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Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

09 OCT 2002

MEMORANDUM

SUBJECT: Conditional Approval of QAPP for Lead Deposition at
Herculaneum, Missouri

FROM: *RB Dona*
Robert B. Dona, Superfund Quality Assurance Coordinator
SUPR/STAR

TO: Bruce Morrison, Remedial Project Manager
SUPR/FFSE

The Quality Assurance Project Plan (QAPP) for Lead Deposition at Herculaneum, Missouri dated August 2002, has been reviewed for adequacy and completeness in accordance with EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA R-5.

Although the document satisfactorily addressed most of the key issues, a deficiency was noted. This area is fully addressed below and can be adequately addressed by incorporation without resubmission. The document would not be approved without inclusion of the recommendation.

This QAPP does not appear to contain the project-specific calculations or algorithms to be used to translate the analytical data to the decision rule of an increase of 25 ppm/year in soil lead.

If you have any questions, please call me at 913-551-7707.

Attachment: QAPP

QAC Document No. S2086

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ABSTRACT

This Quality Assurance Project Plan (QUAPP) describes the data collection activities needed to determine: 1) if lead deposition to soils from lead smelting operations is presently occurring in Herculaneum, Missouri, and if so, 2) whether deposition is occurring at a rate warranting further controls on Doe Run Company's lead smelting operations. Historic operations of the lead smelter caused high soil lead concentrations in the community, which ultimately resulted in elevated blood lead levels in 28% of children age 6 and under living in Herculaneum. As a result, numerous actions were initiated, including installation of controls on emissions from smelter processes, and excavation of contaminated soil at numerous properties (this is ongoing).

Deposition sampling will be conducted at 21 sites in and outside Herculaneum. This monitoring is in addition to the soil measurements (recontamination study) and ambient air monitoring already underway. Deposition will be monitored by three means: 1) filter paper deposition collectors, 2) field XRF measurements of soil boxes, and 3) field XRF measurements of in-situ soil.

After one year of monitoring, if lead is significantly above zero or baseline concentrations in greater than 10% of any of the sample types from any site, then further data analysis and calculations will be performed to determine the possible rate of soil recontamination. If the rate of soil recontamination for the top 1 inch of soil is determined to be greater than 25 ppm/year, then additional soil sampling and laboratory analysis will be conducted to verify the rate. If the rate cannot be verified, then further deposition monitoring is indicated. If the rate is verified at > 25 ppm/year, then further controls on smelter operations are likely necessary.

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ACRONYMS

CAA	Clean Air Act
CERCLIS	Comprehensive Environmental Response Compensation Liability Information System
DQO	Data quality objective
EPA	Environmental Protection Agency
FPXRF	field portable X-ray fluorescence
HEPA	high efficiency particulate air
HLS	Herculaneum Lead Smelter
ICP/MS	inductively-coupled plasma/mass spectrometry
INEEL	Idaho National Engineering and Environmental Laboratory
MCL	maximum contaminant levels
MDNR	Missouri Department of Natural Resources
NAAQS	National Ambient Air Quality Standard
NPDES	National Pollutant Discharge Elimination System
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SIP	State Implementation Plan
START	Superfund Technical Assessment and Response Team
TSP	total suspended particulate
USFWS	U.S. Fish and Wildlife Service
XRF	X-ray fluorescence

Monitoring Plan for Lead Deposition at Herculanum, Missouri

1. INTRODUCTION

EPA, Region 7, has requested the INEEL prepare a QUAPP for deposition monitoring for the area impacted by the Doe Run Company's lead smelting/refining operation in Herculanum, Missouri. Elevated blood lead levels have been recorded in 28% of the area's children 6 years and under; 52% for children living within ½ mile of the smelter. These high rates are apparently due to lead fallout from many years of smelter operations, accumulation of lead in soil, and subsequent ingestion. Sources include various stacks and vents from plant processes, fugitive emissions from ore handling operations, wind erosion from slag piles, and fugitive emissions from transport of lead concentrate over local roads. High lead levels in soils and house dust have been recorded. In the recent past, numerous controls under the Missouri State Implementation Plan (SIP) have been imposed on Doe Run's operations. For the first time since air quality has been monitored in Herculanum, ambient lead levels at all monitoring sites in the first quarter of 2002 were in compliance with the National Ambient Air Quality Standard (NAAQS). It must now be determined whether and at what rate lead deposition may still be occurring in Herculanum.

1.1 Site Background

The following site description and background is taken from Environmental Protection Agency's (EPA's) "Quality Assurance Project Plan for a site Characterization at the Herculanum Lead Smelter, Herculanum, Missouri, CERCLIS ID No. MOD006266373," September 10, 2001, attached as Appendix B of this document.

The Herculanum Lead Smelter (HLS) site is located at 881 Main Street in Herculanum, Missouri, about 25 miles south of the St. Louis metropolitan area. The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility. The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R. 6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90° 22' 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-

containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu\text{g}/\text{m}^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 150,000 (corrected from QAPP) parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter ($\mu\text{g}/\text{dl}$). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe

Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculanum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.2 Mitigative Actions To Date

Mitigation actions to date include:

- The top 12 in. of soil has been removed from many residential yards and other properties, and replaced with soil containing less than 250 ppm lead; this activity is ongoing.
- Lead dust on and adjacent to haul roads has been, and continues to be, vacuumed up
- Contaminated roadside soil along haul roads has been removed
- Contaminated dust in houses has been removed
- High efficiency particulate air (HEPA)-filtered vacuum cleaners have been issued to residents by Doe Run and EPA
- The Doe Run Company has implemented or is in the process of implementing controls on most of its operations, and revising other operations to lower emissions.
- The DOE Run Company has been buying properties (some 80 to date) in the most heavily contaminated zone (termed the “buyout zone”).

1.3 Pathways from Airborne Lead Particulate to Elevated Blood Lead

Given that most lead enters the bloodstream via the ingestion pathway, possible routes from airborne lead to ingestion are depicted in Figure 1. Only outdoor lead deposition is considered here; it is assumed that most lead transported indoors via foot traffic and dust through open windows originates from nearby contaminated ground surfaces. Direct deposition to soil and indirect deposition to soil via grass, tree leaves, rooftops, and streets and driveways encompass the most significant pathways from airborne lead to soil. The focus of this monitoring plan is on direct deposition from the atmosphere to soil.

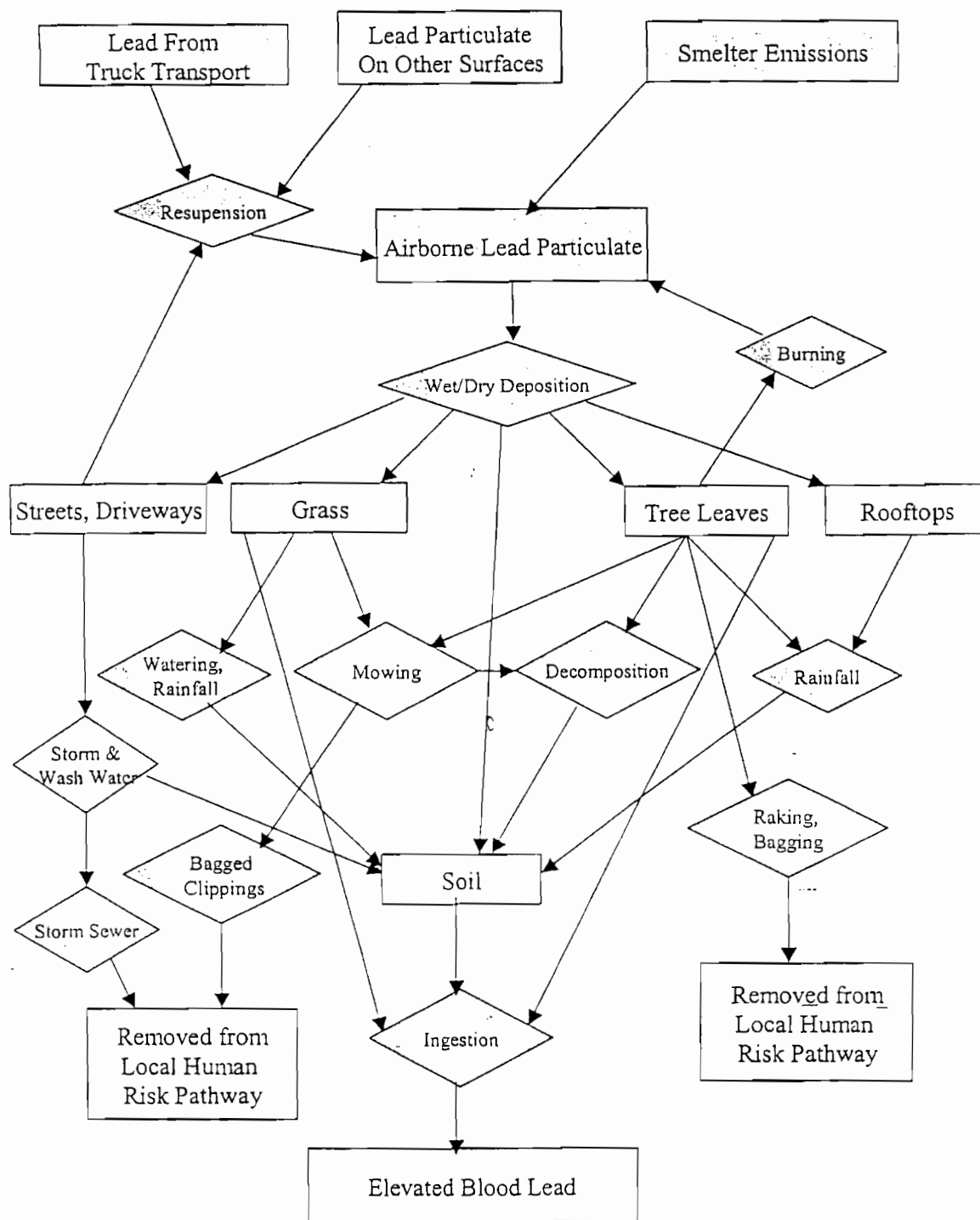


Figure 1. Flowchart depicting physical movement of airborne lead to human blood

2. OBJECTIVES

The objectives of this deposition monitoring effort have been discussed and agreed to among EPA, MDNR, and the Idaho National Engineering and Environmental Laboratory (INEEL), as follows:

1. Determine if properties that have been cleaned under the soil removal program will be recontaminated by lead depositing from air to the extent (400 ppm or greater in top 1 in.) that they must be re-cleaned.
2. Determine the rate of recontamination of soils by atmospheric deposition. That is, how much lead is being deposited per kg of soil (top 1 in.) per unit time (assume we have at least one year to monitor deposition).
3. Develop supportable models of recontamination.
4. Determine if ambient air monitoring data and/or deposition data can be correlated to the rates of recontamination.
5. Determine if estimated rates of recontamination can be correlated to levels predicted by dispersion modeling
6. Determine if specific sources of recontamination can be identified.

2.1 Problem Statement

The problem statement provides a brief description of the problem to be addressed and identifies the project team.

As described in Section 1, surface soils in the town of Herculaneum, Missouri have been heavily contaminated with lead from many years of operation of the Doe Run Company's lead smelter. Sources of lead contamination include stack and fugitive emissions from the many smelter operations, as well as the hauling of lead concentrate over local roads. The goal of this sampling effort is to determine if and at what rate lead deposition is still occurring in and around Herculaneum.

The sampling effort will be lead by the U.S. EPA, Region VII. This QUAPP was developed by the INEEL for EPA through the EPA Technology Support Center (Las Vegas, NV). The field sampling activity will be conducted by EPA's Region VII Superfund Technical Assessment and Response Team (START). Project responsibilities are presented in Table 1. This sampling will be conducted for one full year, subject to continuance based on initial findings (see Section 2.2).

Table 1. Project Responsibilities

Functional Role	Organization	Contact Person
Decision Maker	US EPA, Region VII	Bruce Morrison 913-551-7755 Morrison.Bruce@epa mail epa.com <i>gob</i>
Field Sampling	EPA START Team	Ryan Schuler 636-475-7946 <u>schulerryan@cs.com</u>
Sample Analysis	Analytical Management Labs	Kendall Lindquist 913-829-0101, ext. 24

2.2 Decision Identification

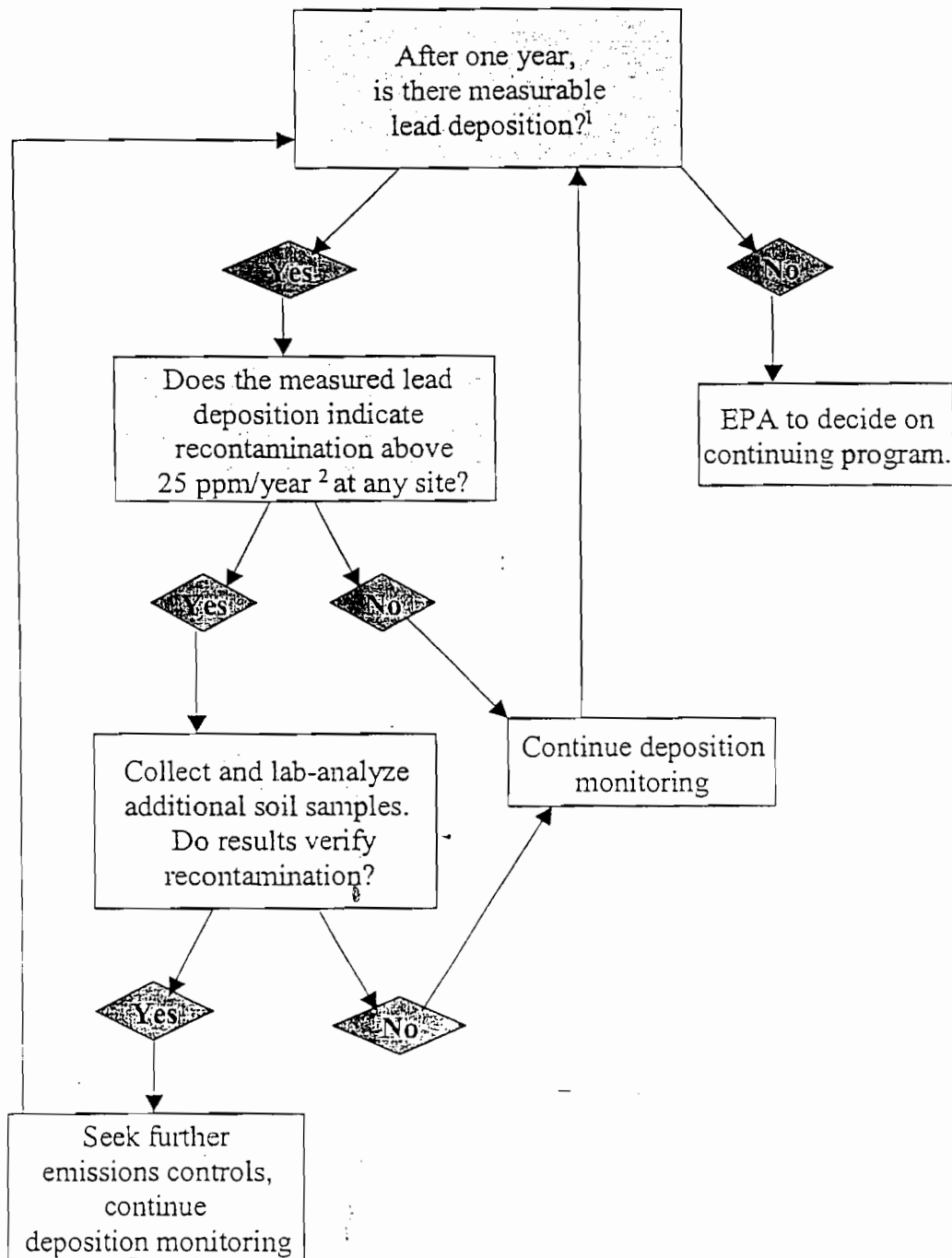
The purpose of this step is to identify the decision to be made based on data collected. The principal question to be addressed by this sampling is: Is lead deposition still occurring in Herculaneum, Missouri at a rate of concern for soil recontamination? The possible actions resulting from resolution of this question are: 1) continue monitoring, refining methods as needed, 2) impose further controls on lead smelter operations and continue monitoring, 3) scale back monitoring to a few sites or methods, or discontinue monitoring. The decision process is depicted in Figure 2.

2.3 Decision Inputs

The purpose of this step is to identify the inputs to the decision discussed in Section 2.2. The decision inputs are: 1) the percentage of deposition samples with measurable lead, 2) rates of increase in soil lead levels as calculated from lead deposition measured on filter paper samplers and as measured in soil boxes and in-situ soil (this program); and 3) rates of increase in soil lead levels measured in composited soil samples (ongoing program). The "acceptable" rate of increase in soil lead concentrations from deposition has not been defined by EPA or MDNR. The action level for soil cleanup is 400 ppm lead in the top 1 in. of soil. Based on deposition rates calculated from air monitoring data, and based on modeled deposition rates, a 25 ppm/year increase in soil lead concentration appears to be a reasonable level on which to base decisions.

2.4 Study Boundaries

This step specifies the spatial and temporal boundaries of the study. The study area consists of the town of Herculaneum, Missouri. Figure 3 shows the spatial extent of EPA's sampling to date. Deposition monitoring will be conducted within this area, except for one sampler being placed as a control south of town (off the map in Figure 3) at the Ursaline high-vol (TSP) sampler site. Deposition monitoring will be conducted for one year, at the end of which, decisions regarding continuance or modification of the program will be made, based on results.



1. > 10% of samples of a given type, at any site statistically > zero or baseline as measured on/in filter papers, soil boxes and in-situ soil
2. In top 1 inch of soil

Figure 2. Possible decision paths based on deposition monitoring results.

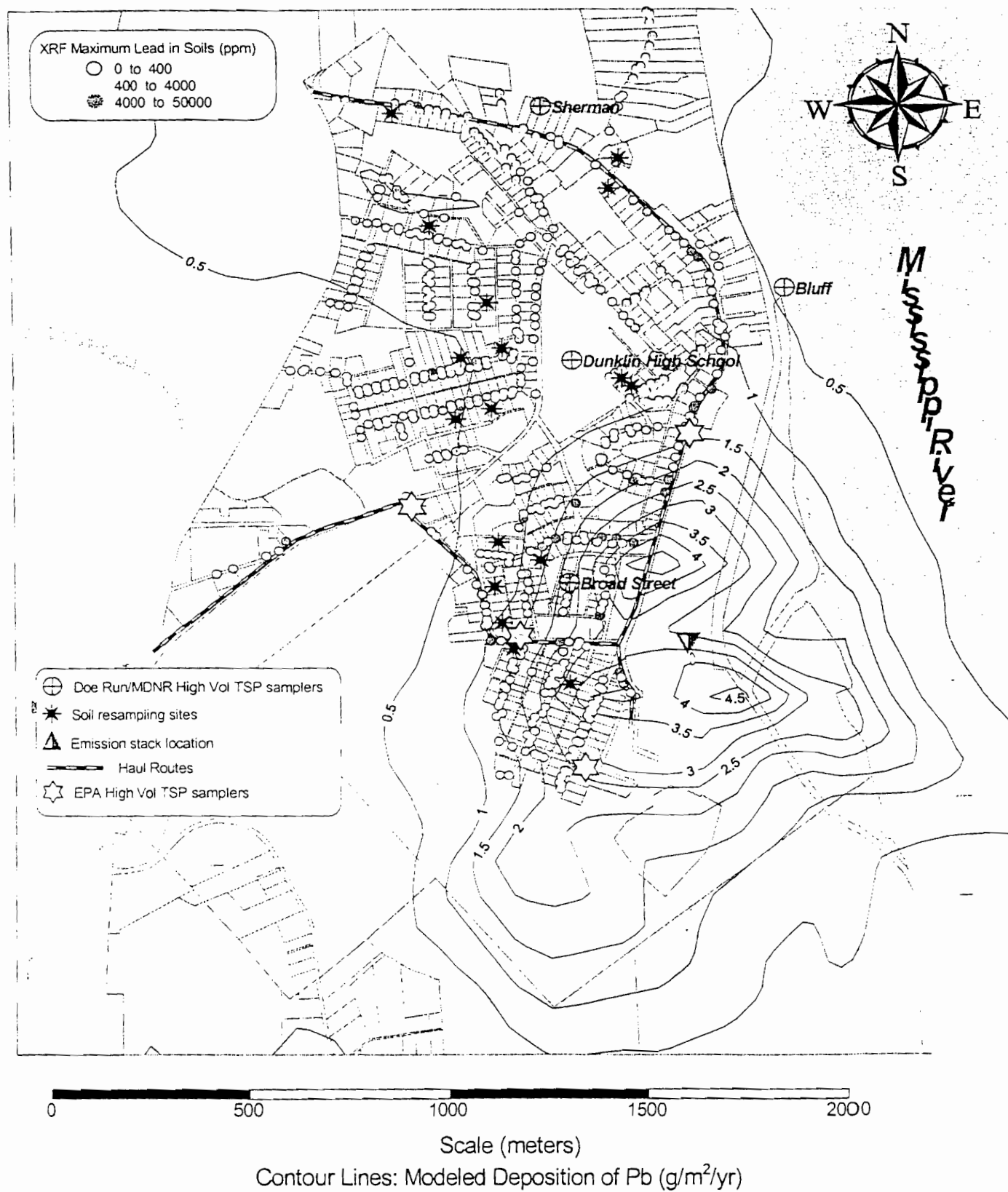


Figure 3. Herculaneum Missouri, showing soil lead levels, air monitor sites, existing soil recontamination study sites, and modeled lead deposition.

2.5 Decision Rule

This step integrates the outputs from the previous steps into a statement that would enable the decision-maker to choose among alternative actions. The decision whether or not lead is being deposited to soil at rates requiring further enforcement actions against Doe Run will be based on combined results of this plan's deposition monitoring and soil sampling already being conducted for EPA's recontamination study. The action level set in this plan is 25 ppm/year lead in the top 1 in. of soil, either calculated from measured deposition, or measured in soil samples. There are two steps to reach the decision (Figure 2): 1) determine if greater than 10% of 1 year's samples of any type at any site are above detection or baseline levels and if so, 2) do any of these samples indicate soil recontamination above the 25 ppm/year action level, then confirmation soil samples will be collected and analyzed in the lab. Positive results indicate further enforcement actions are needed.

2.6 Decision Error Limits

The purpose of this step is to specify the appropriate goals for limiting uncertainty in the decision. Null and alternative hypotheses were developed and are presented, and the probability of making Type 1 and 2 errors is discussed.

The possible range of values for the percentage of deposition monitoring samples showing significant lead deposition range from 0 to 100%.

Null and alternative hypotheses were developed for this monitoring effort. The null hypothesis is that lead is present above detection limits or baseline levels in less than 10% of samples of a given type from a given location; in other words, there is no measurable deposition occurring. The alternative hypothesis is that lead is present above detection limits or baseline levels in greater than 10% of samples, thus indicating that lead deposition is occurring, and further monitoring and evaluation may be required. The objective of this monitoring effort is to test the null hypothesis.

The two types of decision error for this monitoring effort are: 1) deciding that lead deposition is occurring when it is not (Type 1 error), and 2) deciding lead deposition is not occurring when it is (Type 2 error). The consequences of a Type 1 error are additional unnecessary and costly monitoring efforts (see Figure 3). The cost of a Type 2 error is that soil will be recontaminated to the point that it is again a public health threat. There are three decision error limits to specify: the probability of making a Type 1 error, the precision bound, and the probability of making a Type 2 error. The probability of making a Type 1 error is specified as 5% (translated as the 95% confidence interval). The precision requirement is set as the confidence half-width of 0.1 (or 10%). These two factors translate into a requirement that the 95% confidence interval for the null hypothesis is from 0 to 20%. This range is referred to as the "gray area," since the probability of decision errors in this area is large. The probability of making a Type 2 error is dependent on the true percentage of deposition measurements above detection limits or baseline levels. For instance, if 30% of samples indicate lead deposition, the maximum probability of making a Type 2 error is 0.1; if 40% of samples indicate lead deposition, the probability should be 0.001.

2.7 Design Optimization

This step identifies the most effective sampling and analysis strategy that satisfies the data quality objectives.

2.7.1 Sample Design Options

Sample design options are limited for this project because of restrictions on sampling locations. Because samplers will be left out for a month at a time, they must be placed in areas with limited public access to prevent advertent or inadvertent tampering. Therefore, random sampling is virtually impossible. Additionally, one aspect of this study is to assess correlation among deposition measurements, actual soil concentrations, and air sampling data, which necessitates co-location with existing sampling sites. EPA already has a soil sampling program in place (recontamination study), so it is logical to co-locate samplers with soil sampling sites. A Limitation is that not all landowners are likely to allow additional intrusion on their property. EPA and Doe Run/MDNR operate a total of ten high-vol TSP samplers and deposition samplers will be placed at nine of those sites also.

2.7.2 Selected Sample Design

Of necessity, the sample design is non-random, based on existing air and soil sample sites. Sample size was determined from the number of available sample sites.

2.7.2.1 Collection of Duplicate Samples—Because of the nature of the lead contamination in Herculaneum, i.e., much existing ground-level contamination associated with large particles, and smelter emissions likely associated with fine particles, it is anticipated that deposition will be quite variable over time and space. Therefore, at five of the sites (see locations in Section 3.2, below) duplicate filter papers and soil boxes will be staged to provide a measure of precision.

3. SAMPLE DESIGN

This section describes the laboratory and field analyses needed for this monitoring effort, the sampling locations, and data analyses.

3.1 Laboratory/Field Analyses

Analyses performed in the field will consist of field portable X-ray fluorescence (FPXRF) measurements (EPA Method 6200) made directly on in-situ soil and on soil in soil boxes. Deposition filter papers will be analyzed in the laboratory by inductively-coupled plasma/mass spectrometry (ICP/MS), Method 6020.

3.2 Sampling Locations

Deposition monitoring will be set up at 21 locations, as follows:

1. At each of the four existing MDNR/Doe Run-operated high-vol sites shown on Figure 3, plus the Ursaline site south of Herculanum, considered a control site (not shown on Figure 3),
2. At each of the four EPA-operated high-vol sites (F3, F6, F8, and F10),
3. Adjacent to and 50 m downwind (NNW or SSE) of a haul road. The EPA TSP sampler at the START trailer (F3 - see #2, above) on Station St. will serve as the adjacent site; an additional site 50 m from Station St. NNW or SSE of this location is needed.
4. At eleven of the seventeen residence locations currently being sampled for soil recontamination. According to START personnel, the eleven addresses at which residents are most likely to approve sampler emplacement are:

446 Thurwell - <i>new house</i>	441 Main
438 Washington	439 Hill - <i>no access</i>
434 Sherman	292 Park
157 Joachim	485 St. Joseph
907 Dale	824 Brown
407 Burris	

At five of the sites [Broad St., Ursaline and Bluff air stations, EPA Air Station F6 (994 Main St.), and either 438 Washington or 485 St. Joseph], duplicate filter papers and soil boxes will be staged. For deposition filters, this may involve mounting additional platforms to the pole (see Section 4.4, below). These sites were selected from the 21 sites based on modeled deposition contours and location with respect to haul roads, to attempt to span what is expected to be a range of deposition rates.

3.3 Data Analysis

Data analysis will consist of first determining what percentage of samples show lead levels significantly above either detection limits (for filters and soil boxes) or above baseline levels (for in-situ soil). After one year, if greater than 10% of samples of any sample type from any location are significantly above detection limits or baseline levels, then further analysis and calculations will be done to determine if the indicated annual deposition would result in greater than 25 ppm additional lead in the top 1 in. of soil. If this is the case, further, confirmatory measurements are indicated (Figure 3).

Data from the various sample types (filters, TSP filters, soil boxes, in-situ soil) will also be compared by correlation analysis to determine if the various measurements are correlated, and if so, if some types of measurements can be dropped from future monitoring.

4. EQUIPMENT AND PROCEDURES

4.1 Artificial Surfaces

Various means have been reported in the literature for measuring deposition using different surfaces. Among the most common are sticky surfaces such as Mylar coated with grease or filter paper coated with oil (Franz et al., 1998; Paode et al., 1998; Yi et al., 2001). Square areas of such samplers are typically small (60 cm² or less). We propose using round filter papers, 9 cm diameter or larger (suggest Whatman "Student Grade Circles" filter papers – available in 9 to 15 cm diameters). Filters will be saturated with oil, which serves both to "stick" filters to trays (petri dishes, pie pans, or similar), and to prevent deposited particulate from resuspension.

Filters will be secured on horizontal, flat surfaces (e.g., petri dishes or pie pans) on a pole at 2 levels above ground surface: 0.3 m and 3.0 m. The purpose of sampling at two levels is to attempt to distinguish between larger lead-contaminated particles such as would be resuspended from ground-level sources (and because of their size, remain close to the ground), and those smaller particles that would be expected from smelter operations.

4.2 Soil Boxes

Soil boxes are intended to provide a repeatable means of measuring lead deposition on soil that would be less likely to be disturbed than soil in residential yards. As envisioned by MDNR, soil boxes would be approximately 2 ft × 3 ft, 8-12 in. deep (these could be off-the-shelf plastic storage containers), filled with clean topsoil and set on the ground, or dug in so that soil elevations inside and outside the box are about equal. An option would be to plant the boxes with grass (see Appendix A).

4.3 In-situ Soil

Soil and composite soil samples at recontamination sampling sites will continue to be analyzed by field-portable x-ray fluorescence (FPXRF), per existing protocol, *with samples from air monitoring sites added*. As outlined in the Quality Assurance Project Plan (QAPP) (APPENDIX B), special attention, but separate measurements should be focused on driplines and downspout outflows, since lead from rooftop deposition will be concentrated there.

At each deposition monitoring site, several (5 or more) XRF measurements will be made directly on bare, undisturbed soil. Measurement locations will be established, to the extent practicable, at random directions and distances (but within 5 m) from filter samplers. Markers will be placed and numbered so that the same locations can be measured with the XRF each month. Care must be taken to not disturb these locations.

4.4 Deploying Samplers

At each sampling site a 1.5-2 in. × 12 ft conduit pole would be installed in an augured (post hole size) hole, 18 in. deep, with concrete. Platforms suitable for mounting filter holders would be clamped to the post at the designated heights above ground surface (0.3 and 3.0 m). Small roofs such as vent caps would need to be secured over each platform to keep out rain.¹ Filter holders should be secured to platforms with Velcro strips or other means so that they can be easily removed for filter replacement and cleaning.

Filters would be prepared in a clean environment (lab). Preparation would involve saturating filters with oil (type to be determined by analytical lab) and placing in ziplock bags. Filter holders also would be prepared in the lab by cleaning with an appropriate solvent, then bagging for transport to the field. Filter holders would need to be changed out with filters to prevent contamination of new filters.

Soil boxes would be placed within 5 m of filter samplers, with the soil surface as near ground level as possible, but no higher than the lowest level of filter paper samplers (0.3 m). It will be necessary in most cases to enclose the boxes with chicken wire or hardware cloth to discourage larger animals from disturbing the soil.

At the Dunklin H.S. TSP sampler site, some variation of the above guidance will be necessary. Because Dunklin TSP samplers are on the roof of the building, the sampling site is already elevated. If filter samplers cannot be located nearby and at ground level, only one filter at as near to 3 m above the surrounding ground surface as possible, will be necessary. Also, because this is a school, there may be no location for direct soil measurements or placement of a soil box that can be guaranteed secure or undisturbed.

4.5 Sampling Schedule

EPA (2001) recommends sampling for five years to account for year-to-year climate variations. At present, the soil recontamination study is scheduled for one year at least, and this deposition monitoring program is designed to be conducted in concert with the soil program. Sampling data will be evaluated on an ongoing basis and adjustments to methodology, frequency, or sampling locations made as needed.

Deposition filters will be analyzed monthly, on schedule with the residential soil recontamination monitoring program. Depending on lead levels measured and amount of debris on filters (insects, etc.), this schedule may need to be adjusted. Soil boxes and in-situ soil will also be measured monthly, at least initially.

¹ It is acknowledged that caps over deposition samplers will have some effect on particle collection.

5. SAMPLE HANDLING AND ANALYSIS

Filter papers, both new and "spent" must be handled carefully to avoid cross-contamination and inadvertent contact with possibly contaminated surfaces. Filters will be stored and transported to and from the field in ziplock bags, with each spent filter in a dedicated, labeled bag. One dedicated filter forceps will be used for all clean filters. For spent filters, a clean forceps will be used for each filter then discarded for cleaning; then a clean pair used for the next filter, and so on.

Trays on which filter papers are placed will also be handled to avoid cross-contamination. Trays will be cleaned in the laboratory, placed in ziplock bags, and transported to the field in same. Trays will be changed out with filters, with "dirty" trays bagged and returned to the laboratory for cleaning.

In the laboratory, filters will be halved, with one half analyzed immediately, and the second half stored for composite analysis with other filter halves from each location/sampling height after one year's sample collection.

6. WASTE MANAGEMENT

Laboratory waste will be managed according to applicable regulations and protocol. At the end of the study, soil from soil boxes will be disposed of according to measured lead levels, i.e., if greater than 400 ppm, disposal will be to the soil disposal site south of Herculaneum.

7. QUALITY ASSURANCE

EPA has developed the *Quality Assurance Project Plan for a Site Characterization at the Herculanum Lead Smelter*, attached as Appendix B. Much of this plan is applicable to quality assurance/quality control (QA/QC) for lead deposition monitoring.

7.1 Quality Objectives and Criteria for Measurement Data

As for the existing soil monitoring program at Herculanum, the quality assurance (QA) objective for deposition monitoring is to provide valid data of known and documented quality. Data quality objectives (DQO's) are defined on page 5 of the QAPP (Appendix B) in terms of accuracy, precision, completeness, representativeness, and comparability. Means for achieving DQO's for deposition monitoring are summarized in Table 3, below.

In order to specify quality control limits and quality assurance goals for measurement methods, the following suggested approach will be used for the duplicate filter results. The difference between the duplicates for the five sites will be calculated along with the 95% confidence interval for the true mean difference. If the calculated interval is greater than $\pm 20\%$ of the mean difference, then it should be considered whether that method is acceptable, or whether it can be improved, or needs to be discontinued.

A somewhat similar approach could be suggested for the blank and spiked sample results. There should be one blank and one spike per sampling interval, or three blanks and three spikes per quarter. The difference between the truth and the measured result will be calculated. The 95% confidence interval for each the blank differences and the spike differences will be calculated. The method might be suspect if the blank confidence interval does not contain zero or if the spike confidence interval does not contain the true value.

Table 3. Means of measuring data quality objectives (DQOs) for deposition monitoring project

DQO	Deposition Samplers (filter papers)	In-situ soil and Soil Boxes
Accuracy	Laboratory-spiked and blank samples; 1 each per sampling interval, or 3 each per quarter	Twice daily calibration checks of field XRF against soil samples with known lead concentrations
Precision	Duplicate samples to be collected at 5 of the 21 stations.	Multiple measurements for each sample site and box; duplicate soil boxes at 5 stations.
Data Completeness	Percentage of valid data	Percentage of valid data
Representativeness	Continuous sampling at 21 sites for one year or longer	Continuous sampling at 21 sites for one year or longer
Data Comparability	Common reporting units (Table 4)	Common reporting units (See Appendix B, p.5).

Table 4. Units for reporting deposition monitoring results.

Measurement	Specific Data Reporting Units
Metals concentrations on filter papers -- laboratory	$\mu\text{g}/\text{m}^2$
Metals concentrations on filter papers -- field XRF (optional, if feasible)	ppm
Metals in soil box soil and in-situ soil -- field XRF	ppm

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- Yi, S., U. Shahin, J. Sivadechathep, S. C. Sofuoglu, and T. M. Holsen (2001). Overall elemental dry deposition velocities measured around Lake Michigan, *Atmospheric Environment*, v. 35, pp. 1133-1140.

Appendix A

Alternative Means of Monitoring Deposition

Alternative Means of Monitoring Deposition

Other deposition and particulate sampling methods and media were considered for this plan, and should be kept in mind for future study.

Low-flow TSP samplers. To provide continuous air monitoring, a network of low-flow, continuous TSP or PM-10 particulate samplers are desirable. The intent of using such samplers is to provide another measure of airborne lead that, if comparable to deposition measurements, may be a simpler system to employ in the future than deposition collectors. Unlike high-vol samplers, which are typically operated one 24-hour period per week, low-vol samplers are less likely to miss a significant meteorological event affecting deposition. If possible, low-volume TSP filters should be analyzed in the field with XRF. Because the filters are small, it may only be possible to take one field XRF measurement, but multiple measurements should be attempted. Filters should then be bagged, labeled and sent to a laboratory for metals analysis. If field XRF and laboratory results are in good agreement, it should be possible to rely on field XRF measurements of TSP filters, with occasional laboratory confirmation..

PM-10 Samplers. The purpose of PM-10 samplers would be to aid characterization of lead particulate size, and hence sources, contributing to recontamination. This is especially important along haul roads, where it is likely that particles are large, and not transported significant distances. TSP and PM-10 samplers placed next to, and at intervals downwind of haul roads would help determine the degree of recontamination due to dust from haul roads.

Grass (lawns). Grass cuttings collected (bagged) by homeowners would be subsampled each cutting cycle; composites of subsamples would be ashed and analyzed for lead and other metals. It may also be feasible to use field XRF on subsamples and/or composite samples. Concentrations per mass of cuttings can then be related back to square areas of grass cut. A complicating factor may be mixing with tree leaves in the fall (see below).

Grass (in soil boxes). An option for soil boxes would be to plant the boxes with grass (alternatively, sections of sod could be used). The grass is intended to lend some realism, and to help hold soil in place so it is not lost to wind events. If planted in grass, a small patch (~10 cm diameter) of bare soil would be left in the center, suitable for measurement with the field XRF unit. Boxes with grass would require some maintenance, i.e., watering and clipping of the grass. The clipped grass would be bagged and composited for laboratory analysis. It may also be feasible to analyze clippings with the field XRF.

Tree Leaves. While tree leaves are likely significant collectors of deposition, it may be difficult to relate lead found on leaves to aerial deposition rates. Leaves may, however, provide a means of comparing deposition among different locations. Interspecies differences in leaf surface characteristics would need to be kept in mind. Leaves could be easily collected in the Fall by raking, at which time they would also likely be incorporated into grass cuttings to varying degrees.

Rooftops/runoff. Rooftops present large areas for deposition, with rain runoff collected from downspouts a potential sample collection point. Variability of roof surfaces and resuspension or adhesion of particulate are complicating factors.

Rainfall. Though it is likely that wet deposition plays a minor role in overall deposition, some attempt should be made to collect and analyze precipitation. To avoid dry deposition into precipitation samplers, they would need to be automatically uncovered/covered during rain/dry periods.

Appendix B
EPA's QAPP

QUALITY ASSURANCE PROJECT PLAN FOR A
SITE CHARACTERIZATION AT THE
HERCULANEUM LEAD SMELTER
HERCULANEUM, MISSOURI
CERCLIS ID NO.: MOD006266373

Prepared For:

U.S. Environmental Protection Agency Region VII
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Prepared By:

USEPA Region VII Superfund Technical Assessment and Response Team (START) 2

September 10, 2001

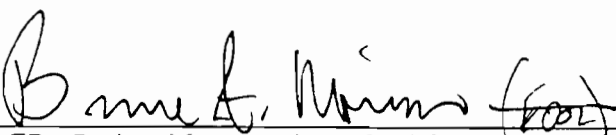
APPROVED BY:

START Project Manager, Ryan Schuler

Date

START Program Manager, Hieu Q. Vu, PE, CHMM

Date


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8-9-02
Date

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Date

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ATTACHMENTS

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1. PROJECT MANAGEMENT

1.1 Distribution List

Region VII EPA ~~Joe Davis~~ *Bruce A. Monahan* USEPA Project Manager
Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START Ryan Schuler, START Project Manager
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1.2 Project/Task Organization/Scope of Work

Ryan Schuler, of the U.S. Environmental Protection Agency (USEPA) Region VII Superfund Technical Assessment and Response Team (START), will serve as the START Project Manager for the activities described in this Quality Assurance Project Plan (QAPP) to be conducted at the Herculanum Lead Smelter Site in Herculanum, Missouri. He will be responsible for overall coordination of site activities, ensuring implementation of the QAPP, and providing periodic updates to the client concerning the status of the project, as needed. Joe Davis will be the USEPA Project Manager for this activity.

Eight to ten START members will comprise the field/sampling team. The team will be responsible for assisting EPA with surveying activities, obtaining access to sampling properties, acquisition and calibration of sampling equipment, sample collection, field screening, documentation of residential property conditions and field activities, and coordination of laboratory analyses. The START Quality Assurance (QA) Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This QAPP was prepared to address site characterization to determine the extent of soil contamination caused by operations at the Herculanum Lead Smelter (HLS) site in Herculanum, Missouri. In addition, air monitoring stations will be established to document fugitive releases of airborne contaminants. The scope of work includes obtaining property access, surveying/markings sampling cells at each property, collection of surface soil samples for field screening and laboratory analyses, and collection of ambient air samples at several locations near the HLS site.

Although an attempt will be made to adhere to this QAPP as much as possible, the proposed activities may be altered in the field if warranted by site-specific conditions and/or unforeseen hindrances that prevent any aspect of this QAPP from being implemented in a feasible manner. Such deviations will be recorded in the site logbook as necessary. This QAPP will be available to the field team(s) at all times during sampling activities to serve as a key reference for the proposed activities described herein.

1.3 Problem Definition/Background/Site Description

This QAPP was prepared by the Tetra Tech START to address imminent and long-term concerns that could impact human health and/or the environment at the HLS site (site), where metals-contaminated soils (predominantly lead, cadmium and zinc) have been identified during previous sampling activities.

The HLS site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area (see Attachment A - Figure 1: Site Location Map). The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility (see Attachment B - Figure 2: Aerial Photography). The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R. 6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90° 22' 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu\text{g}/\text{m}^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 12,800 parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter ($\mu\text{g}/\text{dl}$). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculaneum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.4 Project/Task Description

The activities described in this QAPP will address the following:

- A. The extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other child high-use areas affected by the HLS operations located east of and adjacent to U. S. Highway 61 and north of Joachim Creek in the township of Herculaneum. In addition, all residential yards and child high-use areas adjacent to or north of Old Route 61 Highway between the Joachim Creek overpass and U.S. Highway 61 shall be characterized. This includes all residential lots owned by the Doe Run Company and vacant residential lots.
- B. If the results of the site characterization along haul routes conducted in item A above indicate that high levels of surface soil contamination exists beyond the boundaries specified, sampling will be conducted to delineate the extent of this contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high use areas affected by the HLS operations.

1.5 Quality Objectives and Criteria for Measurement Data

The QA objective for this project is to provide valid data of known and documented quality. Specific Data Quality Objectives (DQO's) are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The measurement process of a contaminant concentration includes separate field and laboratory measurements. Errors are associated with each of these two types of measurements. These errors will be quantified and expressed as a measure of accuracy. The analytical component of accuracy will be expressed as Percent Recovery based on the analysis of lab-prepared spike samples and Performance Evaluation (PE) audit samples.

Precision for this project is defined as a measure of agreement among individual measurements of the same property and will be expressed via duplicate samples. The overall precision is assessed by collection of duplicate or collocated samples. Approximately 10% of duplicate/collocated samples is anticipated.

Data completeness will be expressed as the percentage of data generated that is considered valid. A completeness goal of 100% will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No specific critical samples have been identified for the project.

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this QAPP.

Data comparability is achieved by requiring all data generated for the project be reported in common units. The following table lists the various types of data that will be generated and the specific reporting units.

Specific Data Reporting Units

PARAMETER	UNIT
Metals in Soil by X-ray Fluorescence Spectrometer (XRF)	ppm
Metals in Soil by Laboratory Analysis	milligrams per kilogram (mg/kg)
Metals in Air	micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
Sampled Air Volume at Standard Temperature and Pressure (STP)	cubic meters at STP (m^3 STP)
Sampling Flowrate at STP	cubic meters per minute at STP (m^3/min STP)
Wind Speed	miles per hour (mph)
Wind Direction (Field Report)	degrees on an azimuth compass
Temperature	degrees Fahrenheit ($^{\circ}\text{F}$)
Barometric Pressure (not corrected to sea level)	millimeters of mercury (mm Hg)
Time	military time (00:00 - 24:00)
Date	month/day/year

1.6 Special Training Requirements/Certification

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarization with the Niton™ XRF and its operating procedures will also be necessary for the START members.

1.7 Documentation and Records

START personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by START will also be recorded in the field logbook. Information pertaining to all samples (i.e., sampling dates/times, locations, etc.) collected during this event will be recorded on sample field sheets generated by START. Labels generated by START will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses. Chain of custody records will be completed/maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

A health and safety plan will be prepared by START prior to the field activities that will address site-specific hazards. The health and safety plan will be reviewed and signed by all field personnel prior to field work, indicating that they understand the plan and its requirements. Copies of the plan will be available to all personnel throughout the sampling activities.

2. MEASUREMENT/DATA ACQUISITION

2.1 Sampling Process Design

The proposed sampling scheme for this project will be in accordance with the Removal Program Representative Sampling Guidance, Volume 1: Soil, OSWER Directive 9360.4-10, November 1991, and judgmental (based on the best professional judgement of the sampling team). The sampling design proposed in the following paragraphs has been selected to identify the extent of soil contamination at the site. The proposed number of samples is a balance between cost and coverage and represents a reasonable attempt to meet the study objectives while staying within the budget constraints of a typical site investigation.

The characterization sampling will be conducted in a priority hierarchy as follows:

- A. Residential yards where a known child under 7 years old resides.
- B. Residential yards along the primary and secondary concentrate haul routes.
- C. Child high use areas.

At a minimum, residential properties located in the previously identified area will have four quadrants established around the home, which will radiate out 50 feet from each side of the home. In each quadrant, a nine-aliquot composite sample will be collected from the upper 1 inch of soil and screened with a Niton™ XRF. Therefore, a minimum of 4 four samples will be collected from each residential property. Soil samples will not be collected from within 3 feet of the residential dwellings to reduce the potential lead-based paint contribution to soil-lead concentrations. In addition, multi-aliquot surface soil samples will be taken at the drip line of each structure where a child under 6 years old with elevated blood lead is known to reside. Multi-aliquot surface soil samples will also be collected from any play areas, gardens, sand piles, unpaved driveways, and other areas appearing to be frequented by children. The number of aliquots for these areas will be dependent upon size, but, in general, will follow the aliquot density used for the quadrants.

A 9-aliquot soil sample will be collected from the five-foot section of residential yards and high child use areas adjacent to roads used as haul routes by the Doe Run Company and within the first 50 yards of the streets intersecting with those haul routes.

In addition to soil sampling at residential properties, indoor dust samples will be collected at residential homes which meet the one of the following criteria: 1) homes which have a child less than 6 years of age; and 2) homes which have an XRF screening concentration of greater than 10,000 ppm from any area of the yard.

For locations where there are no residences, a center point, depicting a possible future building site, will be established and flagged. From the center point, four quadrants will be established, which will radiate out 100 feet in each compass direction, and the aforementioned sampling protocols will be completed (e.g. collecting a nine-aliquot composite from each quadrant).

If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the specified limits, further sampling will be conducted on properties beyond the defined sampling.

In addition to soil sampling, four to five ambient air sampling apparatus will be established at several locations near the smelter to determine the potential impact of transporting lead materials from and to the smelter. Specific monitoring locations will be based on field judgment. The monitoring locations will include high traffic and low traffic areas, in order to study any differences. The sampling apparatus will include Hi-Vol and PM-10 Hi-Vol air monitoring instruments. The air monitoring instruments will be placed on the ground. At least one Hi-Vol and one PM-10 Hi-Vol will be collocated at one location.

A summary of anticipated samples to be collected for this project is provided in the following table. The exact number will depend on field screening results, as previously described. Approximately 10 percent of all screening samples will be collected for laboratory confirmation analysis.

Matrix	Number of Samples		
	Field Screening (Lead)	Laboratory	Laboratory Analyses ^a
Soil	4,000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA ^b	250	Lead, cadmium, arsenic, zinc, nickel
Air	NA	200	Lead, cadmium, arsenic, zinc, nickel

a. See Section 2.4 for details pertaining to analyses.

b. NA = Not Applicable

2.2 Sampling Methods Requirements

Soil samples will be collected following the EPA Region 7 SOP #2231.12A: ERT #2012; "Soil Sampling". Confirmation soil samples will be collected with a clean, dedicated stainless steel spoon and homogenized in a clean, dedicated aluminum pie pan. The samples will be screened with the XRF after homogenizing the soil, and three consecutive XRF readings will be collected. The three homogenized XRF readings will be recorded on a field sheet. Screening samples using the XRF will follow EPA Region 7 SOP # 4231.707A. The location of the XRF readings (as well as confirmation sample location, if necessary) will also be recorded on each field sheet. Confirmation samples will be transferred directly into the appropriate container for analysis. The samples will be submitted to a subcontracted laboratory.

Indoor dust sampling will be conducted in accordance with EPA Region 7 SOP #4231.1 1A with a minor modification to include the use of a hand-held electric vacuum sweeper. A dedicated filter will be used for each sample. The dust sample will be collected from an adequate area to provide a minimum of 5 grams of weight. The sampling area will include high traffic areas, children bedrooms, and/or undisturbed areas. Pertinent sampling information will be documented on field sheets. The dust sample will be transferred directly into a dedicated ziplock bag and labeled for laboratory analysis.

All ambient air sampling will be accomplished using Hi-Vol and PM-10 Hi-Vol Air Samplers (manufactured by General Metals Work, Inc., Village of Cleves, Ohio), or equivalent. The samplers will be operated in accordance with EPA Region 7 SOP No. 2314.1A and No. 2314.2A except where procedures differ from this QAPP. In all cases, the policies described in this QAPP shall take precedence over other EPA SOPs. Each sampler will be positioned on the ground level. Suitable supporting structures meeting all local and Federal safety codes will be used. Samplers will be operated continuously for a 24-hour ($\pm 10\%$) sampling duration. Sampler start and completion times will be referenced to 2400 hours.

Air samples may be voided by the EPA OSC or START Project Manager under the following conditions: (1) If the sampling duration is outside the 21.6 to 26.4 hour limit; (2) evidence of sample tampering is observed; or (3) sample is known to be unrepresentative (due to contamination, sampler failure, etc.).

One meteorological station will be established for the air monitoring. The station will be sited and operated in accordance with "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV Meteorological Measurements", EPA-600/4-82-060, August 1989. Specifically, the station will measure wind direction, wind speed, and temperature from a height of 10 meters. Data logging will be accomplished electronically using an averaging time of 1 hour. Surface pressure (not corrected to sea level) will be recorded hourly. If larger scale meteorological data are required, such "synoptic" data will be acquired from the nearest US Geological Survey stream recording station or from the nearest reporting airport.

Disposal of investigation-derived wastes (IDW) and procedures for equipment/personal decontamination will be addressed in a site-specific health and safety plan prepared by the Tetra Tech START. In general, it is anticipated that most IDW will consist of disposable sampling supplies (gloves, paper towels, etc.) that will be disposed of off-site as uncontaminated debris.

2.3 Sample Handling and Custody Requirements

Samples will be collected in accordance with procedures defined in Region VII EPA SOP 2130.4B. Chain of custody procedures will be maintained as directed by Region VII EPA SOP 2130.2A. Samples will be accepted by the contracted laboratory according to their specific procedures and SOPs.

All soil sample containers will be placed in plastic bags to control spillage in case the containers break during shipment. Soil and dust samples will be placed in coolers containing packing material and enough ice to ensure that the temperature of the samples does not exceed 4°C. Necessary paperwork for all samples, including chain of custody records, will be completed by the Tetra Tech START and maintained with the coolers until delivery to the laboratory. If shipment of the samples is required via commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed/dated and placed across the lid opening. The samples will be submitted to the receiving laboratory by START personnel in a time-efficient manner to ensure that the applicable holding times are not exceeded.

2.4 Analytical Methods Requirements

The samples will be analyzed at a pre-qualified laboratory contracted by the Tetra Tech START, according to the EPA methods listed in the following table. Detection limits that are typically reported by those methods are expected to be adequate for this activity. The requested analyses have been selected based on past sampling data and historical information collected for the site:

ANALYTICAL METHODS	
Analytical Parameter ^a	EPA Method Number
SOIL/DUST	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010B
AIR	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010 B and 7000 Series

a. EPA may cease the analysis for zinc and nickel content if zinc and nickel concentrations in the initial confirmation samples are consistently below MDNR's Any Use Soil Levels.

2.5 Quality Control Requirements

Because dedicated supplies will be used for all samples (i.e., stainless steel spoons, pie pans, etc.), no QC samples will be required to assess the potential for cross-contamination. Analytical error (precision and accuracy) will be determined by the analysis of laboratory-prepared duplicates and spike samples. These criteria, along with other laboratory QC elements, will be performed in accordance with the contract laboratory's quality assurance plan.

To satisfy the quality control elements for the XRF, data will be collected and analyzed for comparability to laboratory data, to determine detection and quantitation limits, and to determine accuracy and precision. The mean of the three XRF readings taken for each confirmation sample will be compared statistically to the laboratory results for each confirmation sample to assess comparability. The measure of agreement (r^2) for the XRF unit should be above 0.7 or greater for the XRF data to be considered screening level data.

For every measurement, the Niton™ gives an uncertainty range that represents a 95 percent confidence interval. In general, precision/accuracy increases with increasing sample run time. Due to preliminary sample results indicating high lead levels, XRF sample run time will be increased accordingly to improve precision and accuracy. The goal is for samples to be screened long enough to obtain precision measurements within 20% of the actual concentrations.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Testing, inspection, and maintenance of all sampling equipment and supplies, along with field screening instrumentation, will be performed by START personnel prior to deployment for field activities. Testing, inspection, and maintenance of analytical instrumentation will be performed in accordance with the contracted laboratory's analytical SOPs and manufacturers' recommendations.

2.7 Instrument Calibration and Frequency

Calibration of the field screening and laboratory analytical instrumentation will be in accordance with the referenced SOPs and manufacturers' recommendations.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers*. The certificates of cleanliness will be maintained in the project file.

2.9 Data Acquisition Requirements

Previous data/information pertaining to the site (including other analytical data, reports, photos, maps, etc., which are referenced in this QAPP) have been compiled by START from various sources. Some of that data has not been verified; however, that information will not be used for decision-making purposes without verification of its authenticity.

2.10 Data Management

All laboratory data will be managed as specified in the contract laboratory's QAM. Preliminary data will be received by the project manager on site. The final data package will be forwarded to a chemist trained in data validation to complete the validation process. The results will be summarized and included in the report submitted to EPA.

3. ASSESSMENT/OVERSIGHT

3.1 Assessments and Response Actions

Assessment and response actions pertaining to analytical phases of the project are addressed in the contracted laboratory's quality assurance manual(s). Because of the short duration of this sampling event, no field audits of sampling procedures will be performed. Corrective actions will be taken at the discretion of the EPA Project Manager, whenever there appears to be problems that could adversely affect data quality and/or resulting decisions affecting future response actions pertaining to the site.

3.2 Reports to Management

A letter report describing the sampling techniques, locations, problems encountered (with resolutions to those problems), and interpretation of analytical results will be prepared by START, following completion of the field activities described herein and validation of laboratory data. The laboratory data for soil samples will be compared to all applicable or relevant and appropriate requirements (ARARs), including removal action levels that have been established for the site, to determine whether further response is warranted.

4. DATA VALIDATION AND USABILITY

4.1 Data Review, Validation, and Verification Requirements

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager in accordance with the contracted lab's quality assurance program. Follow-up validation of the data will be performed by a Tetra Tech START chemist. The START Project Manager will be responsible for overall validation and final approval of the data, in accordance with the projected use of the results.

4.2 Validation and Verification Methods

A qualified Tetra Tech START chemist will review the data for laboratory spikes/duplicates and laboratory blanks to ensure that they are acceptable. The START Project Manager will inspect the data to provide a final review. The START Project Manager will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

4.3 Reconciliation With User Requirements

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

ATTACHMENT A

Figure 1: Site Location Map

(One page)



Not to Scale

Herculanum Lead Smelter
Herculanum, Missouri

Figure 1
Site Location Map

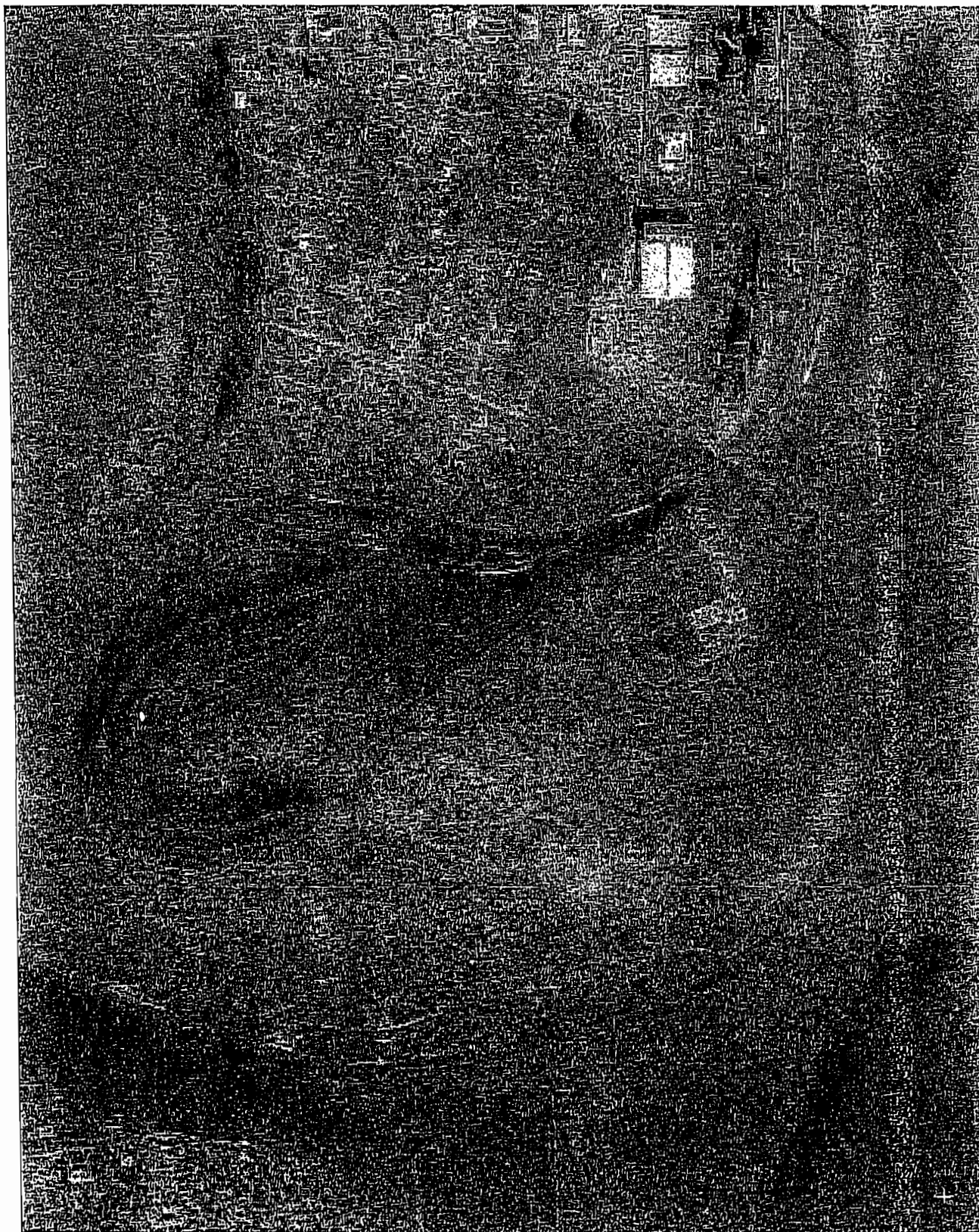


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ATTACHMENT B

Figure 2: Aerial Photography

(One page)



Not to Scale

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 2
Aerial Photography

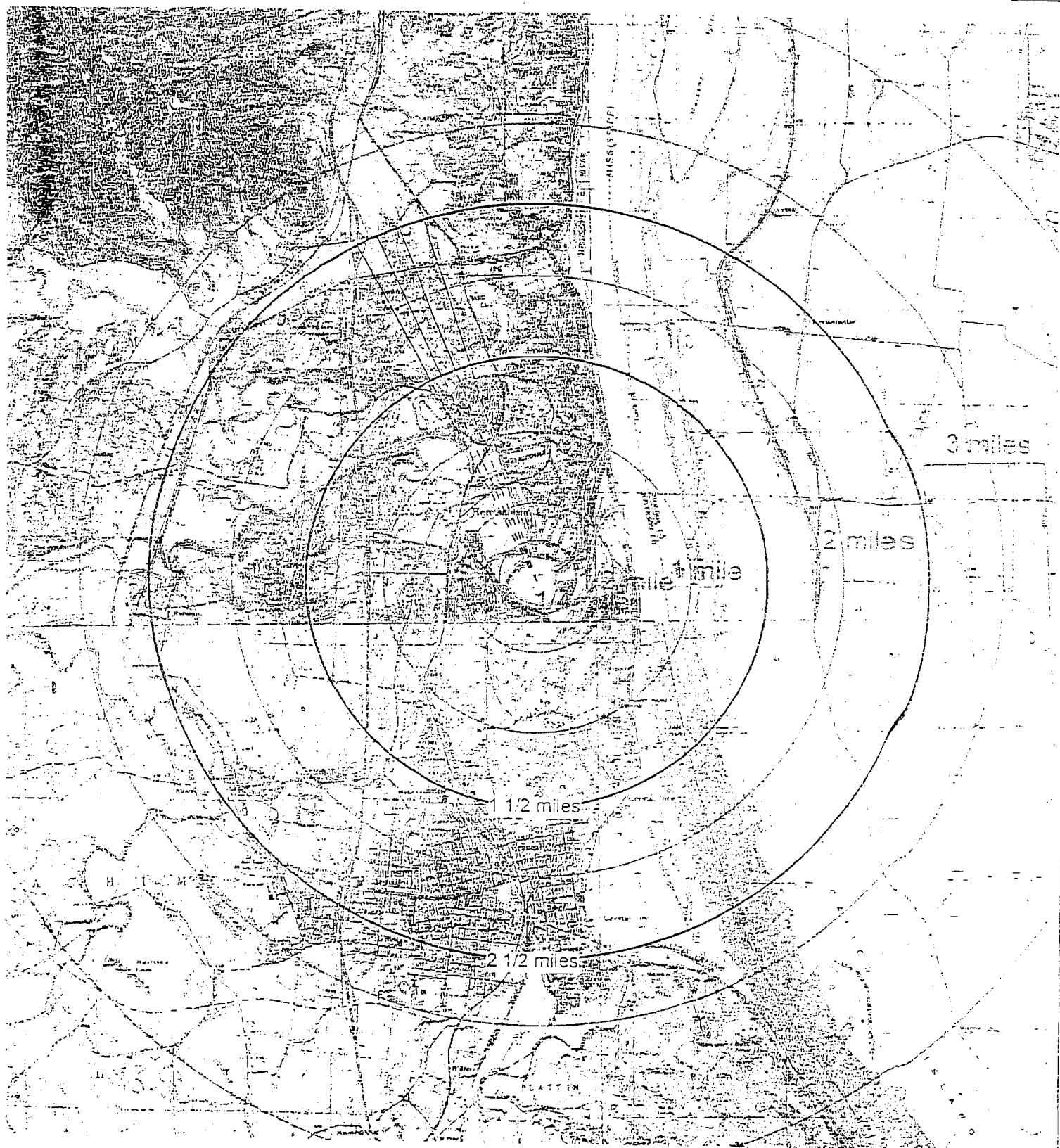


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ATTACHMENT C

Figure 3: Sampling Map

(One page)



- Legend
- Radius rings
 - Transect lines
 - Transect lines where sampling will occur



Note: Samples will be taken every 200 hundred feet along the transect lines between the 1 1/2 miles radius ring and the 2 1/2 miles radius ring.

Source: USGS Festus, MO 7.5 Minute Topo Quad

Herculanum Lead Smelter
Herculanum, Missouri

Figure 3
Sampling Map



Tetra Tech E&M Inc.

Date: 4/1/01

Drawn By: Dan Wills

Project No.: 0201101-001-001