Incremental Sampling Methods & Best Practices for Lead Investigations

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FRTR

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Former Chattanooga Foundries

- 60+ foundries historically located in Chattanooga.
- Generated spent sand and baghouse dust over many decades.

Former Chattanooga Foundries

Spent Foundry Sand

- Foundry waste material can contain lead
- Foundry material was used as fill

Initial EPA Involvement

- 2011: resident presented at ER with Pb poisoning
- 2012: EPA removed Pb contaminated soil at 84 residences
- Limited geographic area
- Extent of contamination undefined
- Other residential areas may be similarly impacted
- Risk undefined

Potential Large Urban Lead Site: Where to Begin?

Is all of downtown Chattanooga contaminated?

NO

Objectives of the Investigation

- Establish urban background levels
- Collect high quality data to support risk management decisions
- Produce data that can be used for multiple purposes:
  - Site characterization
  - Time-critical removal decisions
  - Future RI & Risk Assessment

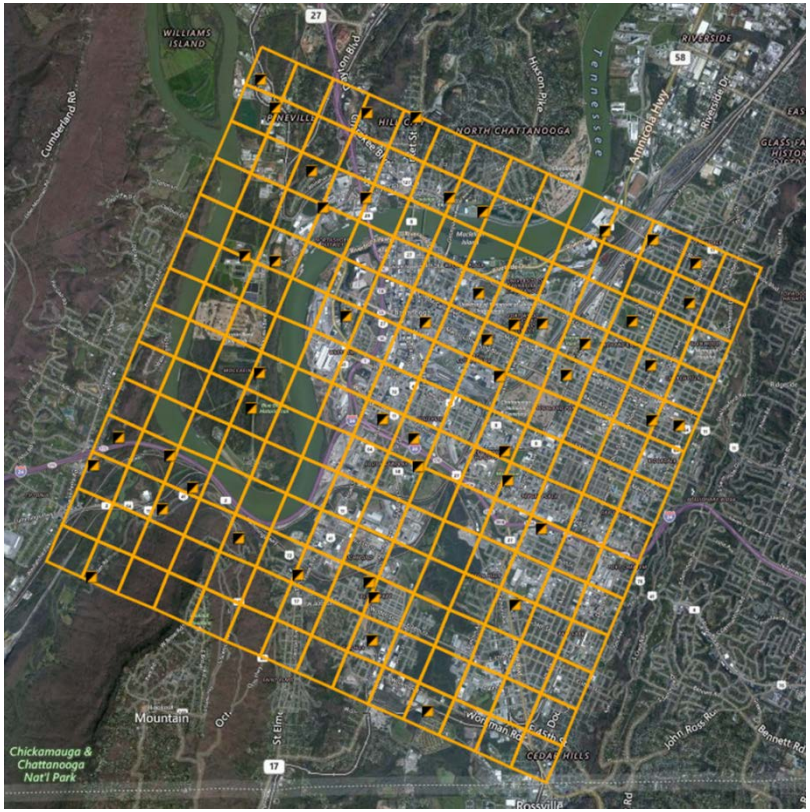
Best Practices for Sampling for Lead in Soil

- Establish robust background concentration/range
- Incremental Sampling Method (ISM)
- OLEM Directive for sieving soil at lead sites
- EPA Superfund XRF Field Operating Guide
- Lead bioavailability testing
- Develop site-specific cleanup level for lead

Best Practice:
Establish Background Level for Lead

Chattanooga Urban Bkg Study

- 5x5 mile grid; 50 randomly selected cells
- Used SAP/QAPP template from larger R4 urban background study
- 7 metals associated with foundries: Pb, As, Cd, Cr, Cu, Ni, Zn

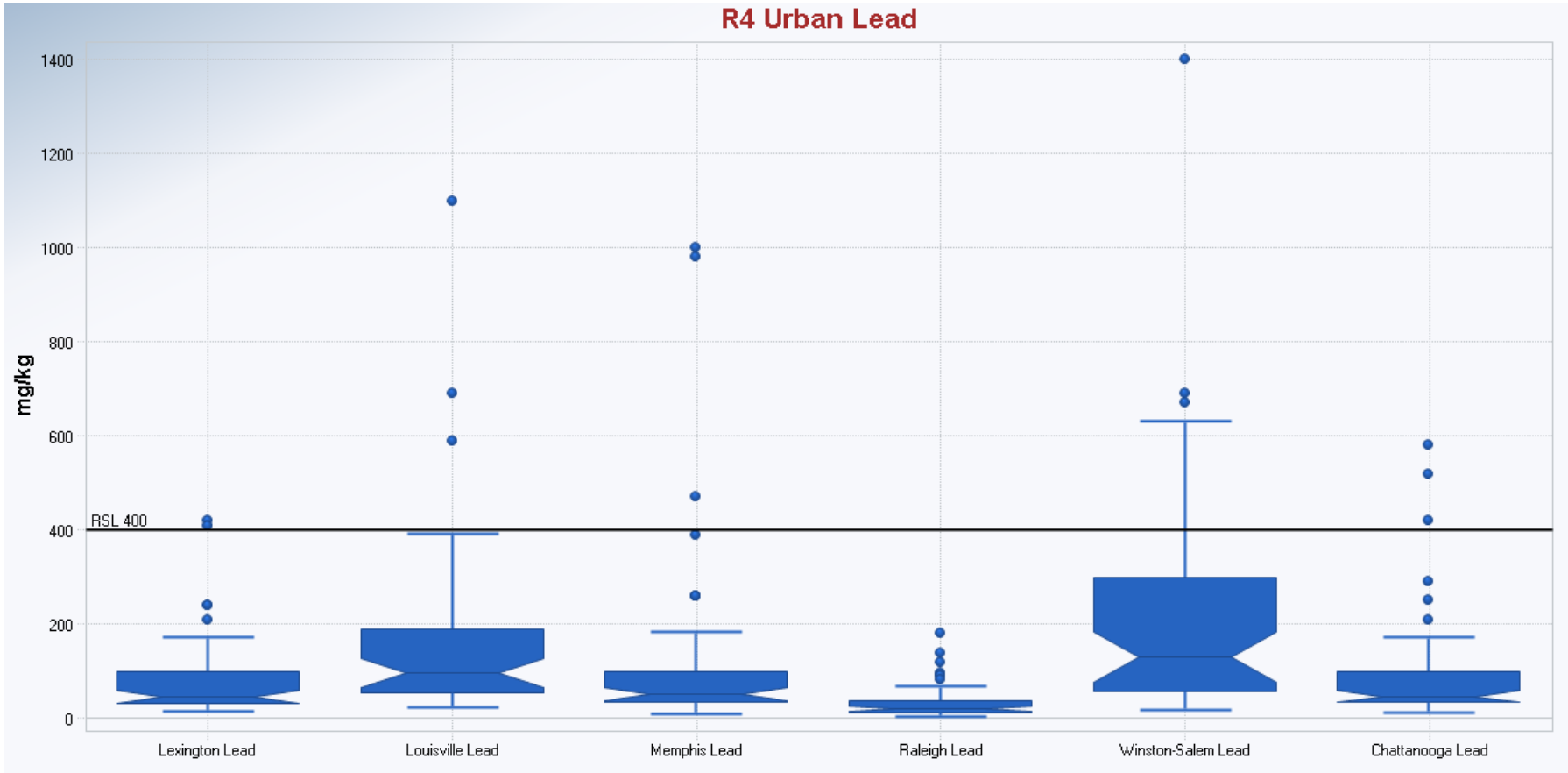


Urban Background Results

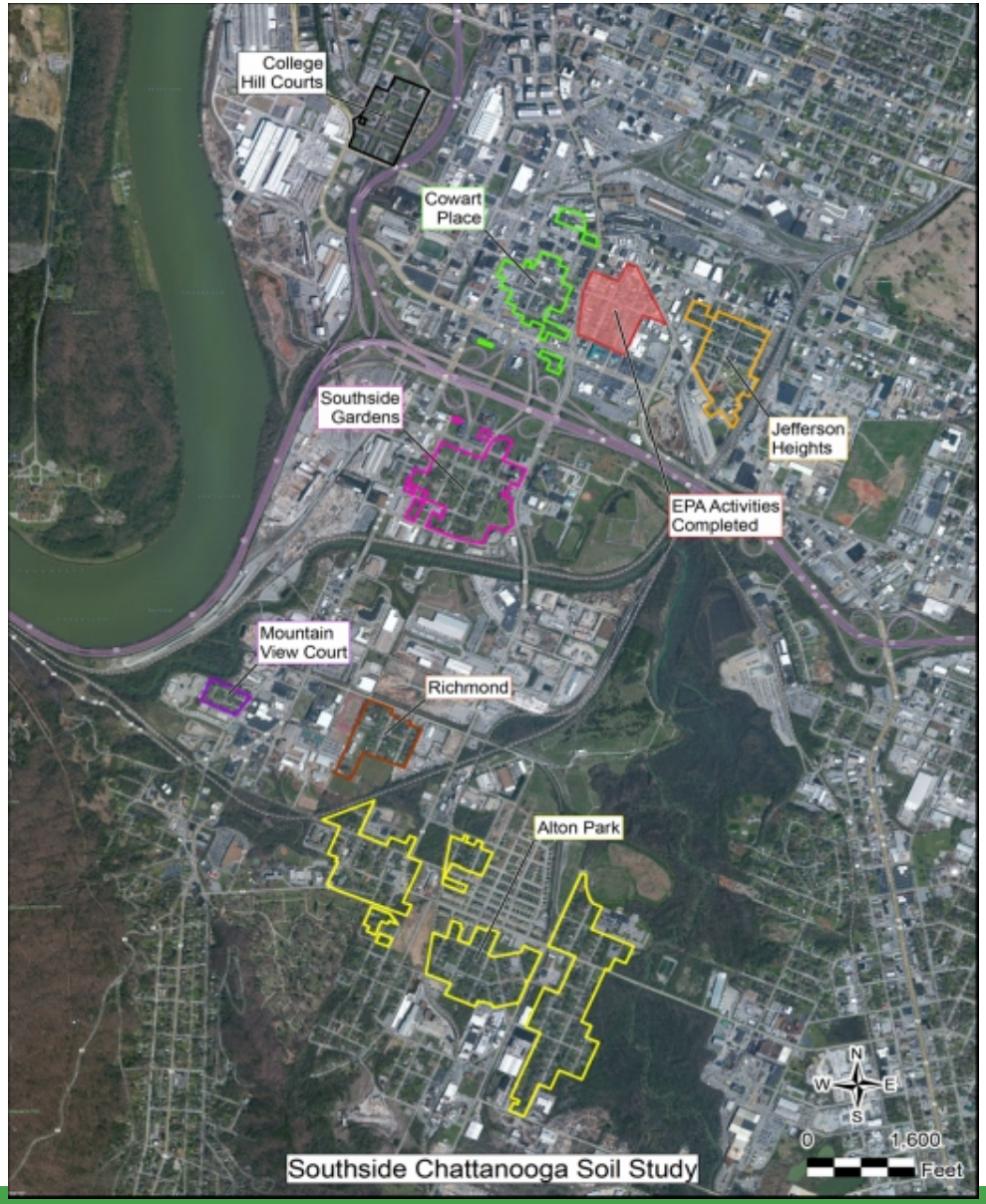
	RSL	Mean Bkg (SI)		Urban background 95% UTL
Lead	400	60		175
Arsenic	0.68	3.4		7
Chromium		25		33

- Background lead consistent with other Southeastern cities
- Robust background dataset ready for RI
- Elevated lead is not “everywhere”

Chattanooga Lead Background vs. 5 Cities



Identify Study Areas



Field Operation

Best Practice: Incremental Sampling Methodology (ISM)

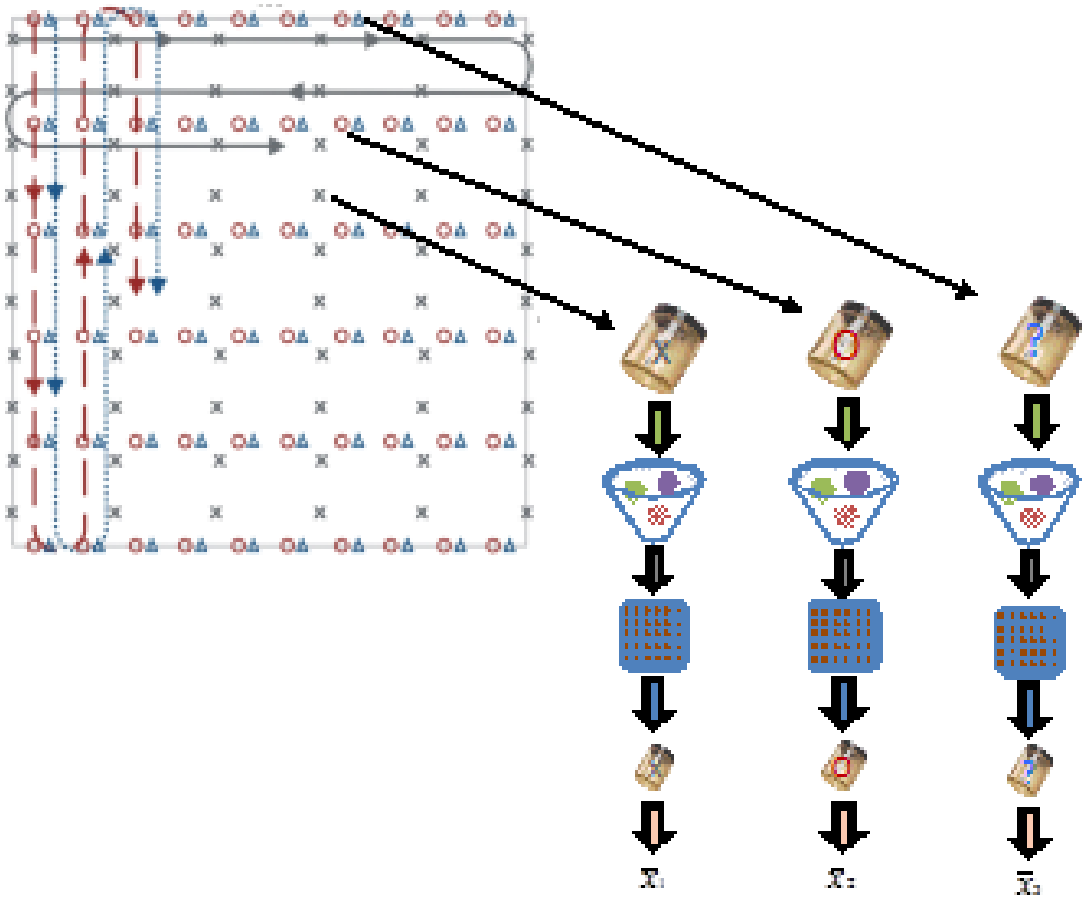
Why ISM?

Superior method to derive an unbiased estimate of the mean concentration of a given area (i.e. decision unit)

One ISM sample is collected for each decision unit

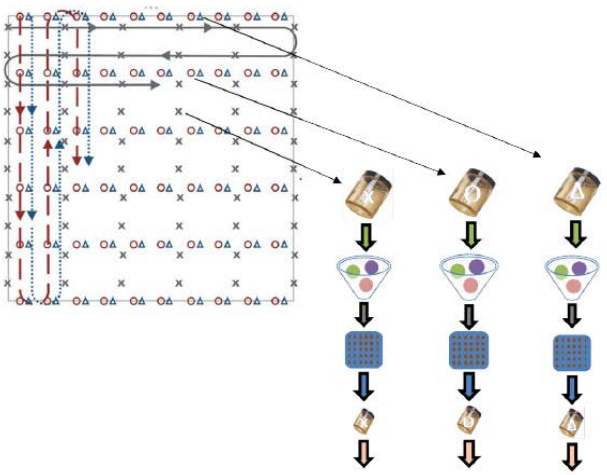
Each sample is comprised of 30 aliquots, and produces one concentration that represents the entire decision unit (yard)

Statistically defensible data on which to base decisions



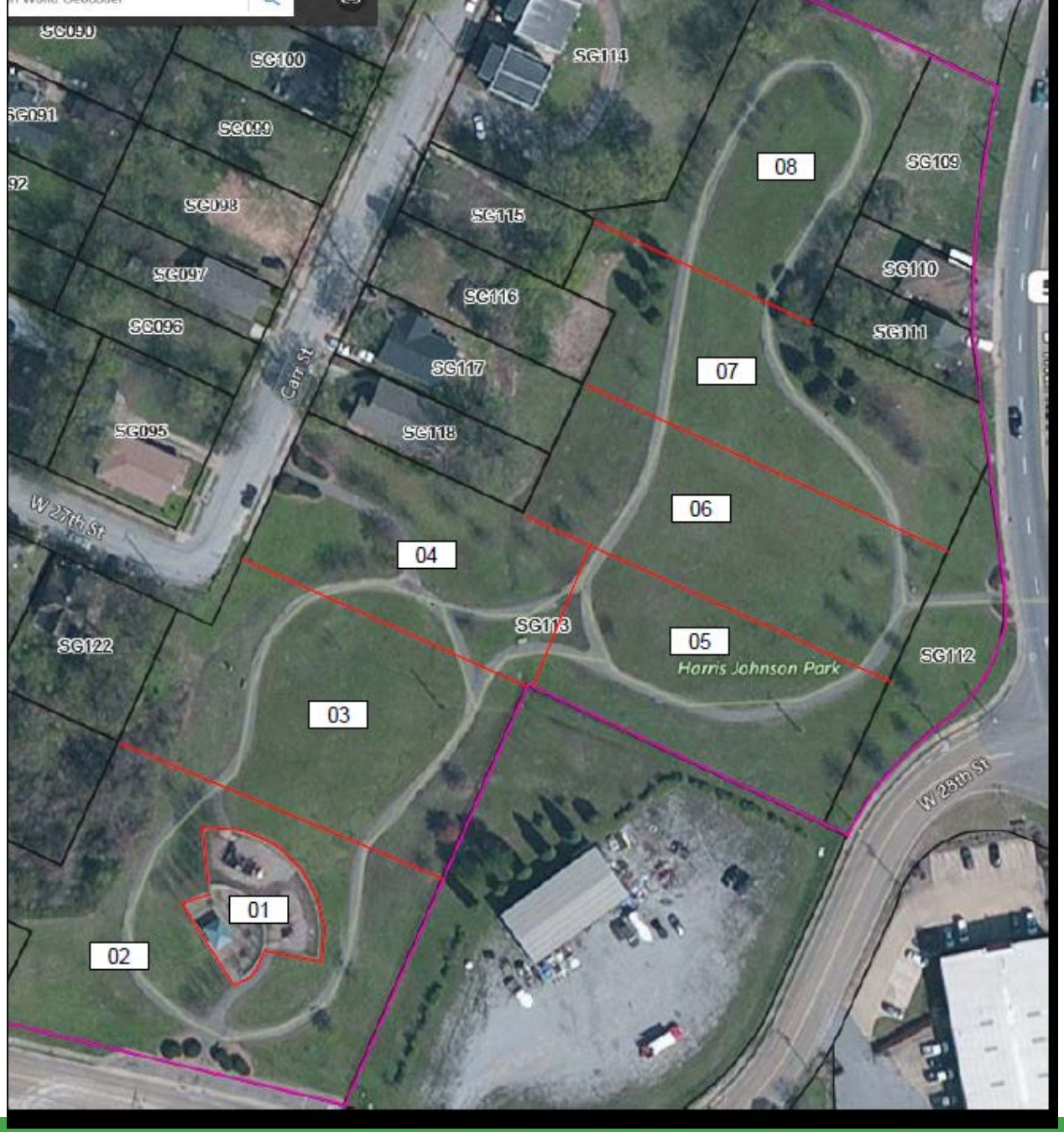
Technical and Regulatory Guidance

Incremental Sampling Methodology



February 2012

Prepared by
The Interstate Technology & Regulatory Council
Incremental Sampling Methodology Team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Harris Johnson Park
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W 28th St
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Jefferson Street Park
JH075
JH079
JH080
JH081
JH082
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JH096
JH123
JH124
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JH127
JH128
JH129
JH092
JH093
JH094
JH095
E 19th St
Madison St

Incremental Sampling in Chattanooga

Collecting ISM: Time & Effort

One 30-point composite from a residential yard takes 8 minutes to collect

ISM Includes Representative Subsampling

Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples EPA/600/R-03/027, November 2003

Disaggregation and Drying

OLEM Lead Sieving Directive

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WASHINGTON, D.C. 20460

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MEMORANDUM

OLEM Directive 9200.1-128

SUBJECT: Recommendations for Sieving Soil and Dust Samples at Lead Sites for Assessment of Incidental Ingestion

Recommendations for Sieving Soil and Dust Samples at Lead Sites for Assessment of Incidental Ingestion, OLEM Directive 9200.1-128

OLEM Lead Sieving Directive

- Recommends < 150 µm particle size (#100 mesh)
- Incidental ingestion greater for fine particles.
- Dermal adherence greater for fine particles.
- Increased contaminant concentration, mobility, and bioavailability in fine particles.

Dermal Adherence

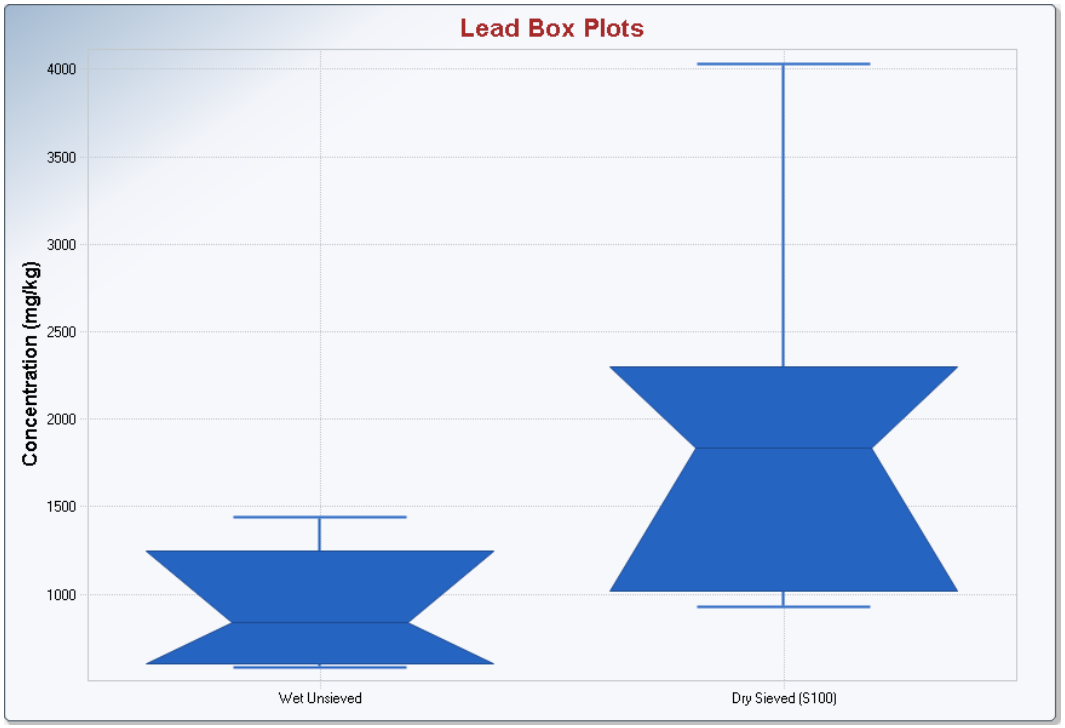
Sieve of Stacked Mesh (#10 and #100)

Fine Fraction <150 microns

Lead Concentrates in the Fine Fraction

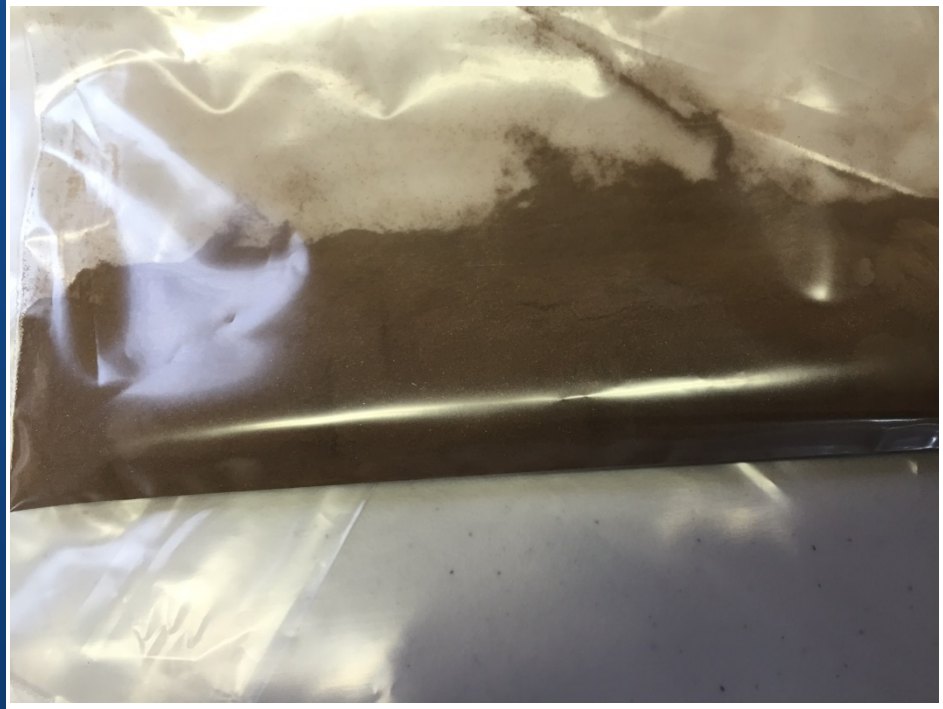
Pb in mg/kg

Unsieved	Sieved
603	1016
837	1832
1434	4021
1245	2300
591	936

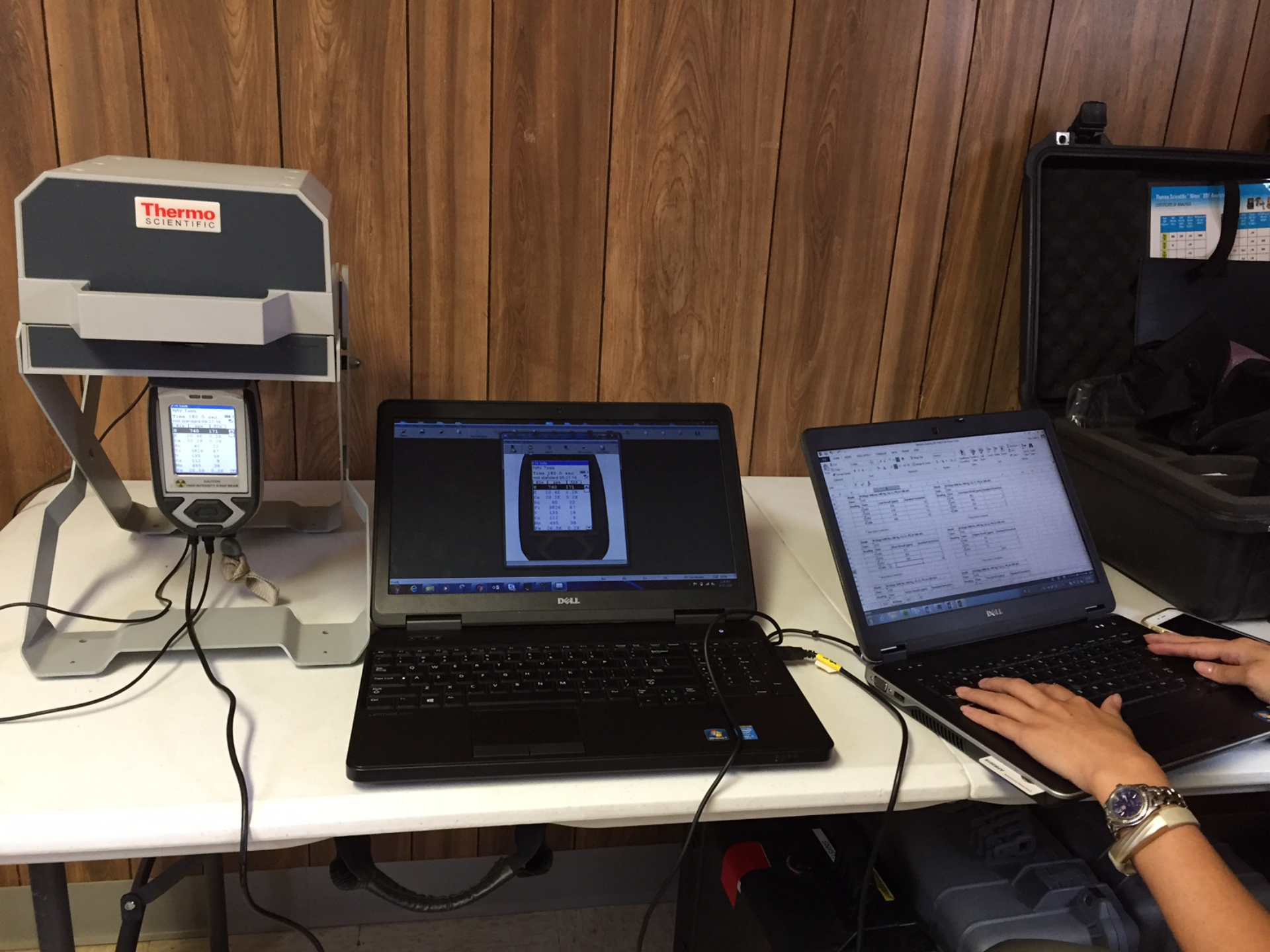


At this site, sieved soil has approximately 100 ppm higher concentration than in unsieved.

ISM Includes Representative Subsampling



Representative subsamples for analysis

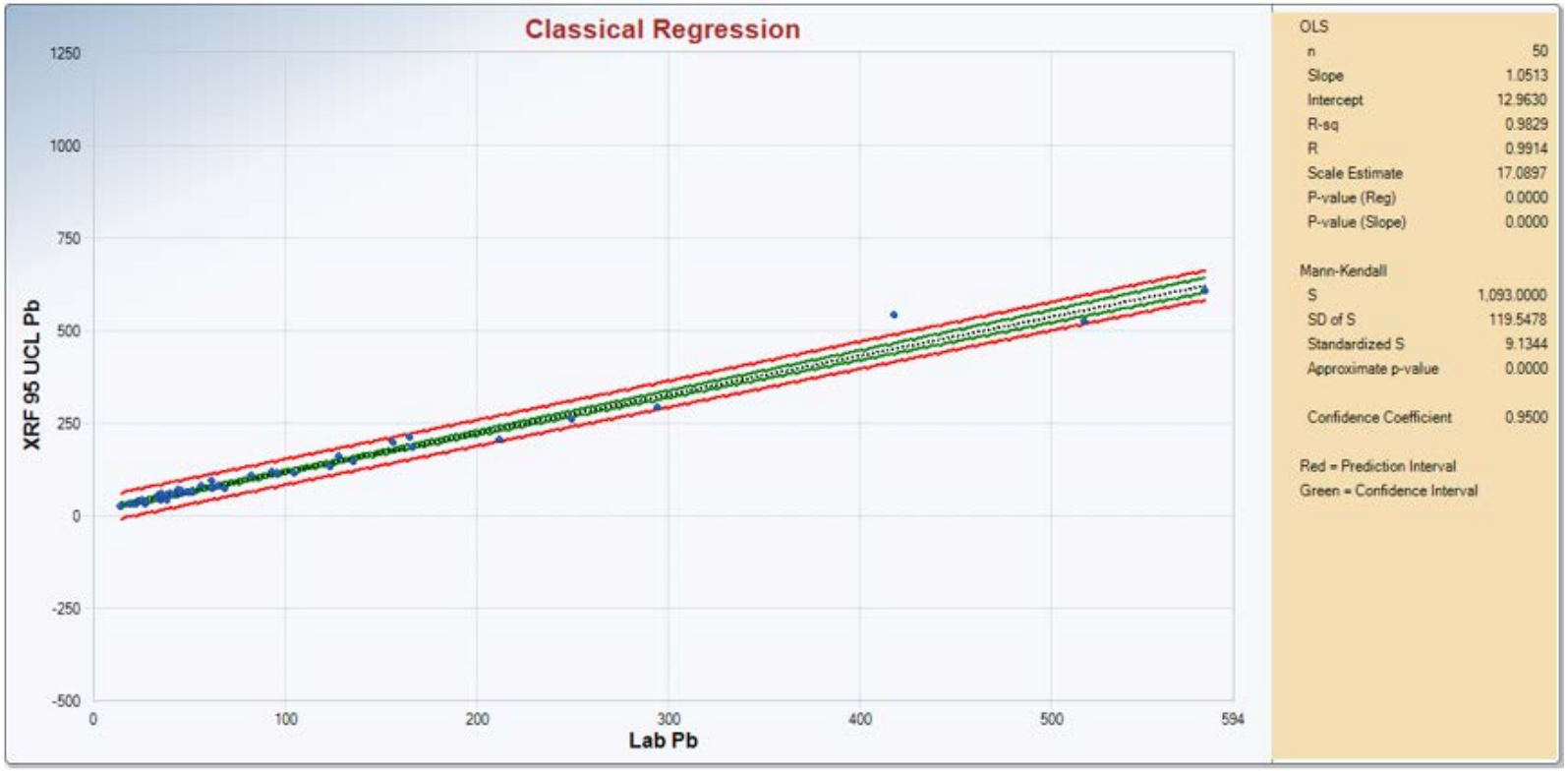

Thermo
SCIENTIFIC
DELL
DELL

Best Practice:
X-Ray Fluorescence Field Operations Guide

Superfund X-Ray Fluorescence Field Operations Guide, EPA Region 4, July 19, 2017 (SFDGUID-001-R0)

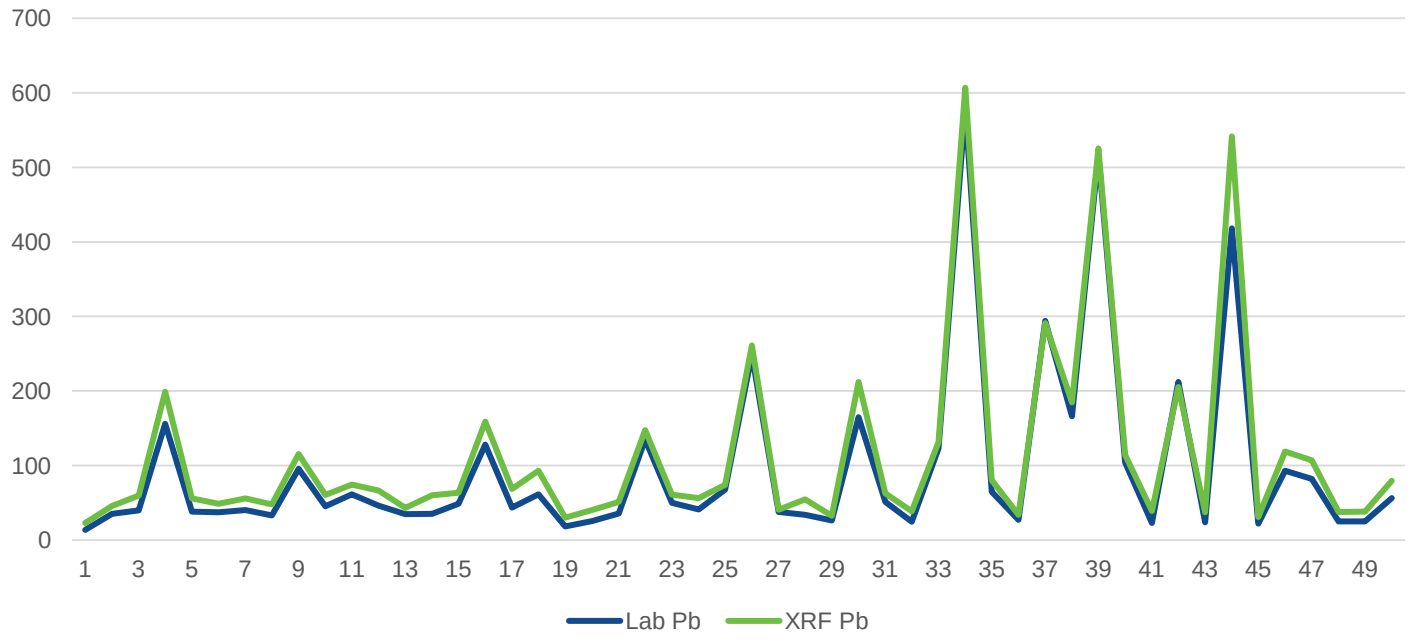
- Tool for OSCs and RPMs
- Methodology to collect high quality XRF data for lead and arsenic
- Provides real-time data
- Multiple readings and QA/QC measures
- Produces “definitive” data = data of sufficient quality to use in remedial and removal decisions and in the BLRA

XRF vs Lab Data: Lead



R Squared = 0.98
Excellent agreement between XRF data and lab data.

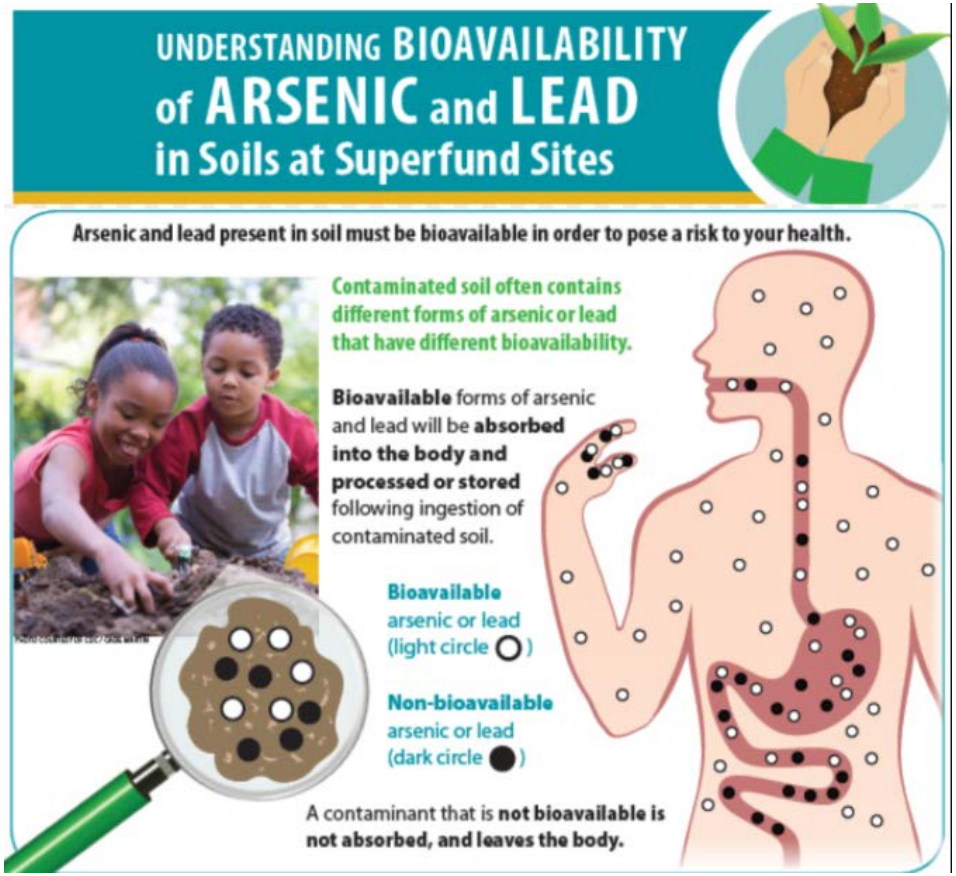
XRF vs. Lab: Pb



XRF provides reliable, reproducible & defensible data for Pb for this project (n = 300+)

Best Practice:
Site-specific Clean-up Levels for Lead

Best Practice: Lead Bioavailability



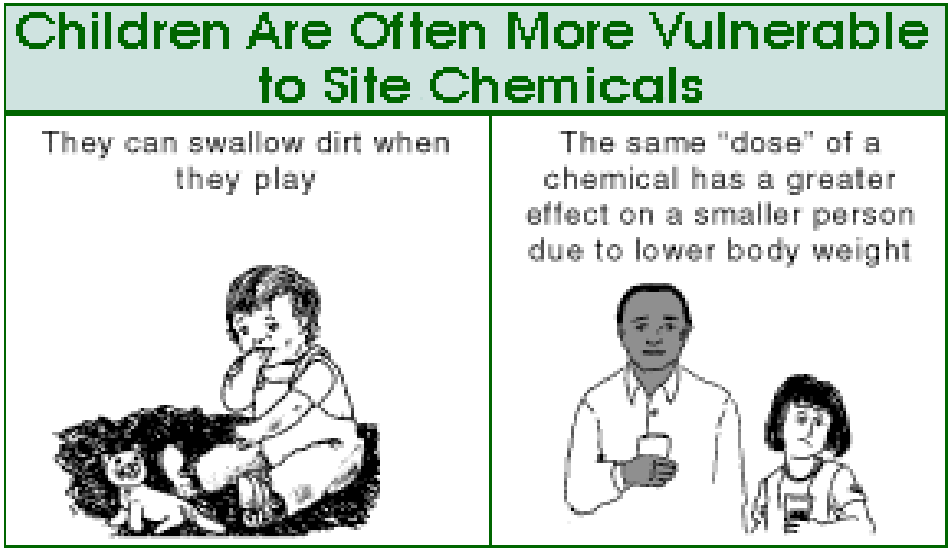
Bioavailability

- **A measure of the amount of lead absorbed into bloodstream**
- **Important input in clean up level**

Integrated Exposure Uptake Biokinetic (IEUBK) Model

Predicts blood lead levels in children resulting from environmental exposures.

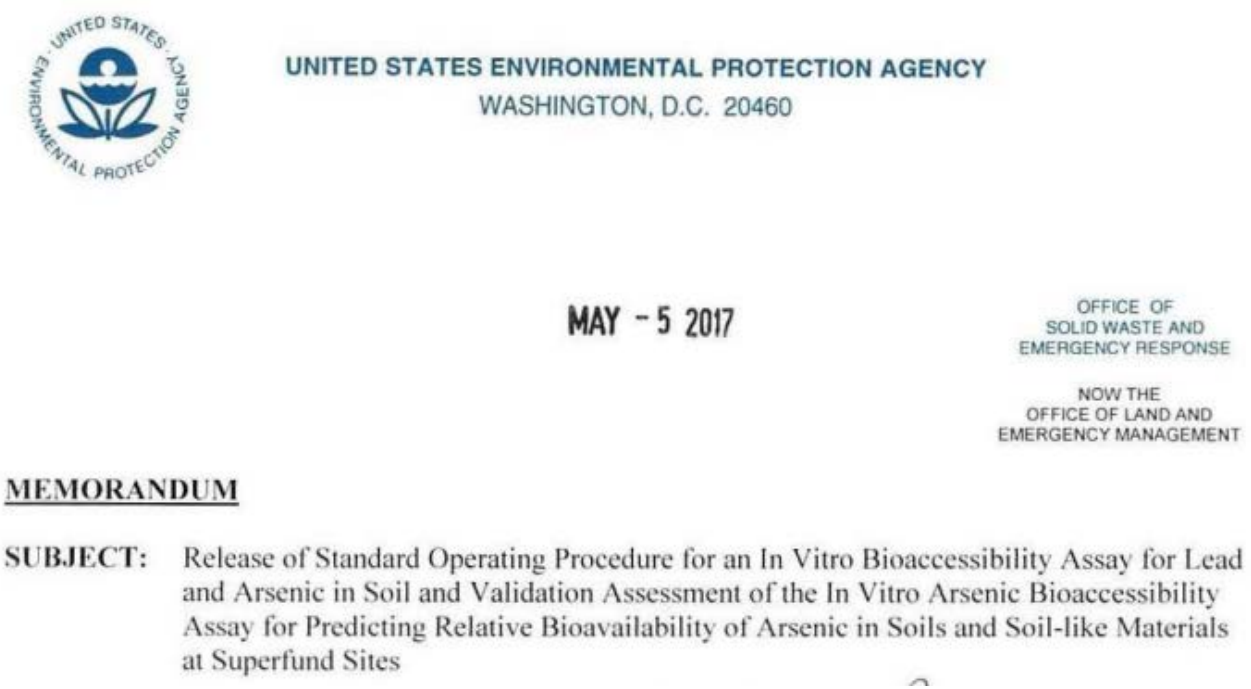
Utilized by EPA to set cleanup goals for lead in soil.



Best Practice:
Site-specific Clean-up Levels for Lead

- Use site-specific lead bioavailability in the IEUBK model
- ‘ BA will “ health-based clean-up level
- IEUBK default BA = 30%
- In this case, 33 soil samples were analyzed for lead bioavailability
- Chattanooga site soils BA = 29-50%; mean = 36%
- Other inputs to IEUBK being updated, esp. target blood lead level

SOP for *In Vitro* Lead and Arsenic Testing



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MEMORANDUM

SUBJECT: Release of Standard Operating Procedure for an In Vitro Bioaccessibility Assay for Lead and Arsenic in Soil and Validation Assessment of the In Vitro Arsenic Bioaccessibility Assay for Predicting Relative Bioavailability of Arsenic in Soils and Soil-like Materials at Superfund Sites

Standard Operating Procedure… OLEM, May 5, 2017

Conclusion of Chattanooga Soil Study

- ✓ Elevated lead is not “everywhere; can distinguish between suspect material and urban background
- ✓ Data supports risk management decisions
- ✓ Unacceptable risk at some properties
- ✓ Removal warranted at some properties
- ✓ Remedial action planned
- ✓ Site-specific cleanup level can be developed

Best Practices for Sampling for Lead in Soil

- Establish robust background concentration/range
- Incremental Sampling Method (ISM)
- Sieve soil; analyze fine fraction
- Consider XRF analysis
- Determine site-specific lead bioavailability
- Develop site-specific cleanup level for lead

Q & A