comparisons of site versus "background" COPEC concentrations and hazard quotients (HQs) *in the risk characterization*, to document the relative, site-derived *incremental* risks to ecological receptors, as a basis for guiding subsequent risk management decisions. Background data should be used to compare sediment and surface water HQs within site-impacted habitats to the corresponding HQs in aquatic and wetland *reference* habitats *not* affected by the site, but *only after* (a) surface water or sediment COPECs are identified by screening the maximum detected analyte concentration against its lowest available ESV, and (b) total site risks are calculated for each COPEC that exceeds an ESV.

When evaluating incremental risk, statistically-derived background data on local/regional COPEC concentrations are ecologically inferior to site-specific analytical data for surface water and sediment samples, collected from *upstream or reference* habitats. Section 2.3.7(d) of the *Alabama Environmental Investigation and Remediation Guidance* (ADEM, March 2005) also specifies that an upstream location should be sampled to establish surface water "background" for flowing water conditions:

For flowing water situations, samples should be collected from a minimum of three locations. If possible, the first sample should be collected downstream of an area of actual or suspected release, the second sample collected at the point of the actual or suspected release, and the third sample should be collected upstream of the area of the actual or suspected release. The ***upstream sample should be used to determine background levels*** *[If an upstream sample is unattainable, a nearby site that has not been affected by the release should be used]*.

ADEM guidance in Section 2.3.7(e) prescribes the same approach to the sampling of sediments: *The factors that should be considered when conducting a sediment sampling event*.

Finally, Section C.5.1 (d) of *Appendix C – Sampling Methods* of this ADEM guidance also specifies surface water sampling of upstream locations: *A control station upstream from the waste source is as important as the stations downgradient, and should be chosen with equal care to ensure representative results.*

Thus, whenever possible, ambient concentrations of sediment and surface water COPECs *actually encountered* by aquatic biota (or their terrestrial predators) within upstream/upgradient habitats should be used to calculate incremental site-related sediment and surface water risks in the ERA. These incremental risks should be discussed *the risk characterization*, along with other lines of evidence (e.g., COPEC bioavailability), to evaluate the overall significance of any site-derived ecological risks for sediment and surface water.

Response 3: COPECs were not eliminated prematurely or inappropriately. USEPA Region 4 and ADEM guidance were appropriately applied in the identification and selection of COPECs in each environmental medium at the IMR and BGR Ranges at FTMC. Please see Response to General Comment 1.

Comment 4: All Tables: The ITRC January 2003 document, *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges* is cited at the bottom of each table (footnote b). Table 1-1 in this January 2003 ITRC document lists contaminants potentially found at small arms firing ranges. Subsequent to the 2003 document, another ITRC document was released in February 2005 entitled *Environmental Management at Operating Outdoor Small Arms Firing Ranges*. Table 2-1 in this document also lists contaminants potentially found at ranges and further includes a note that this list has been modified from the January 2003 ITRC document. Therefore, the 2005 document should be referenced on these tables since it is more current and contains information on additional potential contaminants not listed in the 2003 document. Specifically, the following tables/metals should be revisited based on the 2005 document. The results for these metals must be revisited to delete the justification that these are not known constituents of small arms ammunition and also to determine whether or not these metals may now qualify as COPCs based on the new data presented in the 2005 document:

a. Table 4-8: cobalt: listed in the 2005 document as potential contaminant as it was used in alloys in some ammunition rounds.
b. Table 4-8: nickel: listed in the 2005 document as potential contaminant as it was used in coatings to improve performance.
c. Table 4-9: chromium: listed in the 2005 document as potential contaminant as it was used in alloys in some ammunition rounds.
d. Table 4-9: iron: listed in the 2005 document as potential contaminant because used as iron tips on penetrator rounds and steel shot.
e. Table 4-9: nickel: listed in the 2005 document as potential contaminant as it was used in coatings to improve performance.
f. Table 4-10: cobalt: listed in the 2005 document as potential contaminant as it was used in alloys in some ammunition rounds.
g. Table 4-12: cobalt: listed in the 2005 document as potential contaminant as it was used in alloys in some ammunition rounds.
h. Table 4-12: chromium: listed in the 2005 document as potential contaminant as it was used in alloys in some ammunition rounds.
i. Table 4-12: iron: listed in the 2005 document as potential contaminant because used as iron tips on penetrator rounds and steel shot.
j. Table 4-12: nickel: listed in the 2005 document as potential contaminant as it was used in coatings to improve performance.

Response 4: See response to General Comment 2 above.

Additional References for Table

[d] U.S. Coast Guard Research and Development Center, Report No. CG-D-03-00; Laboratory Evaluation of Remediation Alternatives for U.S. Coast Guard Small Firing Ranges, November 1999.

[e] Jay L. Clausen, Nic Korte, Benjamin Bostick, Benjamin Rice, Matthew Walsh, Andrew Nelson; Environmental Assessment of Lead at Camp Edwards, Massachusetts Small Arms Ranges, August, 2007.

[f] URS Corporation, T Range Best Management Practices: Operations, Maintenance, and Monitoring Plan Camp Edwards, Massachusetts.

[g] Radian International; Range Scrap (Firing Point) Study Data Review and Inventory Report, June 1999.

RESPONSE TO COMMENTS

U.S. ENVIRONMENTAL PROTECTION AGENCY

Response to U.S. Environmental Protection Agency Comments on the Draft-Final RI Report for the Iron Mountain Road Ranges (dated May 2008) Fort McClellan, Alabama

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Comments from Doyle T. Brittain, EPA Senior Remedial Project Manager, dated July 22, 2008.

GENERAL COMMENTS

Comment 1: **Much interest has been expressed in derivation of risk-based remedial goals. Shaw is preparing a technical memorandum to discuss the derivation of risk-based remedial goals for protection of ecological receptors from site-related contaminants in soils and sediments. The technical memorandum was not received in time for these comments. However, to move the project forward, the preferred risk-based remedial goals presented in the April 2004 Draft RI report for Iron Mountain Road Ranges were considered. The May 2008 draft-final report did not include the preliminary remedial goal recommendations, per project team agreement that these would be provided in a separate document. EPA proposes the "Rule of Five" method for developing risk-based remedial goals from information contained in the draft-final RI report. The Rule of Five considers the full range of assessment endpoints when recommending risk-based remedial goals. Goals evaluated here are termed preliminary remedial goals as a reminder that the final choice of goals should consider goals necessary to protect human health, groundwater, and surface water. There are no comments here on the results of the No Observable Effect Concentrations (NOECs), Lowest Observable Effect Concentrations (LOECs), or Apparent Effects Thresholds (AETs) as reported in the draft-final report. All comments on the draft report pertaining to these toxicity test result parameters have been successfully addressed in the draft-final. For the food web calculations, two comments on the draft-final document could potentially affect the preliminary remedial goals. These were Editorial Comments 8 & 9. The tables of EPA-calculated preliminary remedial goals (Tables 1 & 2) reflect a 15-acre assumed size of the average firing range and a food ingestion rate for the marsh wren of 0.1833 g/g/day in wet weight (Page J-6-34). Tables 1 & 2 are presented as a correction to Table J-8-1, which used a slightly lower food ingestion rate for the marsh wren. (See Editorial Comment 9.) Preliminary risk-based goals in Table 1 are the same as in Table J-8-1. Some differences are possible in the last digits due to truncation errors. The preliminary risk-based goals in Table 2 are the same as in Table J-8-1 except for the difference with the marsh wren mentioned.**

As a setup to the Rule of Five, the results in Tables 1 and 2 for the range between the NOAEL (or NOEC) and LOAEL (or LOEC) were subdivided into six sections by inserting five nodes. The term NOAEL is used here to

mean the NOAEL, NOEC, or the lower bound to the uncertainty range for an Apparent Effects Threshold (AET). While the AET is usually a single number, this assessment considered the AET (or concentration equal to and above which adverse effects are always observed) and the highest concentration below the AET as an uncertainty range on the AET, analogous to a NOAEL-LOAEL range. The nodes were spaced out with a geometric progression, such that the middle node (Node 4) was equivalent to the geometric mean of the NOAEL- and LOAEL-based preliminary remedial goals (Tables 3 through 8). The nodes are merely decision-making aides. The Rule of Five encourages risk managers to consider the range of preliminary cleanup goals within and among the assessment endpoints. Where the preliminary remedial goal ranges among the assessment endpoints overlap, the Rule of Five approach recommends the geometric mean (Node 4) for assessments based on growth or reproductive endpoints.

The application of the Rule of Five to the IMR and BGR Ranges is somewhat unique due to sensitive growth endpoints, sensitive wildlife receptors, and elevated background levels. When the ranges of potential risk-based remedial goals overlap, concordance is sought among the nodes. Risk-based cleanup goal ranges that are much higher or much lower than the cluster of overlapping ranges may influence a choice within the overlap of the others. Outlier risk-based ranges generally make a poor choice for cleanup decisions when they are interpreted independent of the others. Risk-based ranges that are much higher than the others can reflect an assessment endpoint that happened to be not very conservative. The baseline problem formulation step in the ecological risk assessment attempts to focus the risk assessment on conservative assessment endpoints, but actual results can be difficult to predict. High outliers usually have less effect on the decision, because the goal is to protect sensitive receptors. Risk-based remedial goal ranges that are much lower than the others may be impossible to achieve from a practical standpoint, for example when cleanup goals are below background. The ultra conservative assessment endpoints might not govern the choice of risk-based remedial goal directly. They may, however, inform the choice of the risk-based remedial goal from within the overlapping range. When a measure of risk is described as having discriminating uncertainties (see General Comment 3), it might be possible to justify raising or lowering the preliminary cleanup goal. The preceding discussion is a general description of the Rule of Five. These discussions, however, describe considerations in selecting a risk-based remedial goal and are not hard-fast rules, despite the name. The overlap of the cleanup goal ranges and their Rule of Five nodes are found in Tables 3 through 8 and are illustrated in Figures 1 though 6.

The following discussion evaluates the risk-based remedial goals presented in the 2004 draft RI report. Preliminary risk-based remedial goals were

not provided in the draft-final RI report. The draft RI report recommended a preferred risk-based remedial goal for antimony in soil of 17.9 mg/kg. The American robin is the most sensitive receptor. The robin had a LOAEL-based risk-based goal of 13.9 mg/kg (Figure 1). While the LOAEL-based risk-based goal of 13.9 mg/kg for the American robin is slightly lower than 17.9 mg/kg, it is within the uncertainty of the food-web model. EPA agrees with the Army's choice of 17.9 mg/kg as the preferred risk-based remedial goal for antimony in soil. It provides a protective level of exposure to all ecological receptors–earthworm, mouse, robin, shrew and woodcock. It is also above the background concentration of antimony in soil of 2 mg/kg.

The preferred risk-based remedial goal for copper in soil in the draft RI was 334 mg/kg, which was equal to the earthworm growth AET (Figure 2). The earthworm growth AET protects the white-footed mouse at node 6. It also protects the American robin and short-tailed shrew. EPA agrees with the Army's choice of the risk-based remedial goal of 334 mg/kg for copper in soil. It is above background level of copper in soil of 12.7 mg/kg.

The preferred risk-based remedial goal for lead in soil proposed in the draft RI was 779 mg/kg. It was set equal to the LOEC for earthworm growth as a preliminary recommendation (Figure 3). The assessment endpoints for the American robin, short-tailed shrew, and American woodcock were more sensitive to lead than the observed toxicity to earthworms. It would appear that the originally proposed preference value is not sufficiently protective of wildlife receptors. EPA recommends a risk-based remedial goal for lead in soil of 500 mg/kg. EPA recognizes the impracticability of cleaning up to background, as would be necessary to protect the American robin. The risk-based remedial goal of 500 mg/kg is in the middle of the range for the white-footed mouse and short-tailed shrew. Although the remedial goal ranges for the robin and woodcock are unreasonable to attain from a practical perspective, EPA thinks it is necessary to lower the cleanup goal for lead to 500 mg/kg to approach the goals for robin and woodcock in order to be sufficiently protective. EPA recommends that the Army consider 500 mg/kg as a risk-based remedial goal for lead in soil.

For zinc in soil the preferred risk-based remedial goal from the draft RI was 72.8 mg/kg. This was the AET for zinc toxicity to earthworms (Figure 4). EPA supports the Army's initial preference. However, background zinc is 40.6 mg/kg. The geochemistry evaluation in Appendix H (Figures 19 and 20 in Appendix H) indicated that zinc concentrations above 100 mg/kg are rarely associated with background. Sometimes zinc levels between the background value of 40.6 mg/kg and 100 mg/kg are related to elevated alumina-silicate clays in soil samples and are background. EPA, therefore, recommends the Army consider raising the preferred risk-based remedial

goal for zinc in soil to 100 mg/kg. This choice will be protective of the environment and avoid potentially cleaning up zinc to levels below background.

For copper in sediment the draft RI proposed a preferred risk-based goal of 74.9 mg/kg. The preferred risk-based goal of 74.9 mg/kg is agreeable to EPA. It is protective of the marsh wren, whose NOAEL-based, risk-based remedial goal was 98.6 mg/kg (Figure 5). The background concentration of copper in sediment is 17.12 mg/kg. The preferred risk-based cleanup goal for copper in sediment will be protective of ecological receptors and will not require cleanup below background.

For lead in sediment the draft RI proposed a preferred risk-based goal of 76.7 mg/kg. The background level of lead in sediment was 37.8 mg/kg. The Army's suggested preferred value was based on the LOEC for Chironomid growth (Figure 6). The NOAEL to LOAEL range of the remedial goal to protect the marsh wren was below background. EPA agrees that the Army's preferred risk-based cleanup value will provide adequate protection to ecological receptors. Given that background levels of lead can sometimes be as high as 100 mg/kg in sediment, EPA recommends a site-specific geochemistry evaluation on stream segments having lead concentrations between 76.7 and 100 mg/kg as part of post-remedial sampling for confirmation of cleanup or if additional sampling will be part of the remedial design. Lead levels in sediments between 76.7 and 100 mg/kg might not require cleanups if manganese levels in these sediments are high. Please see Figures 32 and 33 in Appendix H. Some flexibility might be required.

Response 1: A revised Identification of Ecological Risk-based Remedial Goals report was submitted to USEPA, ADEM, and USFWS on October 2, 2008 for review. The revised report incorporated the discussions and agreements made by the Army, USEPA, and USFWS at the August 2008 BCT meeting at FTMC, and incorporated many of the comments/suggestions presented in this comment. Additionally, the Identification of Ecological Risk-based Remedial Goals report was discussed extensively at the December 11-12, 2008 meeting at FTMC which was held to discuss unresolved issues. Based on discussions at the December 11-12, 2008 meeting, the Identification of Ecological Risk-based Remedial Goals report will be revised again to incorporate the agreements reached at the meeting.

Comment 2: **Laboratory reports for the toxicity testing should be included as an appendix as they were in the draft RI. The report for the benthic invertebrate community analysis should also be provided.**

Response 2: The laboratory reports for the toxicity testing will be included as attachments to the BERA appendix in the Final RI report. There is no separate report for the

benthic invertebrate community analysis. The data collected as part of the benthic invertebrate community analysis are presented in Tables 5-11 through 5-13 in Appendix J.

Comment 3: **The uncertainty section, (Section 7.3) should discuss the site-specific uncertainties mentioned in preceding risk assessment sections. It is recommended that these uncertainties be presented in a table with a column describing whether the uncertainty is equivocal (i.e., cannot determine whether this uncertainty makes the risk higher or lower) or discriminating (i.e., one can make a case to argue that the uncertainty might go in one direction, making the risk higher or lower than predicted by the risk assessment).**

Response 3: A table will be incorporated into Section 7.3 that summarizes the uncertainties in the BERA and identifies the effect on the BERA results where possible.

Comment 4: **Concentrations of lead and copper in surface water exceed the site-specific toxicity benchmarks developed in the RI report and State standards for ambient water quality. The RI report should discuss preliminary remedial goals in sediment to achieve protective levels of surface water for exposure to aquatic organisms.**

Response 4: The discussion of remedial goals for sediment that are protective of surface water exposures is most appropriately reserved for the Feasibility Study, where a number of remedial goal options for each environmental medium will be discussed and weighted for their protectiveness of human health and the environment, along with a number of other weighting criteria.

SPECIFIC COMMENTS

Comment 1: **Section 7.1.9, Results of the Particulate Lead Ingestion Model, Pages 7-10 through 7-13. The Ecological Risk Assessment Technical Support Center (ERASC) is continuing their work on the revised Peddicord and LaKind (2000) model. The model being under development is likely to provide a more conservative estimation of risk to birds from ingestion of lead fragments than was presented in the BERA. The BCT team agreed that the BERA would not be revised, because the ERASC product would not be available in time for this assessment. No response is necessary to address this comment. Comments on this topic can be directed toward Specific Comment 7.**

Response 1: Comment noted.

Comment 2: **Section 7.1.10. Results of Fathead Minnow Toxicity Tests, Page 7-13. The fathead minnow growth NOEC for copper obtained for the site (0.105 mg/L) was roughly 10 times higher than the 0.0090 mg/L National**

Recommended Water Quality Criteria for copper for a hardness of 100 mg/L as $CaCO_3$. The National Recommended Water Quality Standard is more conservative than a single laboratory test on fathead minnows, because the standard was designed to protect 95 percent of aquatic species, some which might be more sensitive than fathead minnows. The state standard corrected for site specific hardness is recommended as a preliminary remedial goal.

Response 2: The RBRG for copper in surface water, as presented in the revised Identification of Ecological Risk-Based Remedial Goals (Shaw, October 2008), was 0.0211 mg/L, based on site-specific toxicity testing of fathead minnows and ceriodaphnids. It is important to note that this value is a site-specific ecological risk-based remedial goal and that other remedial goal options (e.g., ambient water quality criteria, human health criteria, etc.) should also be considered by risk managers in the feasibility study before selecting a final remedial goal for surface water.

Comment 3: **<u>Section 7.1.11. Results of the Ceriodaphnid Toxicity Tests, Page 7-14</u>. The National Recommended Water Quality Criteria for lead for 100 mg/L hardness as $CaCO_3$ is 0.0025 mg/L. Lead appears to be more toxic to aquatic organisms than copper. Also, the water quality standard is about equal to the detection limit for lead used in the study. Lead might be toxic to Ceriodaphnids at levels below the detection limit used in the present study. Detection limits should be provided. The reference samples were not toxic (Table J-5-8), but site samples with levels below the detection limit were toxic. The study is consistent with the National Recommended Water Quality Criteria. Data do not provide compelling evidence that lead or copper are less toxic at this site than represented by National criteria. Reproduction results from the tests are not appropriate for establishing a site-specific criterion given the high mortality observed in these tests. State surface water standards might be chemical-specific ARARs for this site. The Ceriodaphnia and fathead minnow tests provide insufficient evidence to raise the ARARs. The results, however, especially the LOEC for survival of 0.00236 mg/L for lead and non-detection levels associated with effects, suggest if anything that State standards might not be sufficiently protective. The cleanup goal for constituents in surface water is normally set to the ARAR. However, it is possible to have a cleanup goal lower than the ARAR if site-specific testing indicates ARAR is not sufficiently protective. EPA is recommending that contamination in surface water be taken more seriously, but is not recommending a lower cleanup level than the National Recommended Water Quality Criteria of State standards for lead and copper.**

Response 3: The RBRG for lead in surface water, as presented in the revised Identification of Ecological Risk-Based Remedial Goals (Shaw, October 2008), was 0.0179 mg/L, based on site-specific toxicity testing of fathead minnows and

ceriodaphnids. It is important to note that this value is a site-specific ecological risk-based remedial goal and that other remedial goal options (e.g., ambient water quality criteria, human health criteria, etc.) should also be considered by risk managers in the feasibility study before selecting a final remedial goal for surface water.

Comment 4: **Section 7.1.12. Results of the Chironomid Toxicity Tests. The chironomid survival reported in Table J-5-9 ranged from 4 to 46 percent for all samples. The low survival adds uncertainty to the test results. If the control survival was low, it could invalidate the results of the test. Please provide the laboratory report for the chironomid toxicity testing.**

Response 4: As presented in the response to General Comment 2, the laboratory reports for the toxicity testing will be provided in appendices of the Final RI report. Chironomid survival rates in the laboratory control sample and reference site sample were 82 percent and 33 percent, respectively. The acceptability criterion for the laboratory control sample was 80 percent; therefore, the results are valid. The results do indicate that the sediments in the vicinity of FTMC (both on-site and the reference location) have some limitations regarding their ability to support viable populations of chironomids. This is an important factor in assessing the results of the toxicity tests and other lines of evidence with respect to sediments at the IMR and BGR Ranges.

Comment 5: **Section 7.1.14. Results of Benthic Invertebrate Community Analysis, Pages 7-16 through 7-21. The results of the benthic invertebrate community analysis were not discriminating, because habitat was suboptimal or poor at all stations evaluated. The site stations all scored less than half of the score of the reference site, suggesting an effect potentially related to contamination. A site specific AET for severe impairment for copper was 308 mg/kg. A LOEC to NOEC range for severe impairment for copper was 126 mg/kg to 74.9 mg/kg. Confidence in the results is low. The level of impact would potentially be high, if copper in sediments remained at the site at levels near 126 mg/kg. Similarly, lead levels in the range of levels observed at Stations SAR-85-SD02 and SAR-85-SD08 (495 and 605 mg/kg, respectively) might be associated with severe impairment of benthic communities. Confidence in these results is low. The stations having severely impaired benthic communities are on Cane Creek within Range 27 (Parcel 85Q) of the Bains Gap Road Ranges. There is uncertainty in the direct application of these results to Iron Mountain Road Ranges, as Remount Creek samples were not tested. The low confidence in these data places more reliance on results for other assessment endpoints. The results for the benthic invertebrate community analysis can be used, as long as risk managers understand the low confidence in the results. Uncertainties discussion for the benthic invertebrate community analysis, presented on Page 7-29, should be enhanced.**

Response 5: The uncertainties associated with the benthic community analysis are discussed in detail in the BERA presented as Appendix J of the RI report. Additional detail will be included in the uncertainty discussion in Section 7.3 of the RI report.

Comment 6: **<u>Section 7.1.14. Results of Benthic Invertebrate Community Analysis, Page 7-21</u>. Text indicated that cobbles, boulders, and high energy flows could impair the habitat for benthic invertebrate communities at Stations SAR-85-SW/SD02 and SAR-85-SW/SD08. These stations were both categorized as having sub-optimal, as opposed to poor, habitat in Table J-6-29. Although the confidence in the results of the benthic invertebrate community assessment is low, the severely impaired conditions in the benthic community at these stations cannot be attributed solely to large substrate and high flows. Benthic invertebrates are adept at colonizing cobbles and boulders. A site-specific AET and NOEC to LOEC range can be discerned for copper.**

Response 6: The uncertainties associated with the benthic community analysis are discussed in detail in the BERA presented as Appendix J of the RI report. Additional detail will be included in the uncertainty discussion in Section 7.3 of the RI report.

Comment 7: **<u>Section 7.3, Uncertainties in the Lead Particle Ingestion Model, Page 7-27</u>. The thorough review of the literature presented in the ERASC paper suggests that the particle retention time is shorter than the 10 days estimated by particle deterioration (McConnell 1968). The high end estimate of the 156 days represented a condition where grit was limited, as over the winter when snow cover may limit accessibility of grit. The 156 day retention time does not represent conditions at the site. This comment is not asking for a change to the model. The comment is pointing out that the uncertainties discussion for the Peddicord and Lakind model was unbalanced in that it emphasized uncertainties that might suggest that risk to birds was overestimated by the model. In particular the discussion on Page 7-27 suggested that no information was available in the literature relating lead bullet fragments to bird toxicity. However, Fisher et al. (2006) published a review of lead toxicity to terrestrial birds from ammunition sources that contained 26 text references to toxicity of bullet fragments and 29 references to scientific articles documenting avian poisonings by bullet fragments. Moreover, a crust forms on bullets as they weather (Cao et al. 2003) that can smooth rough edges of bullet fragments, such that shape and texture are not unlike that of natural grit. Text should be revised to discuss the full range of particle retention times. The following information should be considered in this discussion.**

The estimates of the probabilities of ingesting lead particles by the Peddicord and Lakind model are greatly influenced by estimates of the grit

retention time. The grit retention time is used directly to estimate the number of grit particles ingested in a bird's lifetime, *N*, which is an exponent in the model. The grit retention time is highly variable even under controlled experimental conditions with individual birds administered a batch of identical particles. Some of the particles are voided right away while others are retained for extended periods. When reviewing literature on grit retention times, it is important to consider whether the authors reported the mean grit retention time, the maximum or some other expression of retention time. The mean grit retention time is appropriate for estimating the average number of particles ingested over a bird's lifetime.

The shortest estimate of the mean grit retention time was 0.24 days for house sparrows (Fischer and Best 1995). Fischer and Best's (1995) estimate is biased low. The house sparrows in the study were fed an atypically soft diet that did not require grit for digestion; hence, they eliminated their grit rapidly. The longest estimates of grit retention time were reported by Gionfriddo and Best (1999). These authors discussed examples of the ability of birds to retain grit in their gizzards for extended periods of time when grit availability is limited, such as by snow cover. These cases, however, do not describe grit use by birds under typical conditions. The longest grit retention time in Gionfriddo and Best (1999) was based on a study by Robel and Bisset (1979) where bobwhite quail were maintained in environmental chambers for 9 months without access to grit, but at necropsy birds still had some of the original grit from an earlier housing arrangement retained in their gizzards. Most of these examples do not reflect mean grit retention time, and several reflect experimental manipulation of grit availability or diet.

Few studies report actual mean grit retention times in birds. Available studies are summarized in Table 9. For studies that reported the number of grits retained over a series of days, remaining grit as a function of time was fit to an exponential random variable with rate parameter (λ). By describing the retention time as an exponential function, λ is calculated for each distribution to estimate the mean and median retention time. Mean retention time equals $1/\lambda$, while the median equals $\ln(2)/\lambda$ or $0.693/\lambda$.

When grit retention times reflecting experimental manipulation of grit availability or diet were eliminated, the literature-reported mean retention times ranged between 0.43 and 2.08 days. Median retention times ranged between 0.3 and 3 days. This comment is written to suggest that the uncertainties discussion pertaining to the particle ingestion of lead fragments is unbalanced and does not consider the effect on the risk estimate of the full range of literature-reported, grit retention times. Although risk estimates using the Peddicord and LaKind model are

uncertain, it appears more likely that the model underestimated the actual risk to birds as applied in the BERA.

Response 7: The uncertainties associated with the lead particle ingestion model are discussed in detail in the BERA presented as Appendix J of the RI report. Additional detail will be included in the uncertainty discussion in Section 7.3 of the RI report and will include information presented in the comment.

Comment 8: **<u>Section 7.3, Uncertainties in Riparian Food Web Model, Page 7-29</u>. Section J6.2.6.1, Page J-6-33, explained how the food web model to assess aquatic invertivorous mammals modeled the little brown bat (*Myotis lucifugus*). The text says that according to LaVal et al. (1977) gray bats (a cogeneric species) may travel as far as 12 kilometers from roost caves to foraging areas. No information specific to the little brown bat was available at the time. The distance traveled from cave to foraging ground is not the same as the area over which a bat concentrates its feeding, because a bat might travel several kilometers from cave to a preferred feeding ground but then feed in a smaller area. The area use factor (AUF) used in the food web model to assess the invertivorous mammal was 0.1. Therefore, the risks predicted for the invertivorous mammal were small, and the preliminary remedial goals were much higher compared to the invertivorous bird. University of Michigan students performed radiotelemetry studies of little brown bats and reported a 95% kernel home range for female bats in the month of June of 12.2 hectares. For a 15-acre site that would produce an AUF of 0.5. This uncertainty should be addressed. Using an AUF of 0.5 would reduce the preliminary remedial goals for the invertivorous mammal by a factor of 5.**

Response 8: The foraging area for the little brown bat was reported to be approximately 40 acres in size (University of Michigan, 2006). The size of the available bat foraging habitat along Cane Creek and its tributaries at the BGR ranges was estimated to be approximately 16,400 linear feet, and approximately 50 feet wide, resulting in a total foraging habitat size of approximately 19 acres. Therefore, the Area Use Factor for the little brown bat was estimated to be approximately 0.5 at the BGR ranges. The size of the available bat foraging habitat along Remount Creek and its tributaries at the IMR ranges was estimated to be approximately 11,250 linear feet, and approximately 50 feet wide, resulting in a total foraging habitat size of approximately 13 acres. Therefore, the Area Use Factor for the little brown bat was estimated to be approximately 0.325 at the IMR ranges. Because these two range complexes were assessed within the context of a single BERA, the more conservative AUF of 0.5 will be used in the riparian food web model and presented in the BERA for the IMR and BGR ranges (Appendix J of the IMR RI report and Appendix K of the BGR RI report).

Comment 9: **<u>Section 8.1.4, Surface Water Contaminant Distribution, Page 8-2</u>. This comment was written because text on the bottom of Page 8-2 indicated: "After statistical and geochemical evaluation, the maximum lead detection at the Skeet Range was found to be the only anomalous concentration in surface water." EPA disagrees that the lead detected in surface water at SAR-RC-SW06 in April 2000 (0.0871 mg/L) was the only anomalous concentration detected in surface water. Figure 42 in Appendix H clearly shows both of the two elevated lead levels in surface water (SAR-RC-SW06 and SAR-RC-SW10) plotted above the background trend (Figure 7). The argument in Appendix H that the lead surface water concentration of 0.0356 mg/L was below the background maximum of 0.0473 mg/L is not a line of reasoning accepted under the Shaw (2005) background-screening protocol, especially when geochemical evidence is contradictory. EPA's disagreement with using the background maximum as the primary screen for site background was the impetus for the three-tiered, background-screening protocol. Moreover, surface water data collected for the IMR and BGR BERA indicated that several samples had lead levels similar to the 0.0356 mg/L detected in SAR-RC-SW06 (Table 10). The samples of Remount Creek with lead levels consistent with the 0.0356 mg/L had ratios of the concentration of lead to the concentration of aluminum (Al/Pb) greater than the 0.38 value discussed in the response to comments on the draft RI. Six or seven surface water samples collected for the BERA contained lead levels that were above background by all background-screening criteria considered under the Shaw (2005) background-screening protocol yet did not exceed the maximum background concentration. Comparison of site samples to the background maximum is a very poor predictor of elevation above background. Figure 7 indicates that the background maximum is a geochemical outlier and not reliable background. Surface water data at SAR-85-SW07 was replicated. The first sample produced an Al/Pb of 0.71. The second sample produced an Al/Pb of 0.46. This indicates that the accuracy of the ratio is low. Ratios cannot be interpreted to the level of precision applied in the text of Appendix H or in the response to comments. Text in the summary and conclusions underemphasizes the significance of elevated lead levels in surface water detected at the IMR ranges. Text should be revised. Lead in surface water is an important problem that should have its own remedial action objective and risk-based remedial goals.**

Response 9: Lead was identified as a site-related COPC for surface water in the draft-final Iron Mountain Road Ranges RI report. Please see Table 4-11 ("Summary of Inorganic Data Evaluations for Surface Water").

It is unclear to which samples Specific Comment 9 is referring. The surface water data set included in the Iron Mountain Road Ranges site-to-background comparison (Appendix H) consisted of the following nine samples, which were collected in April 2000: HE2001 (location SAR-RC-SW/SD01), HE2003

(SAR-RC-SW/SD03), HF2001 (SAR-RC-SW/SD04), HJ2001 (SAR-RC-SW/SD05), HJ2002 (SAR-RC-SW/SD06), HJ2003 (SAR-RC-SW/SD07), HJ2005 (SAR-RC-SW/SD09), HJ2006 (SAR-RC-SW/SD10), and HJ2009 (SAR-RC-SW/SD13). Of these nine samples, only four had detectable lead: 0.0018 J mg/L (HJ2005), 0.0027 J mg/L (HJ2009), 0.0356 mg/L (HJ2006), and 0.0871 mg/L (HJ2002).

The second-highest lead detection in the Iron Mountain Road Ranges surface water data set (0.0356 mg/L) is observed in a sample (from location SAR-RC-SW/SD10) that has a pH reading of 3.93. The remaining eight samples had pH readings of 4.35 to 8.03, with a median of 5.85 and mean of 5.88. Under the acidic conditions at location SAR-RC-SW/SD10, lead is not expected to strongly adsorb to the surfaces of suspended clay minerals (because of increased competition for sorption sites from H+ ions). The Pb/Al ratios in such waters are therefore not expected to be identical to ratios from samples reflecting circumneutral conditions; natural variability in the ratios is expected. This information will be added to the lead evaluation in Appendix H (please also see the Response to Specific Comment 11, below).

The comment states that "Ratios cannot be interpreted to the level of precision applied in the text of Appendix H or in the response to comments." The methodology text in Appendix H (Sections 2.2.1 and 2.2.2) acknowledges the variability of elemental ratios; for example: "It is important to note that there is natural variability, as well as analytical uncertainty, in the elemental ratios of uncontaminated soil samples. Trace/major element ratios are calculated from two uncertain analytical results, so the resulting uncertainties in the ratios can produce some scatter in the points on a ratio plot. This is especially true when estimated ('J'-qualified) analytical results are used. This can be seen on many of the plots that show more scatter of the points at the lower end of the concentration range, where analytical uncertainties are higher and analytical results are reported with fewer significant figures." Interpretation of elemental ratios is more complicated for aqueous data because trace element behavior is more complex in groundwater and surface water, for all of the reasons explained in Section 2.2.2.

As agreed in previous meetings and responses-to-comments, the results of the geochemical evaluation are used as only one line of evidence, among several lines of evidence, to determine if an element should be considered a site-related COPC. The Appendix H geochemical evaluation concluded that one surface water sample contains anomalously high lead; together with the other lines of evidence, lead was therefore declared a site-related COPC for surface water.

We respectfully disagree with the statement in the comment that "EPA's disagreement with using the background maximum as the primary screen for site background was the impetus for the three-tiered, background-screening protocol." Although modified slightly in recent years (e.g., performing the WRS test at the 80% confidence level, at the request of EPA Region 4), Fort

McClellan's site-to-background comparison approach was initiated by Shaw Environmental in 2002 (and first presented to and discussed by the BCT in January 2003) as a more complete and defensible alternative to the statistically invalid comparison of site concentrations to two-times-the-background-mean. The hot measurement test, Wilcoxon rank sum test, and geochemical evaluations have been used at dozens of facilities across the United States, in all ten EPA regions, to distinguish naturally elevated metals concentrations from site-related contamination, in all media.

Comment 10: **<u>Section 8.3. Recommendations</u>. The text on Page 8-8, lines 6 and 7 should say "The contamination poses a risk to human health and the environment." The BERA has not shown that risk is limited to sensitive ecological receptors. The BERA used central tendency exposure estimates to predict risk to typical receptors. The BERA conclusions are not limited to sensitive ecological receptors.**

Response 10: The last sentence in the first paragraph of Section 8.3 will be revised as follows: "The contamination may pose a risk to human health and ecological receptors."

Comment 11: **<u>Section H3.4, Surface Water. Appendix H, Page 24, Lead Geochemical Evaluation</u>. Text was not revised according to the agreement made in the response to comments on the draft RI report. Ratio plots were not included in the evaluation. Other lines of evidence were not included in the RI report to address lead contamination in surface water. See the response to Specific Comment 1 for Volume IV Appendix H of the Draft RI Report. The uncertainties in the geochemical evaluation identified in the comment have not been adequately addressed.**

Response 11: Appendix H was revised pursuant to responses to comments on the draft RI report and agreements made during conference calls/meetings. Ratio plots were incorporated in the reviewed geochemical evaluation for the draft-final Iron Mountain Road Ranges remedial investigation report. As stated in the original Response to 2004 Specific Comment 1, "…These plots are used to supplement the correlation plots for the ambiguous cases in which site samples lie near and perhaps only slightly above the background trend." This is a reference to visually ambiguous cases; not all correlation plots require an accompanying ratio plot, because in some cases all of the site samples clearly exhibit elemental ratios that are consistent with those of the background samples. Ratio plots are used in the report for the convenience of readers, to visualize the data in another way. Pages 8, 9, and 11 of Appendix H (draft-final RI report) provide several paragraphs explaining the purpose, use, and interpretation of ratio plots. The ratios are calculated in Excel spreadsheets and conditional formatting is used to highlight exactly which site samples have ratios that exceed the background ratio range. This is a reproducible approach and is not subjective. The absence of ratio plots (e.g., for nickel in soil; correlation plot in Figure 14) does not add uncertainty to the evaluation, because the ratio plots themselves are not the

deciding criteria for the determination of whether site concentrations are most likely natural.

A ratio plot (new Figure 42) will be added to the evaluation of lead in surface water. However, we emphasize that caution is always required when evaluating elemental ratios for aqueous samples: as noted on page 9 of Appendix H, "…ratio plots must be used with care when depicting aqueous data, and they should only be used for samples from oxidizing waters. For samples from low-redox areas, redox-sensitive elements (such as arsenic, iron, and manganese) are expected to display a higher degree of scatter on correlation plots and, hence, a wider range of ratios on ratio plots."

The title of Attachment 1 ("Geochemical Correlation Plots") might be confusing because it does not acknowledge the inclusion of ratio plots. Attachment 2 will be renamed "Geochemical Correlation Plots and Ratio Plots."

The other lines of evidence noted in the above Comment 11 and in the original Response to 2004 Specific Comment 1 are provided elsewhere in the RI report and are not a component of the Appendix H site-to-background comparison. "Lines-of-evidence" tables are provided in Section 4.0 of the RI report, and are titled "Summary of Inorganic Data Evaluations for Surface Soil," etc.

Comment 12: **<u>Section J6.1, Terrestrial Ecosystems, Page J-6-2</u>. An assessment endpoint–maintenance of healthy populations of gallinaceous and other ground-feeding birds–was not included in this section although it was agreed to be added according to the response to specific EPA comments on Volume IV, Appendix I. It was added as a risk question in Section 7.1.5, which is a start but not sufficient. Text should be revised.**

Response 12: The Terrestrial Assessment Endpoints are presented in Section 3.1.1 of Appendix J and include an assessment endpoint of "Maintenance of healthy populations of gallinaceous and other ground-feeding birds at the small arms ranges at FTMC." This assessment endpoint was inadvertently omitted from Section 6.1 of Appendix J, but it will be included in the revised BERA.

<u>EDITORIAL COMMENTS:</u>

Comment 1: **<u>Section 7.1.7, Results of Earthworm Bioaccumulation Test, Page 7-8</u>. This comment refers to in-text tables on Pages 7-8 and 7-16. Tables should explain *x* and *y*, specifically that these variables are natural logarithms. The table should be self explanatory.**

Response 1: Footnotes will be added to subject tables in Sections 7.1.7 and 7.1.13 to explain the x and y variables, as well as tables in Section 6.1.2 and 6.2.4 of the BERA.

Comment 2: **<u>Section 7.1.9, Results of Particulate Lead Ingestion Model, Pages 7-10 through 7-13</u>. Table references are incorrectly referring to Appendix I. Table 7-3, showing the results for the three grit retention times, is not referenced by the text. In-text table on Page J-6-16 should indicate that the values of 1.66 and 4.9 listed as the fractions of grit-sized particles that are lead are actually percents, not unit-less fractions.**

Response 2: Table references will be verified and the text will be revised to add a reference for the table showing the results of the three grit retention times. The in-text table will be revised to show the values of 1.66 and 4.9 as percentages and not unitless fractions.

Comment 3: **<u>Section 7.1.14. Results of Benthic Invertebrate Community Analysis, Pages 7-16 through 7-21</u>. Text indicated that details of the benthic community analysis were presented in Appendix I. Appendix I covers the Streamlined Human Health Risk Assessment. Figures that show the sampling stations in Remount Creek, Cane Creek, and tributaries should be provided in Appendix J for the benthic community analysis and other types of samples collected for the BERA.**

Response 3: The details of the benthic community analysis are presented in the BERA (Appendix J in the IMR RI report and Appendix K in the BGR RI report). All references to the BERA will be verified. Map(s) of the sampling locations for the BERA are presented as Figures 5-1 through 5-9 in Appendix J. These figures were inadvertently omitted from the previous version of the BERA, but will be included in Appendix J.

Comment 4: **<u>Section 8.1.7, Baseline Ecological Risk Assessment, Page 8-5</u>. Table 8-1 does not include potential risk-base remedial goals (RBRGs) for surface soils. The table appears to be incomplete.**

Response 4: Table 8-1 includes a range of RBRGs for the COPECs in soil which may have been inadvertently omitted from the BERA report. Table 8-1 will be checked for completeness in the Final BERA.

Comment 5: **<u>Section J6.1.3, Terrestrial Food Web Model, Page J-6-8</u>. Equation on top of Page J-6-8 does not need the ($1-M_{diet}$) term because ingestion rates are all already expressed on a dry-weight basis. Calculations are correct. Only the formula was explained incorrectly. Units explaining wet weight or dry weight should be provided for the parameters used in the equation on Page J-6-8. Text should be revised to include the units on all variables. Equation on Page J-6-32 also has the ($1-M$) term to remove.**

Response 5: The moisture content term will be removed from the pertinent equations. The text explaining the input parameters will incorporate clarification regarding wet weight or dry weight and will include units for all input parameters.

Comment 6: **<u>Section J6.1.3.4. Terrestrial Invertivorous Bird Model Parameters, Page J-6-11</u>. The equation expressing the ingestion rate of soil and the accompanying text does not explain how the risk calculations for the terrestrial receptors incorporated a factor of 0.6 bioavailability adjustment for metals contained on incidentally ingested soils. Text and equation should be modified to explain exactly how risk calculations were performed.**

Response 6: The text will be revised to include a discussion of the bioavailability fraction used in the exposure equations.

Comment 7: **<u>Section J6.1.3.4. Terrestrial Invertivorous Bird Model Parameters, Page J-6-11</u>. The text in the middle paragraph of Page J-6-12 indicated that an area use factor (AUF) was used to account for the home range of the receptor. However, the text did not indicate the assumed area of the firing range that was used to calculate the factor. If appears as if the assumed area of the average range was 15 acres. This comment is not questioning the assumption of the 15 acres but is asking that the text clarify that this assumption was used. A table of range areas is recommended.**

Response 7: The text will be revised to clarify the area of the firing ranges and the foraging areas for each receptor used to estimate the Area Use Factor.

Comment 8: **<u>Section J6.2.6.2. Riparian Invertivorous Bird Model Parameters, Pages J-6-33 through J-6-35</u>. Text on the fourth line of Page J-6-34 indicated that the food ingestion rate for the marsh wren used in the riparian food web model was 0.1833 g/g/day. The value was correct according to the explanation in the text of its derivation. However, Table J-6-30 listed the food ingestion rate of the marsh wren as 0.1722 g/g/day. The incorrect value of 0.1722 g/g/day affected food web model results shown in Tables J-6-34, J-6-36, J-6-40, J-6-42, J-6-43, J-6-44, J-6-45, and J-8-1. In Table J-8-1 (Page 2 of 3) the NOAEL-based preliminary remedial goal for the marsh wren for copper should be 98.6 mg/kg. The LOAEL-based preliminary remedial goal for the marsh wren for copper should be 168.2 mg/kg. The NOAEL-based preliminary remedial goal for the marsh wren for lead should be 3.07 mg/kg. The LOAEL-based preliminary remedial goal for the marsh wren for lead should be 12.2 mg/kg.**

Response 8: The correct food ingestion rate for the marsh wren is 0.1833 g/g/day. The riparian food web model and all other associated tables will be revised to ensure the correct value for the food ingestion rate of the marsh wren is reflected in the results.

Comment 9: **<u>Section J8.1.17. Results of Benthic Invertebrate Community Analysis, Page J-8-19</u>. The comparison to reference for all eight matrices was not presented in Table 5-10. Please correct table reference.**

Response 9: The comparison to the reference station was made in Table 5-13 in Appendix J. The text will be revised to correct the table reference.

Comment 10: **<u>Section J8.2.1. Terrestrial Ecosystems</u>. Peddicord is spelled incorrectly on Page J-8-23.**

Response 10: The spelling of Peddicord will be corrected as noted.

Comment 11: **<u>Section J9.0. References</u>. The reference to LaVal et al. (1977) pertaining to the home range of gray bats is missing from the reference section. Please provide.**

Response 11: The LaVal et al. (1977) reference is no longer used in the report due to the use of the University of Michigan (2006) reference to estimate foraging areas for little brown bats.

Comment 12: **<u>Table J-6-3. Biological Fate and Transport Properties for the Constituents of Potential Ecological Concern in the Terrestrial Foodweb</u>. Table J-6-3 listed the bioaccumulation factor (BAF) for soil to plant for zinc as 1.2E-12 when the risk assessment calculations used a value of 0.0055. This discrepancy should be corrected and the source of the BAF identified and documented.**

Response 12: The soil-to-plant BAF for zinc of 1.2E-12 is the correct BAF as referenced from USEPA (1999). The spreadsheets for the terrestrial food web model will be revised accordingly.

Comment 13: **<u>Table J-8-1. Summary of Potential Ecological Risk-based Remedial Goals</u>. Please include a 28-day earthworm growth AET for antimony of 63.3 mg/kg. All antimony concentrations above 63.3 mg/kg in Table J-5-5 showed significant effects on growth.**

Response 13: A 28-day earthworm growth AET for antimony of 63.3 will be added to Table 8-1 in Appendix J.

<u>REVIEWER REFERENCES:</u>

Cao, X.; Ma, L.Q.; Chen, M.; Hardison, D.W., Jr.; and W.G. Harris. 2003. Weathering of lead bullets and their environmental effects at outdoor shooting ranges. *J. Environ. Qual.* 32:526-534.

Fischer, D.L. and Best, L.B. 1995. Avian consumption of blank pesticide granules applied at planting to Iowa cornfields. *Environ. Toxicol. Chem.* 14: 1543-1549.

Fisher, I.J.; Pain, D.J.; and V.G. Thomas. 2006. A review of lead poisoning from ammunition sources in terrestrial birds. *Biological Conservation* 131: 421-432.

Gionfriddo, J.P. and Best, L.B. 1995. Grit use by house sparrows: Effects of diet and grit size. *The Condor* 97: 57-67.

Gionfriddo, J.P. and Best, L.B. 1999. Grit use by birds: A review. *Current Ornithology* pp. 89-148. Kluwer Academic/Plenum Publishers, New York, NY.

King, J.R. and Bendell-Young, L.I. 2000. Toxicological significance of grit replacement times for juvenile mallards. *Journal of Wildlife Management* 64: 858-862.

Mateo, R. and Guitart, R. 2000. The effects of grit supplementation and feed type on steel-shot ingestion in mallards. *Preventative Veterinary Medicine* 44: 221-229.

McConnell, C.A. 1968. Experimental lead poisoning of bobwhite quail and mourning doves. Webb, J.W. Proceedings of the Twenty-first Annual Conference Southeastern Association of Game and Fish Commissioners. 1968.

Peddicord, R.K. and J.S. LaKind. 2000. Ecological and human health risks at an outdoor firing range. *Environ. Toxicol. Chem.* 19(10): 2602-2613.

Robel, R.J. and Bisset, A.R. 1979. Effects of supplemental grit on metabolic efficiency of bobwhites. *Wildlife Society Bulletin* 7: 178-181.

Shaw Environmental, Inc. 2005. *Selecting Site-related Chemicals for Human Health and Ecological Risk Assessments for FTMC: Revision 3,* Technical memorandum by K. Thorbjornsen, J. Meyers and P. Goetchius, dated 14 March.

Trost, R.E. 1981. Dynamics of grit selection and retention in captive mallards. *Journal of Wildlife Management* 45: 64-73.

REVIEWER TABLES AND FIGURES:

Figure 1. Rule of Five Plot for Antimony in Soil.

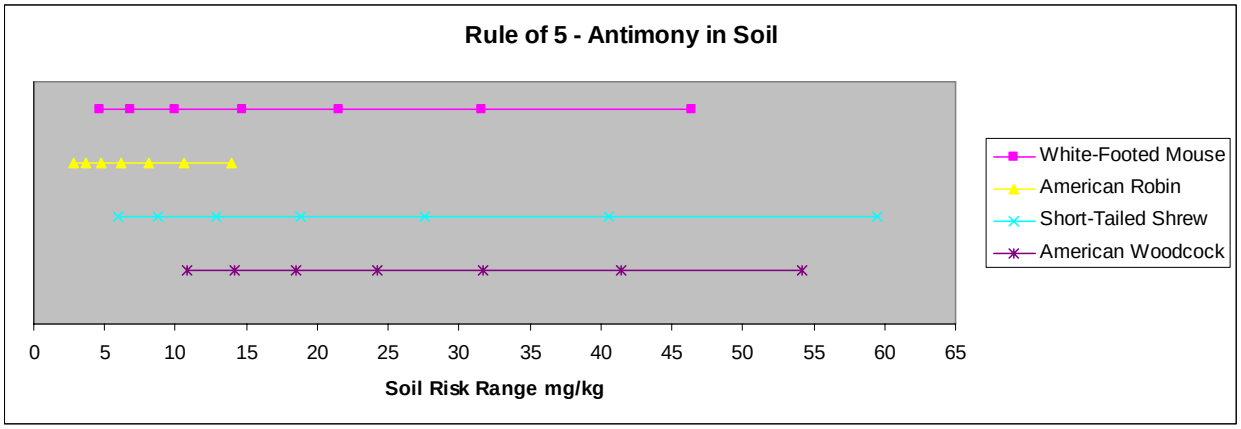


Table 3. Rule of Five Nodes for Antimony in Soil

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Earthworm Growth (AET)	39.5	42.7	46.2	50.0	54.1	58.5	63.3
White-footed Mouse	4.64	6.81	10.0	14.7	21.5	31.6	46.4
American Robin	2.78	3.64	4.75	6.22	8.13	10.6	13.9
Short-tailed Shrew	5.95	8.73	12.8	18.8	27.6	40.5	59.5
American Woodcock	10.8	14.1	18.5	24.2	31.7	41.4	54.2

Figure 2. Rule of Five Plot for Copper in Soil.

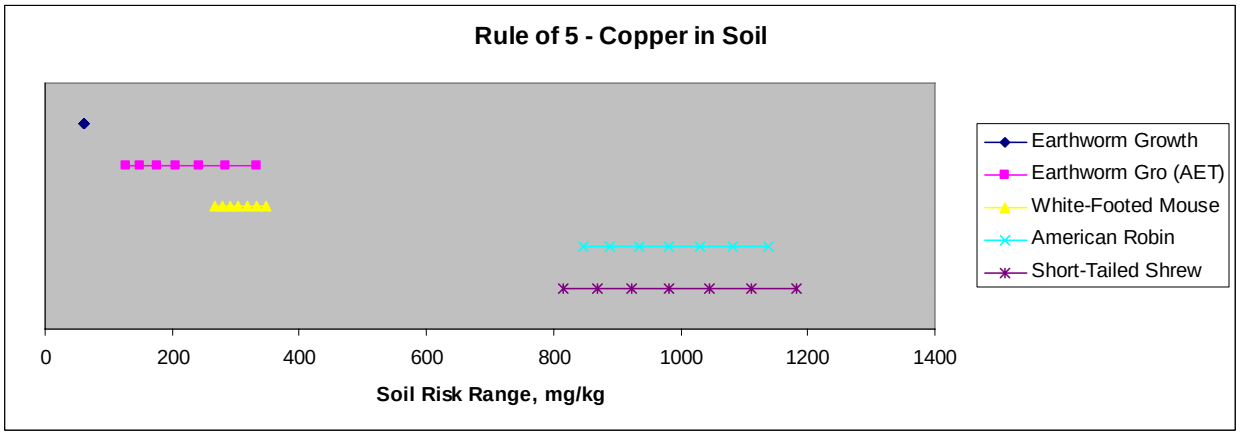


Table 4. Rule of Five Nodes for Copper in Soil

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Earthworm Growth	61.4	61.5	61.7	61.8	61.9	62.1	62.2
Earthworm Growth (AET)	127	149	175	206	242	284	334
White-footed Mouse	266	278	291	304	318	333	348
American Robin	847	890	934	981	1,031	1,083	1,137
Short-tailed Shrew	816	868	923	982	1,045	1,111	1,182

Figure 3. Rule of Five Plot for lead in Soil.

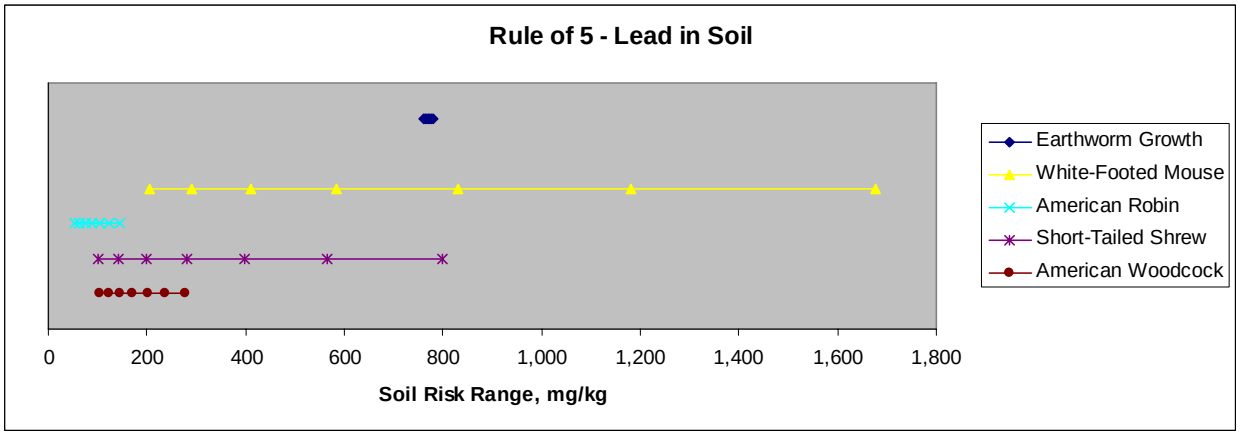


Table 5. Rule of Five Nodes for Lead in Soil

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Earthworm Growth	760	763	766	769	773	776	779
Earthworm Growth (AET)	4,660	4,965	5,291	5,637	6,007	6,401	6,820
White-footed Mouse	204	290	412	585	831	1,181	1,678
American Robin	55	65	76	90	106	124	146
Short-tailed Shrew	100	141	199	282	399	564	798
American Woodcock	105	124	146	171	202	237	279

Figure 4. Rule of Five Plot for Zinc in Soil.

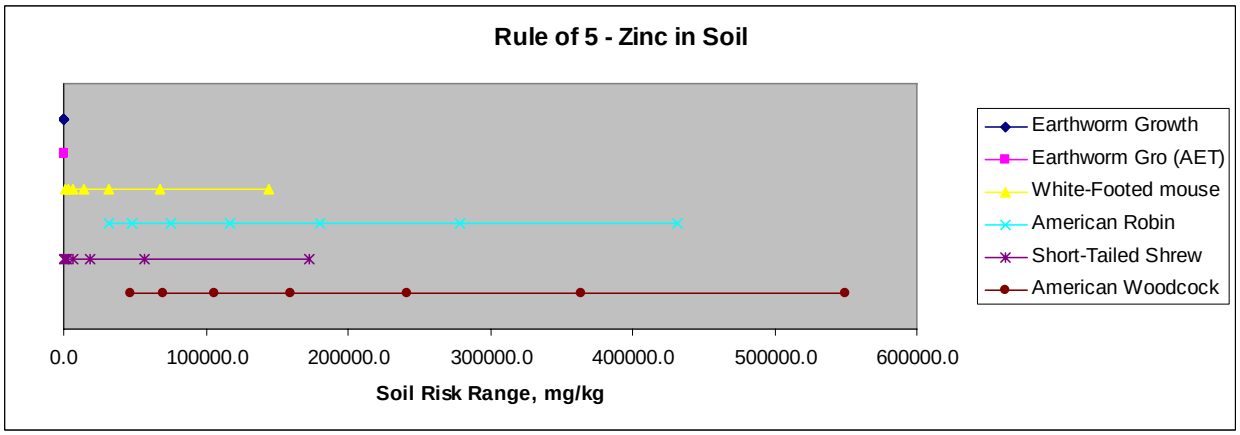


Table 6. Rule of Five Nodes for Zinc in Soil

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Earthworm Growth	33.5	33.8	34.0	34.3	34.6	34.8	35.1
Earthworm Growth (AET)	71.5	71.7	71.9	72.1	72.4	72.6	72.8
White-footed Mouse	1,489	3,191	6,839	14,658	31,415	67,329	144,300
American Robin	31,393	48,589	75,205	116,401	180,163	278,852	431,600
Short-tailed Shrew	213	650	1,984	6,055	18,481	56,405	172,150
American Woodcock	46,470	70,135	105,850	159,754	241,108	363,891	549,200

Figure 5. Rule of Five Plot for Copper in Sediment.

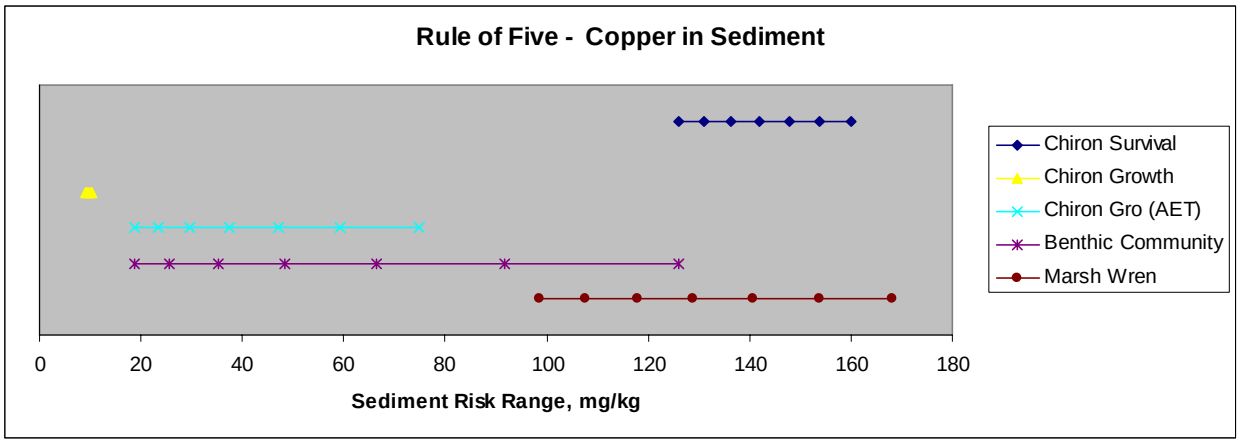


Table 7. Rule of Five Nodes for Copper in Sediment

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
10-Day Chironomid Survival	126	131	136	142	148	154	160
10-Day Chironomid Survival (AET)	271	287	303	321	340	359	380
10-Day Chironomid Growth	9.06	9.27	9.49	9.71	9.93	10.2	10.4
10-Day Chironomid Growth (AET)	18.6	23.5	29.6	37.3	47.1	59.4	74.9
Benthic Community	18.6	25.6	35.2	48.4	66.6	91.6	126
Marsh Wren	98.6	107.8	118	129	141	154	168

Figure 6. Rule of Five Plot for Lead in Sediment.

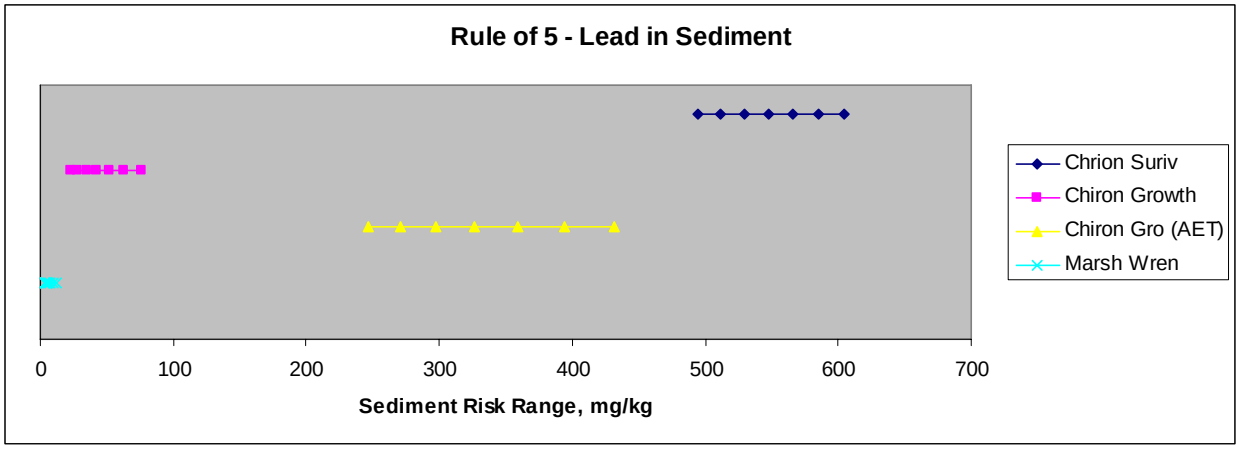
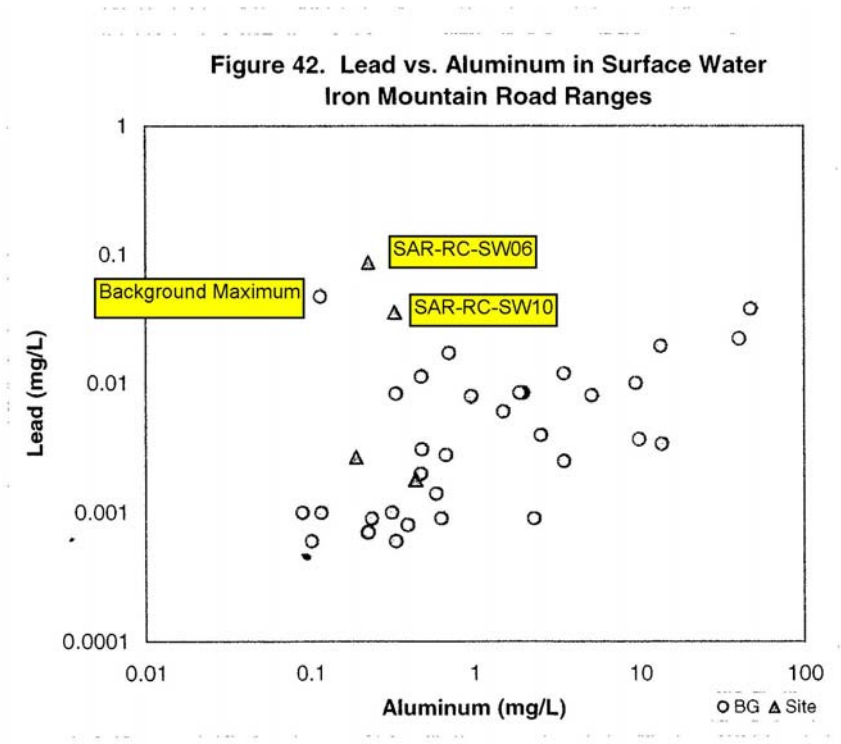


Table 8. Rule of Five Nodes for Lead in Sediment

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
10-Day Chironomid Survival	495	512	529	547	566	585	605
10-Day Chironomid Growth	23.1	28.2	34.5	42.1	51.4	62.8	76.7
10-Day Chironomid Growth (AET)	247	271	298	327	359	394	432
Marsh Wren	3.07	3.86	4.86	6.12	7.70	9.69	12.2

Figure 7. Figure 42 in Appendix H Repeated with Notations.



REVIEWER TABLES

Table 1. Summary of Ecological Preliminary Risk-based Goals for Soils

Receptor	Preliminary Remedial Goals							
	Antimony		Copper		Lead		Zinc	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Earthworm Growth NOAEL & LOAEL	ND	ND	61.4	62.2	760	779	33.5	35.1
Earthworm Growth or Mortality AET Range	39.5	63.3	127	334	4,660	6,820	71.5	72.8
White-footed Mouse	4.64	46.4	266	348	204	1,678	1,489	144,300
American Robin	2.78	13.9	847	1,137	54.9	146.4	31,393	431,600
Short-tailed Shrew	5.95	59.5	816	1,182	99.7	798	213	172,150
American Woodcock	10.8	54.2	11,800	16,110	105.2	279.3	46,470	549,200

Table 2. Summary of Preliminary Ecological Risk-based Goals for Sediments

Receptor	Preliminary Remedial Goals			
	Copper		Lead	
	NOAEL	LOAEL	NOAEL	LOAEL
10-Day Chironomid Survival NOAEL & LOAEL	126	160	495	605
10-day Chironomid Survival AET Range	271	380	NA	NA
10-Day Chironomid Growth NOAEL & LOAEL	9.06	10.4	23.1	76.7
10-Day Chironomid Growth AET Range	18.6	74.9	247	432
Benthic Community Bioassessment	18.6	126	NA	NA
Little Brown Bat	4,059	6,609	527	10,202
Marsh Wren	98.6	168.2	3.07	12.2

Table 3. Rule of Five Nodes for Antimony in Soil

Receptor	**Node 1**	**Node 2**	**Node 3**	**Node 4**	**Node 5**	**Node 6**	**Node 7**
Earthworm Growth (AET)	39.5	42.7	46.2	50.0	54.1	58.5	63.3
White-footed Mouse	4.64	6.81	10.0	14.7	21.5	31.6	46.4
American Robin	2.78	3.64	4.75	6.22	8.13	10.6	13.9
Short-tailed Shrew	5.95	8.73	12.8	18.8	27.6	40.5	59.5
American Woodcock	10.8	14.1	18.5	24.2	31.7	41.4	54.2

Table 4. Rule of Five Nodes for Copper in Soil

Receptor	**Node 1**	**Node 2**	**Node 3**	**Node 4**	**Node 5**	**Node 6**	**Node 7**
Earthworm Growth	61.4	61.5	61.7	61.8	61.9	62.1	62.2
Earthworm Growth (AET)	127	149	175	206	242	284	334
White-footed Mouse	266	278	291	304	318	333	348
American Robin	847	890	934	981	1,031	1,083	1,137
Short-tailed Shrew	816	868	923	982	1,045	1,111	1,182

Table 5. Rule of Five Nodes for Lead in Soil

Receptor	**Node 1**	**Node 2**	**Node 3**	**Node 4**	**Node 5**	**Node 6**	**Node 7**
Earthworm Growth	760	763	766	769	773	776	779
Earthworm Growth (AET)	4,660	4,965	5,291	5,637	6,007	6,401	6,820
White-footed Mouse	204	290	412	585	831	1,181	1,678
American Robin	55	65	76	90	106	124	146
Short-tailed Shrew	100	141	199	282	399	564	798
American Woodcock	105	124	146	171	202	237	279

Table 6. Rule of Five Nodes for Zinc in Soil

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Earthworm Growth	33.5	33.8	34.0	34.3	34.6	34.8	35.1
Earthworm Growth (AET)	71.5	71.7	71.9	72.1	72.4	72.6	72.8
White-footed Mouse	1,489	3,191	6,839	14,658	31,415	67,329	144,300
American Robin	31,393	48,589	75,205	116,401	180,163	278,852	431,600
Short-tailed Shrew	213	650	1,984	6,055	18,481	56,405	172,150
American Woodcock	46,470	70,135	105,850	159,754	241,108	363,891	549,200

Table 7. Rule of Five Nodes for Copper in Sediment

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
10-Day Chironomid Survival	126	131	136	142	148	154	160
10-Day Chironomid Survival (AET)	271	287	303	321	340	359	380
10-Day Chironomid Growth	9.06	9.27	9.49	9.71	9.93	10.2	10.4
10-Day Chironomid Growth (AET)	18.6	23.5	29.6	37.3	47.1	59.4	74.9
Benthic Community	18.6	25.6	35.2	48.4	66.6	91.6	126
Marsh Wren	98.6	107.8	118	129	141	154	168

Table 8. Rule of Five Nodes for Lead in Sediment

Receptor	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
10-Day Chironomid Survival	495	512	529	547	566	585	605
10-Day Chironomid Growth	23.1	28.2	34.5	42.1	51.4	62.8	76.7
10-Day Chironomid Growth (AET)	247	271	298	327	359	394	432
Marsh Wren	3.07	3.86	4.86	6.12	7.70	9.69	12.2

Table 9. Studies of Avian Grit Retention in Gizzards with Estimates of Mean and Median Retention Times.

Study Description and Reference	Species	Time Since Dose (days)	Proportion of Initial Dose Remaining	Rate Parameter or λ ($days^{-1}$)	Mean Retention Time (days)	Median Retention Time (days)
Birds were dosed with 5 silica particles, released to the wild, and collected at various time intervals post-dosing (Fischer and Best 1995).	House sparrow	1	0.50	0.693	1.44	1.00
	Red-winged blackbird	1	0.1	2.303	0.43	0.30
Birds with access to quartz grit were switched to feldspar grit and euthanized at specific time intervals. The proportion of two grit types in gizzards was recorded (Gionfriddo and Best 1995).	House sparrow	0.25	0.6	2.043	0.49	0.34
		1	0.12	2.120	0.47	0.33
Birds were dosed with 25 green quartzite particles, and particles passed in feces were counted over 24 day period (Trost 1981).	Mallard	Multiple measurements		0.224[1]	4.46	3.09
Ducklings with access to one color of grit were switched to another color and euthanized at specific time intervals. The weight of original color grit was recorded (King and Bendell-Young 2000).	Mallard	Multiple measurements		0.48[2]	2.08	1.44
Birds with access to calcareous grit were switched to siliceous grit and euthanized at specific time intervals. The weight of calcareous grit remaining was recorded (Mateo and Guitart 2000).	Mallard	Multiple measurements		0.49[3]	2.04	1.42

[1] Trost (1981) expressed retention of quartzite particles as a negative exponential function with a 4-day interval retention rate of 0.408, which is equivalent to a daily rate parameter (λ) of 0.224 $days^{-1}$.

[2] King and Bendell-Young (2000) expressed retention of grit particles as an exponential function with "grit turnover rate" of 0.02/hr, which is equivalent to a daily rate parameter of 0.48 $days^{-1}$.

[3] Mateo and Guitart (2000) expressed retention of calcareous grit as an exponential function with a daily rate parameter of 0.49 $days^{-1}$.

Table 10. Surface Water Concentrations in IMR Ranges in BERA, mg/L

Sample	Aluminum	Iron	Lead	Ratio Pb/Al
HR-85Q-SW02	0.0744	0.297	0.0361	0.49
REFST	0.0778	0.0755	0.01	0.13
SAR-77-SW15	0.0648	0.112	0.00357	0.055
SAR-77-SW20	0.0852	0.227	0.00236	0.028
SAR-78-SW12	0.058	0.179	0.0306	0.53
SAR-78-SW13	0.0601	0.201	0.0105	0.17
SAR-78-SW14	0.0718	0.185	0.00762	0.11
SAR-85-SW05	0.0888	0.294	0.0321	0.36
SAR-85-SW07	0.0595	0.295	0.0422	0.71
SAR-85-SW07	0.0789	0.301	0.0366	0.46
SAR-85-SW08	0.0673	0.356	0.0462	0.69