NEVADA DIVISION OF
ENVIRONMENTAL
PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Steve Sisolak, Governor
Bradley Crowell, Director
Greg Lovato, Administrator

March 2, 2021

Jay A. Steinberg
Nevada Environmental Response Trust
35 East Wacker Drive, Suite 690
Chicago, IL 60601

Re: **Tronox LLC (TRX) Facility**
Nevada Environmental Response Trust (Trust) Property
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to: *Soil Background Dataset Summary Report, Revision 1*

Dated: February 9, 2021

Dear Mr. Steinberg,

The NDEP has received and reviewed the Trust's above-identified Deliverable and provides comments in Attachment A. A revised Deliverable should be submitted **by 05/03/2021** based on the comments found in Attachment A. The Trust should additionally provide an annotated response-to-comments letter as part of the revised Deliverable.

Please contact the undersigned with any questions at wdong@ndep.nv.gov or 702-668-3929.

Sincerely,

Dong Weiquan

Weiquan Dong, P.E.
Bureau of Industrial Site Cleanup
NDEP-Las Vegas City Office

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Attachment A

Except for those comments to the Response to Comments (RTCs) noted below, all responses are deemed acceptable.

RTC to Specific Comment #14 Field duplicates are discussed in Section 3.1 of the Dataset Summary Report, describing the statistical approach for comparing the RI UMCf data set to previous background data sets. Section 2.3 of the report only addresses data usability from a validation standpoint.

Comment to RTC #14 The inclusion of field duplicates as separate observations may be fine if they still demonstrate coming from a random sample. If, for example, the primary sample and field duplicate both show a lower concentration than other locations, then there is a problem with assuming independence which would bias the estimates for mean and variance. Please provide justification for the method in which field duplicates are used, with the inclusion of some exploratory data analysis regarding the field duplicates and the primary samples.

Response to RTC #14 Due to soil exhibiting some heterogeneity on the scale of field duplicate soil sampling, soil field duplicate samples can generally be treated as independent samples. Additional conceptual justification and data analysis has been added to the report in Section 2.6.

Specific Comment to RTC #14 Response

The purpose and importance of the boxplots of 'average pair concentrations' as it relates to the discussion of field duplicates being treated as separate observations is not clear. Suggest either delete these box plots or provide some explanation of their use in Section 2.6 (currently all interpretation in Section 2.6 focuses on the difference box plots).

However, it is clear that the 'pair concentration difference' boxplot is relevant to the discussion. Please consider an option to replace the orange points showing the differences from the field duplicates and the primary samples (which are sometimes difficult to see), with a boxplot made separately for those pairs and placed to the side of the other boxplot of 'pair concentration difference'. Rephrased, that means two boxplots for each metal placed side-by-side with one showing all pairwise differences among concentrations and the other showing pairwise differences between field duplicates and their primary samples. The idea being that If there are clear differences in the boxplots, then it may not be appropriate to treat the field duplicates as separate samples. Note when interpreting the plots that the range of the differences will be greater for the sample differences than for the duplicate differences simply because of sample size, but the center boxes should be somewhat aligned.

Note that the conclusions presented in Section 2.6 otherwise seem fine.

RTC to Specific Comment #25 The Figure 4 series included in the new Dataset Summary Report has been revised to remove the lognormal lines. The phrase "ideal lognormal distribution" was intended to encapsulate the idea that the distribution line shown is mathematically ideal and therefore only approximates reality. For the discussion of Site arsenic distributions in Section 1.4, this phrase has been replaced with "best-fitting lognormal distribution" for clarity.

Comment to RTC #25 While a lognormal distribution may fit the data, it is an approximation and there is no scientific reason to justify why it would. It is more useful to compare the average concentration for both sets, and even with right (positive) skew data the distribution of the mean can be approximated with a normal distribution.

Response to RTC #25 The only section with lognormal distribution approximations to data is Section 1.4, in the discussion of Site arsenic concentrations. The lognormal approximations are included to highlight the difference in distributions between the alluvium and UMCf to suggest that the UMCf distribution might be natural (not to prove that the distribution is natural). These distribution approximations illustrate this more than a simple comparison of alluvium and UMCf Site averages (11 mg/kg and 20 mg/kg, respectively) and standard deviations (80 mg/kg and 10 mg/kg, respectively) would. The text has been edited to remove one imprecise reference to a lognormally distributed population (see Specific Comment #2).

Specific Comment to RTC #25 Response

The point of Section 1.4 appears to be in the title - that is, rationale for collecting additional UMCf background data. The reason to do so would seem to be because the current UMCf data are considered insufficient in some way. Previous DQOs appear to suggest at least 35 samples are needed, and the current background data from the UMCf has only 24. Further rationale is provided in terms of geographic location.

The 2nd paragraph provides further support for the need for background data specifically from the UMCf, although that support is based on site-specific data, which seems somewhat disconnected. It is not clear that arsenic concentrations at the site are not affected by site activities, even in the UMCf. It seems reasonable to believe that arsenic has been released from the soil matrix, at which depths is not clear, and how arsenic has then been transported is not clear, and perhaps never will be. Arsenic in groundwater plume maps clearly show unexpected, elevated concentrations. The effect of this transport of arsenic on Qal and UMCf "soil" concentrations is not clear, which is perhaps a reason for further characterizing background in the UMCf. These arguments are sufficient for justifying collecting more UMCf background samples, without the need for the rest of this section - see below. It is not clear why 7.2 mg/kg is referenced as a target remediation goal for the site - this is true for the near surface soils, but it not necessarily the same for the UMCf. Please clarify.

The remainder of the section (last 2 paragraphs) further addresses the arsenic data from the site. They are not necessary to the central argument, which is adequately made in the 1st 2 paragraphs of this section. The data shown are from the site, in which case it is not clear why further exploration of them is needed to support the need to collect more background data from the UMCf. In addition, NDEP continues to have concerns about how the lognormal distribution is used. Why does the "data approximately following a lognormal distribution" make the data “natural”? The point, still, is that continuous probability distributions are used because they simplify mathematics if they can be used as reasonable approximations to data, not because they are real or natural, which they are not. The lognormal distribution might reasonably approximate some of the data, but it is not central to the argument that more data need to be collected - in fact the distributions of the site data seem largely irrelevant to the arguments presented for the need for more background samples. Any text regarding lognormal distributions seems irrelevant, other than to say the data are right-skewed and pointing out the range of the depths that the UMCf concentrations were taken from. Please consider deleting these paragraphs or making further changes to them.

The mean and standard deviation presented are more informative and reflective of the data and the concerns presented than an approximate lognormal distribution to each subset of Site data.

The simplest path forwards would be to delete most of the last 2 paragraphs of this section (maybe keep the final conclusion in the final sentence that more data are needed). They seem to obfuscate the point of this section and the report, rather than clarify anything.

New Comments

Specific Comment #2 Section 1.4, 3rd paragraph.

Please review and revise the text regarding the lognormal distribution. The data should not be considered lognormally distributed. It is recognized that they might approximately follow a lognormal distribution but as noted in RTC#25 above, distributional forms are statistical artifacts that allow simpler mathematical evaluation of data. There is no physical reason that contaminant data actually come from a lognormal distribution, but they might be approximated by a lognormal distribution. Please change the last sentence of this paragraph along the same lines (reference to "another lognormal distributed population" – none of these concentrations are drawn from a lognormal distribution, but the data might be approximated by such a distribution – if they were they would probably also be approximated by a gamma distribution, or a Weibull distribution, or any other skewed distributional form, and also by a mixture of normal distributions (since any distribution can be approximated as closely as desired with a mixture of normal distributions). These are data – statistical distributional forms are used for convenience, not because they are real.

RTC to Specific Comment #2 Text has been edited in Section 1.4 to revise this reference. The lognormal approximations were chosen solely to highlight the difference in distributions between the alluvium and UMCf in order to suggest that the UMCf distribution might be natural (not to prove that the distribution is natural). It is acknowledged that other distribution approximations may have shown the same suggestive difference.

Comment to RTC #2. The report suggests that the justification for data sources used as background for a metal is based on conceptual understanding of the Site and lithology. It is unclear how the discussion of Site data being fit by multiple lognormal distributions is necessary to the decision regarding which background data are to be collected or used.

Section 1.4, paragraph 2, second to last sentence states "Since it is unlikely that arsenic contamination has migrated to these deeper soils to such a degree, Figure 2a suggests that the background concentration of arsenic increases with depth and that this increase may be related to changes in lithology at the Site." Figure 2a shows increases in arsenic concentrations at deeper depths at the Site, but not necessarily in background. The opposite was observed in Figure 5c which shows the arsenic concentrations from both background data sources for UMCf. Please clarify.

See comments above to RTC #14, suggesting some deletion in this section, to simplify to why more background data are needed, which does not need much analysis of the site data.

Specific Comment #3 Table 6 and supporting text.

The uranium chain radionuclides seem to show secular equilibrium, and yet some of them are consistent and some are inconsistent which does not make sense. Note that the secular equilibrium statistical tests

do not appear to have been run. They should be run, even though it appears that the uranium chain isotopes will be shown statistically to be in secular equilibrium and the thorium chain isotopes will not because of the noted Ra-228 analytical issues. Some further evaluation of the data should thus, be performed so that the secular equilibrium conclusions are consistent with the conclusions from the comparison tests. Because secular equilibrium is obtained, either all the radionuclides in that chain are consistent, or they are all inconsistent.

RTC to Specific Comment #3 The secular equilibrium statistical tests have been run and incorporated into the report. Ideally, if two data sets are shown to each be in secular equilibrium, the entire chain should either be consistent or inconsistent between the two data sets. However, the secular equilibrium test developed by Neptune is designed to be less sensitive to variation than the statistical tests used to determine consistency between data sets. The U-238 decay chain in the RI background data set shows small variations within the tolerance of the secular equilibrium test. Th-230 shows the highest median concentration and is the only radionuclide in this decay chain shown to be consistent with the 2008 BRC background data set. Upon detailed review of the 2008 BRC background data set, it was noted that some radionuclide distributions were biased high due to censoring at the minimum detectable concentration (MDC) counter to current NDEP guidance. The 2008 data were shown to be in secular equilibrium because the MDCs for all the radionuclides were equal and many of the results were censored at the MDC. This MDC was close to the median concentration of Th-230 in both the BRC and RI background UMCf data sets, leading to a consistent statistical testing result between the two data sets for Th-230 and inconsistent results for the other radionuclides in the decay chain with slightly lower median concentrations. Per the discussion with NDEP and Neptune on January 7, 2021, the report has been revised to conclude that data from radium-226, uranium-234, and uranium-238 should not be included in the combined UMCf background data set.

Comment to RTC #3. The figures 5ab, 5ag, 5ai, and 6 should be updated to show open symbols for the concentrations of radium-226, uranium-234, and uranium-238 that were left censored at 1 pCi/g to match the plot description that open symbols are used for results that fall below the minimum detection limit. Likewise, if it is believed these are censored, they should be indicated as such in Table 4. Table 4 shows 100% detection frequency for each species which conflicts with the text in Section 3.3, paragraph 2, that states "up to 45%" of the results were censored at 1 pCi/g.

The decision to exclude BRC UMCf radium-226, uranium-234, and uranium-238 data from the combined dataset due to some concerns over secular equilibrium and high proportion of may be appropriate. However, for consistency in use of data this same rule should be applied to the Th-230 data as well.

The decision to exclude RI UMCf radium-228 data from the combined dataset due to secular equilibrium is accepted.

Table 7 includes one test result for SEQ analysis for each decay chain, and it is believed the test results are based only on the final, filtered and combined dataset. Another table should include the SEQ analysis of each sample separately and using the full, un-filtered and combined dataset.