ADDENDUM 2 TO THE QUALITY ASSURANCE PROJECT PLAN (QAPP) FOR SAMPLING AND ANALYSIS OF PROPERTIES IN THE VICINITY OF THE EXIDE FACILITY (VERNON, CALIFORNIA)

Prepared for:

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1.0 Introduction

This Addendum 2 has been prepared for the Quality Assurance Project Plan (QAPP) dated November 21, 2016 to support site assessment and clean-up activities being conducted for the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) for residential and sensitive-use properties (such as day care centers) located in the vicinity of the Exide Metals facility (site) in Vernon, California. The purpose of this Addendum is to document procedures for evaluating the accuracy and precision of X-Ray Fluorescence (XRF) results. The procedures detailed herein supersede procedures detailed in *Section 3.3.4 – Accuracy and Precision of Field Data and Measurements* in the QAPP.

2.0 Accuracy and Precision of Field Data and Measurements

The evaluation of the XRF's accuracy and precision will primarily be based on the results of the calibration checks completed in the field as described in *Section 3.2 – Calibration Procedures and Frequency for Field Test Equipment* and a comparison of the results obtained from the samples analyzed by XRF in the field to the results obtained from the analysis of the confirmatory samples sent to the fixed laboratory. This assessment should be completed using correlation coefficients applied to data appropriately grouped into data sets. These data sets may include consideration of site related variables including but not limited to spatial proximity, temporal considerations, and/or accounting for variability introduced in the sampling and analytical process, different contractor teams(s), and/or the different XRF instruments used to generate the data. Per EPA Method 6200 (USEPA 2007), correlation coefficients will need to be above 0.7 to be considered valid as screening level data.

2.1 XRF and Laboratory Correlation Approach

XRF and laboratory correlation analyses should be completed approximately bi-weekly to allow for sufficient samples size per XRF machine. In the event that less than 30 pairs of XRF and laboratory data are collected during the bi-weekly period, the evaluation period may be extended. In the event an XRF unit's calibration is modified, or field procedures are revised which may impact the correlation relationship between XRF and laboratory data, the correlation analysis will be conducted in a manner so as to bracket the data appropriately. The regression analysis will follow the outlined approach:

Data Management:

- Paired XRF and confirmatory laboratory observations will be compiled for each XRF unit per approximate bi-weekly period (by serial number and/or team, as appropriate) and will not be evaluated accumulatively.

- To avoid bias, the dataset should have one paired result (XRF and laboratory) per soil sample. Therefore, in the event of duplicate laboratory samples, the mean of primary and duplicate laboratory results will be calculated and used to represent a single laboratory value for each soil sample, regardless of Relative Percent Difference (RPD). If duplicate XRF readings are also present, the mean of primary and duplicate readings will be calculated and used to represent a single XRF reading for each soil sample, regardless of RPD.
- Per EPA Method 6200, if the measured concentrations span more than one order of magnitude, the data will be log-transformed to standardize variance. Once the data have been transformed, all subsequent statistical analysis should be performed on the transformed data. In the event that the majority of lead concentrations fall within less than one order of magnitude, log-transformation may not be required.

Regression Analysis:

- Paired XRF and confirmatory laboratory observations will be evaluated using least squares linear regression analysis per EPA Method 6200. The XRF result will be selected as the dependent variable (y) and the confirmatory laboratory result selected as the explanatory variable (x).
- Each dataset will be examined for outliers upon running the initial linear regression model. In linear regression, an outlier is an observation with a large residual (i.e., an observation with a large difference between the values that were collected and the values predicted by the model) (USEPA 2006). Standardized residuals, which are the residuals that are scaled appropriately by converting them to z-scores, are typically used as a means for identifying outliers. A standardized residual larger than about ±2.5 should be considered as a potential outlier, since that would only be expected to occur randomly about 1% of the time. For each XRF data set, if one or more outliers are removed, the linear regression model will be re-generated. After the regression has been regenerated, outliers will not be reexamined. In order to determine the effect potential outliers may have on linear regression models, regression results for the full and truncated data set will be presented.
- Least squares residuals must be normally distributed (Altman 1991; Draper and Smith, 1998). Goodness-of-fit (GOF) tests will be used to evaluate the normality of residuals, such as the Shapiro-Wilk test (Shapiro and Wilk, 1965) or the Anderson-Darling test (Anderson and Darling, 1954). If the residuals are not found to be normally distributed, the data will be transformed (i.e., logarithmic or gamma) and the linear regression model will be re-generated. In the event the re-generated least squares residuals of the transformed dataset are not found to be normally distributed or approximately normally

distributed (i.e., the dataset passes one of two accepted GOF tests for a distribution), Theil-Sen nonparametric regression will be performed (Sen, 1968).

- The size of least square residuals should be constant over the range of the independent variable, or homoscedastic. Residual plots with potential outliers excluded will be inspected for extreme evidence of heteroscedasticity, or changes in residual variance across the concentration range. However, given that analytical errors tend to increase as concentrations increase, paired environmental data are almost always heteroscedastic (USEPA, 2008).
- The calculations will be performed using proper statistical principles in a spreadsheet format. The ProUCL statistical package (version 5.1; USEPA, 2016) will also be used to assist with the GOF determinations and some calculations.

Reporting and Acceptance Criteria:

- Output statistics, including the correlation coefficient (r), coefficient of determination (r^2), and the linear regression equation, generated from the linear regression models will be presented for each XRF machine. The residual plot with potential outliers, initial linear regression plot, and residual plot and linear regression plot with potential outliers removed will also be provided. Per EPA Method 6200, the r for the linear regression models should be 0.7 or greater to be considered valid as screening level data. If the r is 0.9 or greater and inferential statistics indicate XRF and associated laboratory data are statistically equivalent at a 99% confidence level, the data could potentially meet definitive level data criteria.
- For nonparametric regression analyses (if required), Kendall's tau coefficient will be used to measure the correlation between the XRF and conformation laboratory data (Kendall, 1975). Given that a tau value will generally be lower than the traditional linear correlation coefficient r (i.e., linear correlations of 0.9 or above correspond to tau values of about 0.7 or above; Helsel and Hirsch, 2002), Kendall's tau statistic should be 0.5 or greater to be considered valid as screening level data.
- Any individual property where one or more outliers are removed from the overall evaluation will be evaluated individually to determine accuracy, precision and usability of the data.

3.0 References

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