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
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

Prepared By:

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

September 10, 2001

APPROVED BY:

START Project Manager, Ryan Schuler	9/11/01 Date
START Program Manager, Hieu Q. Vu, PE, CHMM	9/11/01 Date
EPA Project Manager, Superfund Division, Joe Davis	9-11-01 Date
EPA Superfund Quality Assurance Coordinator, Bob Dona	9/12/01 Date

Attachment 4

TABLE OF CONTENTS

ATTACHMENTS

1.0 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Region VII EPA	Joe Davis, USEPA Project Manager Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START	Ryan Schuler, START Project Manager Hieu Q. Vu, START Program Manager Ted Faile, START Quality Assurance Manager

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 Herculaneum Lead Smelter Site in Herculaneum, 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 Herculaneum Lead Smelter (HLS) site in Herculaneum, 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/marking 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 (g/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 (g/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 (g/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 Farenheit (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.

2.0 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:

1. Residential yards where a known child under 7 years old resides.
2. Residential yards along the primary and secondary concentrate haul routes.
3. 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 resedential 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		Laboratory Analyses[1]
	Field Screening (Lead)	Laboratory	
Soil	4000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA	250	Lead, cadmium, arsenic, zinc, nickel
Air	NA	200	Lead, cadmium, arsenic, zinc, nickel

NA = Not Applicable
[1] See Section 2.4 for details pertaining to analyses.

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 #4231.11A 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 (±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 [1]	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

[1] 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.

3.0 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.

4.0 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.

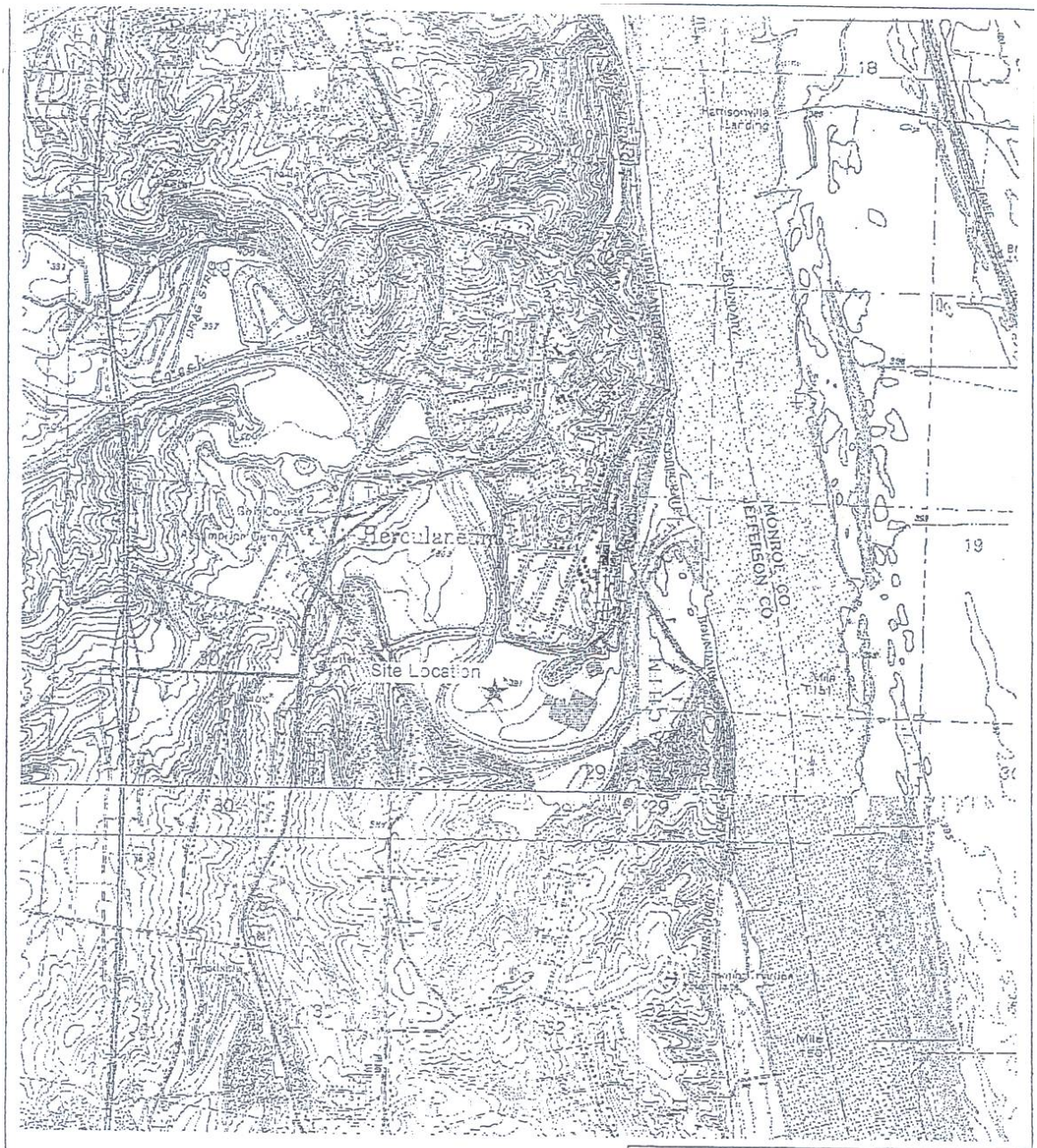
4.3 RECONCILIATION WITH USER REQUIREMENTS

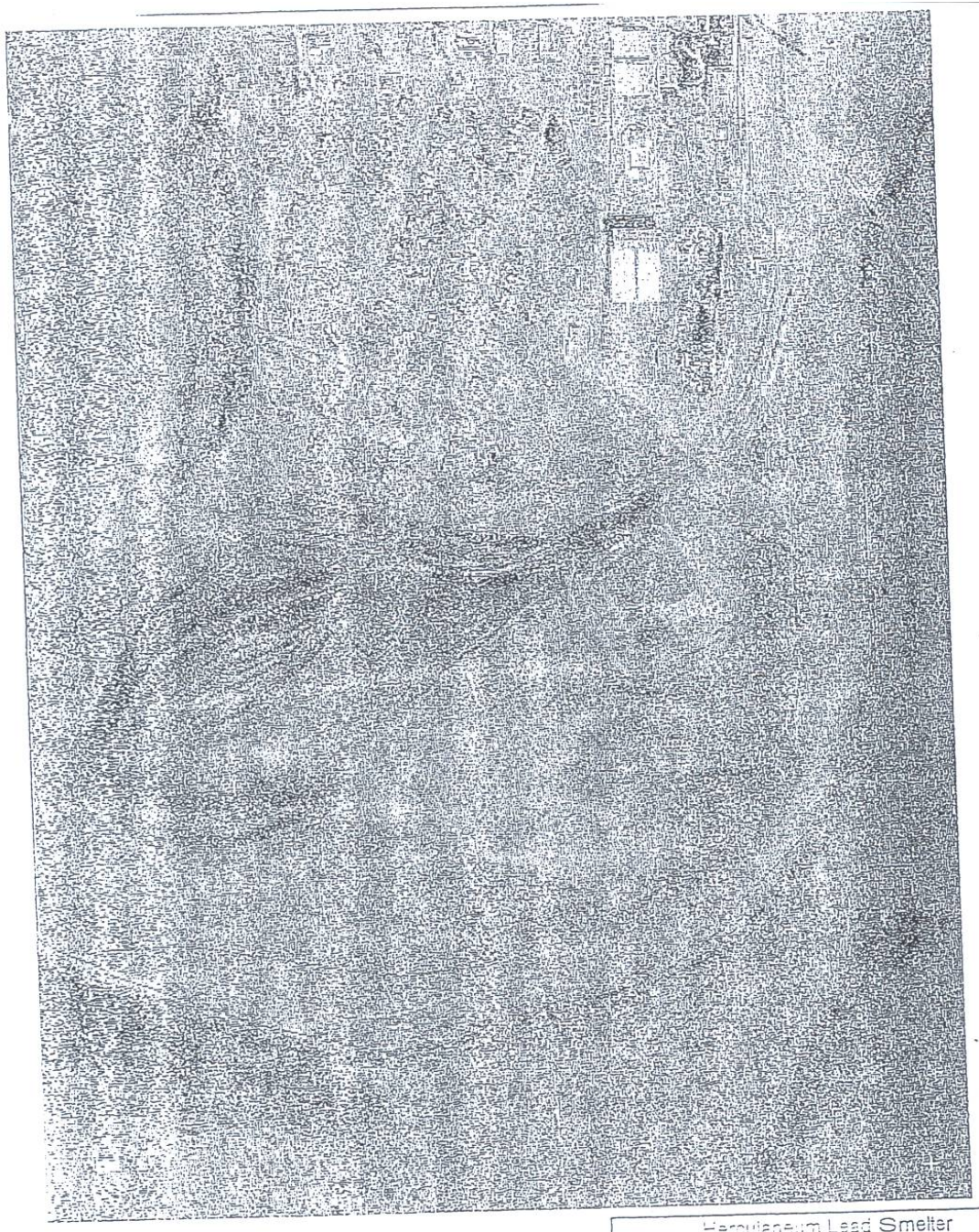
If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

ATTACHMENT A

Figure 1: Site Location Map

(One page)

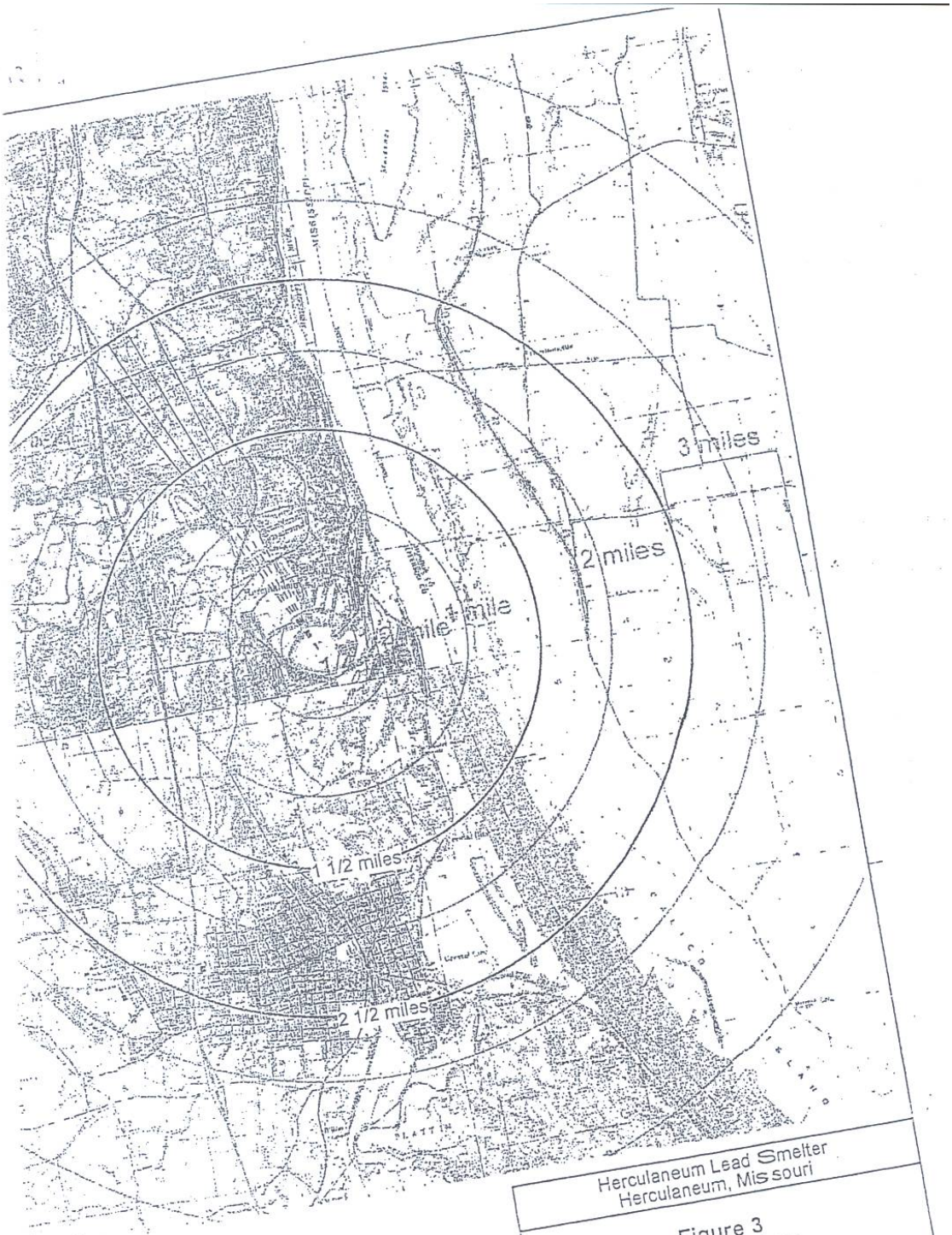

Herculaneum
Site Location
Herculaneum Lead Smelter
Herculaneum, Missouri
Figure 1
Site Location Map
Tetra Tech EM Inc.
Source: USGS Festus MO 7.5 Minute Topo Quad



Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 2
Aerial Photography

Tetra Tech EM Inc.



nd
e rings
ect lines
ect lines where sampling
cour

es will be taken every 200 hundred feet along
nsect lines between the 1 1/2 miles radius ring
ne 2 1/2 miles radius ring.