



Douglas A. Ducey
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY



Misael Cabrera
Director

Sent via U.S. Mail

January 9, 2020
VRP 20-093

Mr. David Rhoades
President and General Manager
Freeport-McMoRan Sierrita Inc.
PO Box 527
Green Valley, AZ 85614-0527

RE: Review of Revised November 2019 *Baseline Human Health Risk Assessment*
Freeport Sierrita Mine, 6200 W. Duvall Mine Road, Green Valley, Arizona
VRP Site Code: 100073-03

Dear Mr. Rhoades:

The Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program (VRP) has reviewed the *Baseline Human Health Risk Assessment* (BHHRA), revised in November 2019. The BHHRA was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of Freeport-McMoRan Inc. Sierrita Operations (FMI) for the FMI Sierrita Mine (the Site), located at 6200 West Duval Mine Road in Green Valley, Arizona.

The comments presented herein were prepared by the VRP and ADEQ's third party risk assessor, The Fehling Group, LLC, (TFG), with support from Neptune and Company, Inc. This letter is divided into the following sections:

- “Outstanding Comments on Overall BHHRA”: Addresses concerns identified with the overall BHHRA, originally raised in an ADEQ review of the November 2018 BHHRA, and further expounded upon after review of the August 2019 revision of the BHHRA. This section includes a response to how each item was addressed in the November 2019 revision of the BHHRA.
- “Additional Comments Specific to August 2019 BHHRA”: Addresses comments made only on the August 2019 revision of the BHHRA, and how these comments were addressed in the November 2019 BHHRA.

OUTSTANDING COMMENTS ON OVERALL BHHRA

A. *Site-related constituents of interest (COIs) are identified based solely on comparison of metals soil concentrations to generic risk-based screening criteria instead of by comparison to background levels. Text in the August 2019 BHHRA discussing site radionuclide concentrations in relation to background levels incorrectly suggests that radionuclide concentrations in site soils are consistent with natural background.*

This concern has been mostly addressed in the November 2019 revision of the BHHRA. Comparisons of the Site and background radionuclide data are referenced to the May 20, 2019 Memorandum from The Fehling Group, LLC to ADEQ, provided as Appendix K of the BHHRA. The Section 5.6 comparison of mean metals concentrations in Site and background soil provides adequate support for

concluding metals at the former CLEAR Plant and Esperanza Mill exposure areas are above background levels.

To complete edits relating to this concern, ADEQ recommends adding footnotes to the embedded table in Section 5.6 explaining the entry “not a COPC” for copper, lead, and molybdenum where this appears in the table. Also, please replace the Ra-226 background results in the table embedded in Section 5.7.3 with the U-238 values and footnote this replacement with reference to the discussion in the last paragraph of Section 5.7.3

- B. *Section 5.3 of the August 2019 BHHRA cites several factors that are claimed to contribute to the representativeness of the data, and references Table 5-1 for supporting information. However, Table 5-1 provides incomplete information for evaluating data representativeness. Table 5-1 indicates field sieving protocols may have differed among field campaigns, and laboratory sieving protocols are not described. Sample mass information across field campaigns is missing.*

This concern has been mostly addressed in the November 2019 revision of the BHHRA. Text describing the field sieving that was documented for some sampling campaigns, and interpretation of this information, has been added to Section 5.3 of the BHHRA. However, **ADEQ recommends revising the text in Section 10.1 of the November 2019 BHHRA to include a discussion of what is known of the mass of the field samples collected across the different sampling campaigns.** The relevance of this information is the representativeness of soil sample data generally increases when a greater mass of field sample is collected and homogenized. This information can be useful for interpreting differences in soil sampling results among the field campaigns.

ADEQ further suggests identifying the sample preparation method used by the analytical laboratories to document appropriate implementation of soil sieving. For example, Method 3050B for partial acid digestion of sediments, sludges, and soils has a provision to sieve samples, if appropriate and necessary, using a USS #10 (2 mm) sieve. If sieving to 2 mm was done in the laboratory, then the importance of comparable field sieving across sampling campaigns to ensure comparability is reduced.

Finally, **ADEQ recommends clarifying the edits to the right column boxes in Table 5-1** that radiological analyses pertain to both the Esperanza Mill and CLEAR Plant exposure areas.

- C. *Spatial data evaluation is still missing from the August 2019 BHHRA. Posting plots with results for risk-driving COIs (radionuclides; arsenic) should be provided in the revised BHHRA for all sampling subareas of the Esperanza Mill and CLEAR Plant. Boxplots comparing subarea results within the Esperanza Mill exposure area, and subarea results within the CLEAR Plant exposure area, should also be provided. The revised BHHRA should document whether there are significant differences in soil concentrations among the subareas included within a larger exposure area.*

This concern has been partly addressed in the November 2019 revision of the BHHRA. Histograms of the data for the primary risk drivers with what appear to be overlaid Normal distribution plots, and the associated mean and standard deviation, have been provided for the former CLEAR Plant area and 3 subareas, as well as the former Esperanza Mill area and 4 subareas. Some of the interpretation of this information in Section 10.3 of the revised BHHRA does not reflect the data presentation in the histograms file. Section 10.3 states the following:

“A review of the histograms and associated data distributions, including differences in variances among the means and 95% Upper Confidence Levels (UCLs) indicate, in general, there is a similarity in the subarea datasets for arsenic, Ra-226, and Ra-228. Additionally, a review of the data presented in the histograms indicate there are no substantial differences in soil concentrations among the subareas included within the larger exposure areas such that the use of alternative

EPCs (i.e., area-weighted means or area-weighted 95% UCLs) would not result in a material change in the numerical risks calculated in the BHHRA nor would there be any change in the conclusions.”

ADEQ notes the 95% UCLs are not presented or described in the histograms file, as is suggested by the first sentence in the cited text. Furthermore, the conclusion that arsenic, Ra-226, and Ra-228 concentrations do not differ substantially among the different areas is not supported by the data presentation. For example, mean arsenic concentrations in the CLEAR Plant subareas are generally less than one-half of the mean value of the CLEAR Plant main area arsenic values. Another example are concentrations of Ra-226 and Ra-228 in the 0 to 15-foot soil in Esperanza Mill subareas are notably larger than in the general Esperanza Mill area. **ADEQ recommends the text describing relative COI concentrations among the sampling areas is corrected to accurately reflect the data presentation.**

The overall conclusion that area-weighting the values related to the subareas would not significantly affect exposure concentrations and conclusions is not necessarily incorrect, but the statement has not been adequately supported. In addition to area weighting, another (simpler) data evaluation would be comparing 95% UCLs with, and without, inclusion of the subarea data. Some example calculations comparing such 95% UCLs should be provided to demonstrate the validity of the conclusion. Reference to the relative sizes of the subareas and main areas of the CLEAR Plant and Esperanza Mill is suggested to support statements regarding the potential importance of area weighting.

ADDITIONAL COMMENTS SPECIFIC TO AUGUST 2019 BHHRA

1. *In Section 2.4.1.4, the August 2019 BHHRA notes that soil concentrations of U-238, U-234 and Ra-226 from the former CLEAR Plant and former Esperanza Mill exposure areas are in secular equilibrium. However, as stated in Section 5.7.1, calculation of exposure point concentrations was done separately for U-238, U-234 and Ra-226. In principle, if a decay series is in secular equilibrium, the same activity should be used for all members of the series. For example, an average concentration could be calculated across these radionuclides, and that average applied to the entire decay series. These calculations should be compared and this comparison should be discussed in Section 10.3 (uncertainty analysis) of the BHHRA.*

No action is required. This comment has been adequately addressed in the November 2019 revision of the BHHRA.

2. *The following text should be added to the end of this paragraph [Section 5.7.1; 3rd paragraph]: “For the actinide series, it was assumed the long-lived parent U-235 is in secular equilibrium with all subsequent radionuclides in the series.”*

No action is required. This comment has been adequately addressed in the November 2019 revision of the BHHRA.

3. *The comparison of site and background risks using the mean should be supplemented with at least a subjective comparison of the site and background variance to address whether uncertainty in the mean for risk-driving COIs is substantially different between site and background. If the site variance is greater and positively skewed, it can be surmised that a comparison of site and background risks using the simple average might underestimate incremental site risk.*

No action is required. This comment has been adequately addressed in the November 2019 revision of the BHHRA.

Upon review of the comments presented herein, FMI and Arcadis are urged to bring any questions or concerns to the VRP’s attention for clarification. If FMI and Arcadis concur with the comments made herein, **a final version of the BHHRA may be prepared provided these comments are addressed therein.**

Regards,

Handwritten signature of Joey Pace in black ink.

Joey Pace, Project Manager
Voluntary Remediation Program

cc: Dave Gosen, FMI – *sent via email*
William Hart, FMI – *sent via email*
Katy Brantingham, ARCADIS – *sent via email*
Anne Thatcher, ARCADIS – *sent via email*