Appendix D

Quality Assurance Project Plan for:

A COMMUNITY BASED ENVIRONMENTAL LEAD ASSESSMENT AND REMEDIATION PROGRAM

Prepared for: _____

Lead Safe Yard Program
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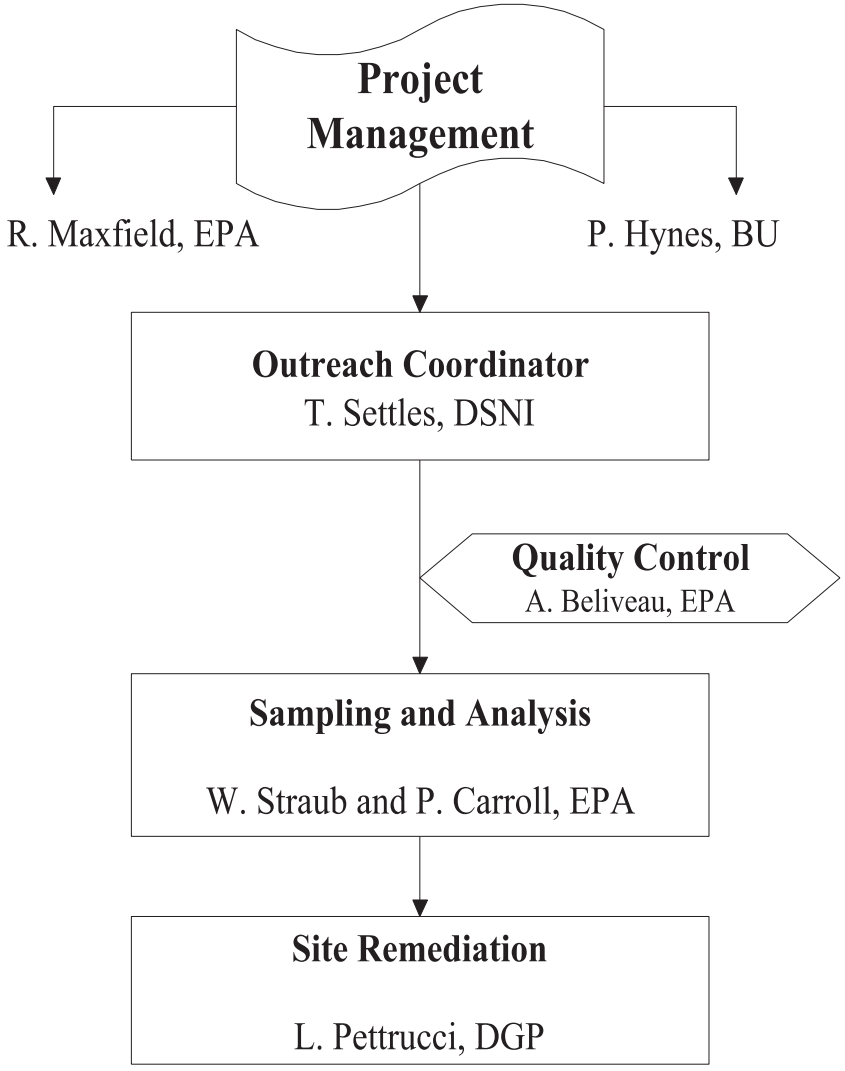
1.0 Scope and Application

This QAAP outlines procedures for the field analysis of lead in soil using the Niton 700 Series Field Portable X-Ray Fluorescence Spectrometer. These methods are designed as part of the sampling and analysis protocol for the Lead Safe Yard Program and are applicable to the measurement of lead in urban soils.



2. Project Organization and Responsibility

The Project Managers are in charge of coordinating, maintaining and monitoring all activities, including direction for preparation of work plans, sampling plans, and analytical procedures relative to the project. The Quality Assurance personnel will evaluate and approve QA/QC plans through the course of the project and oversee all data quality assurance aspects of the project. The Outreach Coordinator will be responsible for locating potential properties for sampling and analysis, contacting property owners and gaining consent to work on the property. The sampling and analysis team will be responsible for scheduling and conducting data collection and data reduction procedures, properly maintain samples, develop site sketches and other observations, generate

required QA/QC records and implement corrective actions. The site remediation group will apply innovative and cost effective landscape techniques for site improvements.

3. Problem Definition

Lead poisoning continues to be an extremely serious environmental health issue for youth, particularly in poorer inner city neighborhoods with older wood framed housing. While considerable attention has been focused on the lead contaminated paint prevalent on the surfaces of homes in these neighborhoods, less attention has been paid to the lead contaminated soil that surrounds each home. The reasons for this lack of attention by regulators stems from a variety of concerns: perhaps foremost is the cost of soil removal and disposal.

4. Project Description

The overall objective of the proposed project is to produce a summary report documenting the effectiveness of low cost residential soil intervention. The project will incorporate two sampling plans to accomplish this goal. One sampling strategy will be to measure surface soil lead at residential properties in the Greater Boston area. Properties that exceed project specific action levels will be mitigated with simple, low cost methods that are designed to minimize the risk of human exposure to the contaminated soil. Soil surfaces will then be measured to evaluate the effectiveness and durability of the intervention measures over time. A second sampling strategy involves measuring tracked-in soil Pb (house dust) to compare pre and post intervention Pb levels inside the residence. This Quality Assurance Project Plan outlines protocol for the residential soil surface sampling program that will be used in this project.

4a. Project Timeline

Activity	Start	End
Review existing data Determine target community	11/99	2/00
Community Outreach	2/00	9/01
Site Investigations Meet with property owners	3/00	11/01
Site Remediation	3/00	11/01

5. Sampling Design

The sampling strategy is designed to assess the potential of excessive lead exposure to humans from soil on the property. Each property will be evaluated with focus on four areas of concern: the dripline along the house foundation, play areas in the yard, areas of exposed soil in the yard, and any other potential sources of soil lead contamination including those from abutting properties. Play areas found to contain greater than 400 parts per million (ppm), and other areas that are found to contain greater than 2000 ppm lead will be further characterized to determine the nature and extent of contamination (note Appendix 1, the Sampling Logic Tree). Two soil sampling strategies,

in situ and bag sampling, will be used to determine lead content in these residential soils. Descriptions of each along with QA/QC protocol follow.

In-Situ Sampling. Samples will be analyzed with a Niton Model 702 XRF Spectrum Analyzer. The 702 is a field portable multi-element, multi-functional x-ray fluorescence analyzer (FPXRF) equipped with a 10mCi cadmium-109 source and a high resolution Silicon-Pin detector. The hand held, battery powered FPXRF is capable of in-situ analysis techniques. Based upon a minimum detection limit study (MDL), the detection limit for this method is approximately 100 ppm. These data are attached as Appendix 4. This instrument is factory calibrated, has been found to hold calibration quite well, and is software compensated for any deterioration of the source. In addition to the MDL, precision and accuracy studies (1998 and 2000) are attached as Appendix 5.

Soil lead measurements will be taken *in-situ* during the screening phase provided that the surface is not inundated with water. Large nonrepresentative debris, including rocks, pebbles, leaves and roots, will be removed from the soil surface prior to sampling. The area will be smooth enough to allow uniform contact between the FPXRF and the ground surface. The initial sample locations will depend upon the size and shape of the region of interest. A line pattern will be used when the area is linear (e.g. dripline). In-situ measurements will be taken at approximate 10 foot intervals along the line depending upon the length of the building. Additional lines are tested at 2 to 5 foot sampling intervals away from the original sampling area to characterize the extent of any lead contamination. Target patterns will be used for sampling larger, nonlinear areas of potential exposure (e.g. play areas). A large "X" will be superimposed upon the space to be analyzed. In- situ measurements will be taken at 5 to 10 foot intervals along each line of the "X" unless the samplers determine that additional (or less) resolution is required. Screening data and descriptive information about each site will be recorded on the Site Worksheet (Appendix 2).

Quality control checks will consist of replicate measurements, standard reference material (SRM) checks and confirmation samples as defined in Section 10, Acceptance Criteria for Soil Lead by XRF. Replicate measurements will be conducted over a minimum of 10% of the screen samples to indicate the precision of analysis and the homogeneity of the sample matrix. Three point SRM measurements and a blank measurement will be conducted at the beginning and end of each sampling day to ensure linearity over the expected sampling range (e.g. 400-5000 ppm) and to determine that the instrument is operating contaminant free. SRMs (NIST 2586 @ 432 ppm lead in soil) will be used as continuing calibration checks after every 10th screen sample. A minimum of one confirmation sample will be collected from each site. Approximately 4 tablespoons of surface soil, to no more than the approximate depth of 0.5 inches, will be collected into a soil sample container and thoroughly mixed for each confirmation sample. The sample will be properly labeled and returned to the laboratory for analysis by EPA Method 6010A.

Bag Sampling. If site conditions are such that *in-situ* sampling is not appropriate and sampling activities must continue, this bag sampling method will be used to evaluate soil lead conditions on the residential properties. The sampling strategy will be a scaled down version of the *in-situ* strategy. The focus will still be on the dripline of the building on the property, play areas, bare soil and other concerns such as sources from abutting properties. The bag approach involves collecting soil samples into a sampling container and returning them to the laboratory for preparation, XRF analysis and ICP confirmation.

Typically, a minimum of 4 discreet soil samples will be collected from each side of the building perimeter within 1 to 3 feet of the foundation (dripline). These samples will be collected at the very minimum of 2 feet from each other. Bare soil areas are the preference (vs. covered areas).

Composite samples from play areas will consist of aliquots collected along an X shaped grid. These subsamples will be collected at a minimum of 1 foot from each other. Bare soil areas are preferred. This method will also apply to bare areas of soil, vegetable gardens and high use areas noted on the subject property.

The decision to sample along the property boundary will be determined by the samplers at the time of the site visit. If conditions exist on an abutting property that would appear to present a risk of soil lead contamination to the subject property, the following protocol will be followed. Aliquots of surface soil will be collected along the property line(s) of interest. These subsamples will be collected no closer than 1 foot apart and will be located within 1 to 5 of the property line. Subsamples will only be collected on the subject property.

Quality control for the composite method measurements will be identical to QA/QC for the in situ method. Three point SRM measurements and a blank measurement will be conducted at the beginning and end of each sampling day to ensure linearity over the expected sampling range (e.g. 400-5000 ppm). SRMs will be used as continuing calibration checks after every 10th screen sample. A minimum of one confirmation sample will be collected from each site.

All bag samples will be collected according to protocol outlined in Section 7 *(Sample Handling and Chain of Custody Requirements).* The samples will be returned to the EPA laboratory where they will be dried, screened to remove nonrepresentative debris, and analyzed using XRF technology. Select samples will be designated for confirmation analysis by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP).

Confirmation Samples. Confirmation samples are collected during sampling activities to be analyzed at the University of Cincinnati, Hematology and Environmental Laboratory by Atomic Absorption Spectrometry. These samples are collected in selected intervals around the house perimeter (designated HC for house composite), any play areas (PC), from any on-site vegatable gardens (GC) and from any high use areas (HUC).

Typically, 12 subsamples are collected for each perimeter composite sample (3 from each side of the house). If possible, 5 subsamples are collected for each play area composite, garden composite and/or each high use area composite using the target pattern approach. The samples are returned to the EPA laboratory, sieved with a number 10 sieve (U.S.A. Standard Sieve Series) to removed any coarse debris, rebagged and analyzed for lead content using the Niton XRF. Each sample is then labeled (street number and name and composite designation), recorded on a chain of custody form and sent to the U. of C. Lab for the extraction and AA analysis for lead content.

6. Sampling and Analytical Methods Requirements

Parameter	Matrix	# of Samples	Analytical	Containers	Preservation	Hold Time
Lead (XRF) insitu	Soil	TBD	EPA 6200	N/A	N/A	N/A
Lead (XRF) confirmation	Soil	TBD	—	ziplock bags	4°C	1 year
Lead (ICP) confirmation	Soil	TBD	EPA 6010A	ziplock bags	4°C	1 year

7. Sample Handling and Chain of Custody Requirements

The majority of the soil lead measurements will be taken in situ during the site characterization phase. Sample handling and chain of custody requirements will not apply to these procedures. Soil will be collected as confirmation samples and as discreet bag samples. Chain-of-custody (COC) procedures will be followed for these samples to maintain and document possession from the time they are collected until they are delivered to the laboratory for analysis. A sample COC form is attached. The sample handling and COC predator will include:

— sample information on the jar/bag with sample ID, time and date of collection and technician ID, all written in unerasable ink.

—a sample seal attached firmly to the sample cover as soon as possible after collection when using sample jars.

—a chain of custody record containing the project name and number, the sampling station ID, date and time of collection, a brief description of the type of sample collected, parameters for analysis, the samplers name and signature, adequate space for any transferee's name and signature and a comment section to describe any special conditions associated with the samples.

All sample sets will be accompanied by a COC document. Any time the samples are transferred, both the sample custodian and the receiver shall sign and date the COC document. COC documentation will be maintained in the project folder.

8. Quality Control Requirements

Analyte	Analytical Method	Detection Limit*	Quantitation Limit**	Precision***	Accuracy****
Lead	EPA 6200	~ 75 ppm	~225	±50	±25
Lead	EPA 6010A	42 ppb	~120	±20	±10
Lead	Kevex XRF	50 ppm	~150	±20	±20

**Typically 3 times the MDL
***Precision determined by replicate sample analyses
****Accuracy determined by analysis of SRMs

9. Data Management and Documentation

A field log book, dedicated to the project, and field data sheets will be maintained during sampling events. There will be separate field sheets for the screening and additional site characterization phases. Each sheet will include the date, time, property name and address, sample locations, a site sketch that includes sampling locations, sample description, important details about how the sample was collected, analyst(s) names, along with the respective measurement data, and any additional comments that would accurately and inclusively describe the sampling activities. Care will be taken to maintain the logbook and field data sheets neatly with factual, objective language that is free of personal feelings and other terminology that may be deemed inappropriate.

These field data sheets, along with confirmation sample data received from the laboratory will be kept on file at the EPA Region 1 Lab. The confirmation information will include results of sample analyses, method blanks, matrix spike/spike duplicates and acceptance criteria. Copies of the field data sheets and validation information from the confirmation samples will be distributed to members of the remediation team to help determine where remediation activity will take place.

10. Assessment and Response Actions

ACCEPTANCE CRITERIA FOR SOIL LEAD BY XRF(*IN-SITU*)

Audit	Frequency	Limits	Corrective Action
Initial Calibration (SRM) @ 50, 500, 5000 ppm	Run prior to daily sampling events	%RSD=30	Investigate problem and re-run initial calibration until an acceptable calibration is obtained
Continuing Calibration	Sample data must be bracketed every 10th sample (or less) using SRM	%D <±25%	Re-analyze CC and if passes continue sample analysis. If fails investigate problem and re-analyze all samples following the last acceptable CC starting with a new initial calibration.
Field Blank	Varies by site	<100 ppm	Corrective action determined by end user.
Replicate Analysis (Accuracy)	Varies by site	%D <±50%	
Confirmation Samples	Site Dependent, minimum 1/site	Variable	Intrusive sample for conformation and/or confirmation analysis
MDL	When there is a change in the method or instrument.	Instrument Specific	Action taken at data validation level.
IDC	When there is a change in sampling method or instrument	± 30% recovery*	Investigate problem and correct. Re-run.

APPENDICES

Appendix 1.....Sampling Logic Tree

Appendix 2.....Site Worksheet

Appendix 3.....IDC Study

Appendix 4.....MDL Studies

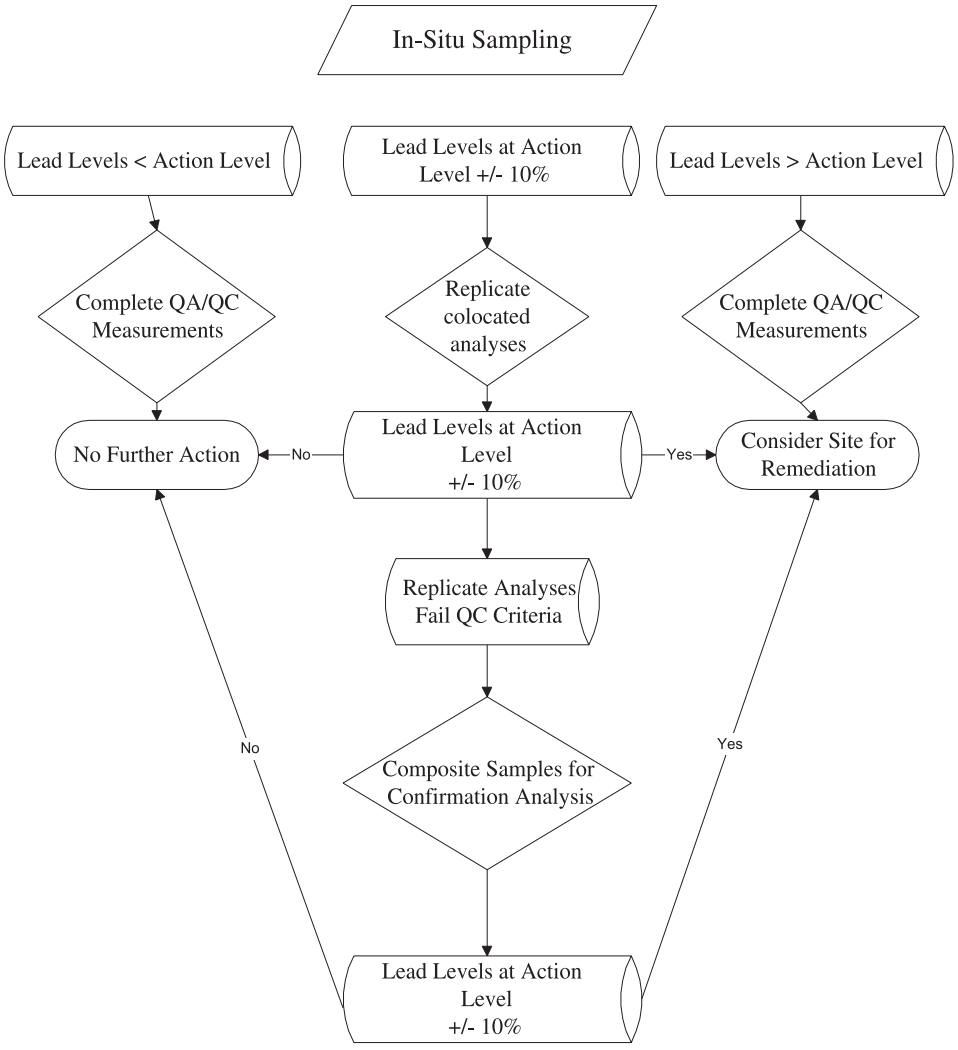
Appendix 5.....Accuracy Studies

Appendix 6.....Results of Confirmation Samples

Attached.....Sample Chain of Custody Form

APPENDIX 1

Sampling Logic Tree



Appendix 2: Site Worksheet

Site Name: _____ Date: _____

Address: _____

_____

Building Type: _____

Condition: _____

Lot Condition: _____

Yard Uses: _____

Sample ID	Location	PPM-Lead	Comments	Distance

Appendix 3

INITIAL DEMONSTRATION OF CAPABILITY FOR LEAD IN SOIL BY NITON XRF

	ppm—lead
IDC1	1123
IDC2	1144
IDC3	1127
IDC4	1225
IDC5	1076
IDC6	1036
IDC7	1095
IDC8	1235
IDC9	1208
IDC10	1228
IDC11	1140
True Value	1162
Average Concentration	1148.8
% True Value	98.9
Standard Deviation	67.2
%RSD	5.9

Criteria: %RSD<30%
%TV<±30%

Appendix 4

MINIMUM DETECTION LIMIT STUDY OF LEAD IN SOIL BY FIELD PORTABLE XRF

	H.P. 600703 5/12/98	H.P. 600703 2/29/00	LCS 0996 2/29/00	NIST 2586 2/29/00
	PPM-Lead	**PPM-Lead**	**PPM-Lead**	**PPM-Lead**
MDL1	190	170	235	365
MDL2	151	209	246	357
MDL3	170	179	303	398
MDL4	177	161	242	355
MDL5	188	220	320	423
MDL6	196	164	254	392
MDL7	170	137	250	422
MDL8	138			
MDL9	138			
MDL10	128			
True Value	129	129	224	432
Avg. Conc.	164.6	177.1	264.3	387.4
% True Value	127.6	137.3	118.0	89.7
Standard Deviation	24.3	28.7	33.2	29.1
MDL	**68.7**	90.3	**104.3**	**91.4**
%RSD	14.8	16.2	12.6	7.5

Criteria: %RSD<30%
%TV<±30%

Appendix 5

ACCURACY DATA (1998) FOR LEAD IN SOIL BY FPXRF

	NIST 2710	NIST 2711	LCS 0996	HP 69073	Cleve-1
	5427	1123	268	204	426
	5632	1144	283	190	554
	5651	1127	269	151	526
	5587	1225	280	170	440
	5657	1076	291	177	488
	5372	1036	202	188	490
	5516	1095	383	196	456
	5769	1235	343	170	494
		1208		138	456
		1228		138	441
		1140		128	
				203	
True Value	5532	1162	224	129	433
Average Concentration	5576.4	1148.8	289.9	171.1	477.1
% Recovered	100.8	98.9	129.4	132.6	110.2
Standard Deviation	122.5	64.1	50.3	25.6	38.8
RSD	2.2	5.6	17.4	15.0	8.1

ACCURACY DATA (2000) FOR LEAD IN SOIL BY FPXRF

	NIST 2710	NIST 2711	NIST 2586	LCS 0996	HP 690703	Lot 217
	5580	1070	365	235	170	241
	5780	1140	357	246	209	220
	5590	1190	398	303	179	230
	5970	1290	355	242	161	159
	5490	1110	423	320	220	144
	5610	1070	392	254	164	135
	5530	1160	422	250	137	211
	5780	1170	397	275	242	175
	5460	1090	388	391	232	173
	5750	1140	408	277	146	126
True Value	5532	1162	432	224	129	101
Average Concentration	5654.0	1143.0	390.5	279.3	186.0	181.4
% Recovered	102.2	98.4	90.4	124.7	144.2	179.6
Standard Deviation	152.4	62.8	23.4	45.5	35.1	39.4
RSD	2.7	5.5	6.0	16.3	18.9	21.7

Appendix 6 Confirmation Sample Results