FEASIBILITY STUDY REPORT

for the

Palmerton Zinc Site
Residential Soil and Household Dust
Operable Unit (OU 3)
Palmerton, Pennsylvania

May, 2000

Prepared for

USEPA REGION III

1650 Arch Street, Philadelphia, PA 19103

Contract No. 68-S8-3002, Work Assignment No. 010-RICO326

BLACK & VEATCH
Special Projects Corp.

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EXECUTIVE SUMMARY

The Palmerton Zinc Superfund Site Operable Unit #3 (community soils) consists of the Borough of Palmerton, the Village of Aquashicola, and other residential areas of Lower Towamensing township exhibiting elevated levels of hazardous substances from the zinc processing activities in Palmerton. Black & Veatch Special Projects Corp. (BVSPC) has been tasked by the USEPA with writing the Operable Unit #3 Feasibility Study (FS). This feasibility study is conducted to identify methods that may be implemented to reduce human health risks.

The need for remedial action is based upon the findings of the Final Risk Assessment Report (FRAR) (CDM, 1998). The risk assessment concluded that there are two major routes of exposure to contaminants that create health risks at the site: ingestion of contaminated residential soil and ingestion of contaminated indoor dust. The FRAR determined contaminant-specific risk-based remediation goals.

The primary remedial action objective is to prevent ingestion of contaminated residential soil and/or indoor dust by reducing contaminant concentrations in these media and/or creating a vegetative barrier to the soils to reduce exposure risk and therefore reduce risk at each residence to acceptable levels. A secondary remedial action objective is to allow for unrestricted land use in the future. A risk-based goal of 650 mg/kg lead in soil and indoor dust will be applied on a residence by residence basis. All of the alternatives are designed such that implementing the lead-based remedy will also meet the arsenic goals identified in the FRAR. Residences containing interior dust or exterior soil with lead levels at or above the site-specific risk-based trigger of 650 mg/kg will be eligible for remediation, the extent of which will be based on residence specific conditions.

The scope of Superfund is to address hazardous substances that pose a threat to human health and the environment resulting from past industrial activities. Therefore, the remedies proposed in this document do not specifically address lead-based paint contamination, which falls outside the scope of Superfund authority. Public education information on the hazards of lead-based paint will be distributed to residents.

The residential soil action alternatives of this FS include no action, long term monitoring, soil removal and disposal to a landfill, 'hot spot' removal and insitu treatment to reduce the contaminant mobilities, barrier soil and/or a vegetation cover layer. The indoor dust action alternative is specialized cleaning, including HEPA vacuuming, carpet removal/replacement and hard surface wet wiping. No Action alternatives for soil and dust are included for comparison.

Actions to remove and dispose of soil and dust from residential properties will be determined by evaluation against the appropriate RCRA characteristic. Only remediation wastes which are listed or identified hazardous waste are subject to RCRA Subtitle C hazardous waste requirements and the increased costs associated with disposal. For example, if removed residential soil passes the toxicity characteristic leaching procedure (TCLP) level for lead, then it could be disposed of as non-hazardous. If the soil does not pass the TCLP level, then it would either require further treatment prior to disposal, or be disposed of at a Subtitle C hazardous waste landfill. This means of characterizing remedial wastes will allow for the remedial action objectives to be achieved efficiently and quickly.

This feasibility study is conducted in accordance with the USEPA Guidelines (USEPA, 1988). The guidelines require a multi-step process to evaluate and screen available technologies and process options. Following an initial screening, technologies and process options were combined into remedial alternatives representing a wide range of costs and effectiveness. Following further screening, five alternatives for residential soil and three alternatives for indoor dust remained. The alternatives were then evaluated and compared against each other in terms of protection of human health and the environment, compliance with applicable or relevant and appropriate requirements(ARARs), long-term effectiveness, reduction of contaminant toxicity, mobility or volume, short-term effectiveness, implementability, and cost. Present worth cost estimates for all of the alternatives are located in Table 6-3. The alternatives that survived the detailed evaluation process are the following:

- **No Action Alternative 1: No Action.** The No Action alternative would not involve any remediation of residential soils or indoor dust. The residencies would be left in their current condition. The No Action alternative is presented for comparison against the other alternatives. The total estimated cost for this alternative is $0.00.

- **Soil and Dust Alternative 2: Long Term Monitoring.** The Long Term Monitoring alternative would not involve any remediation of residential soils or indoor dust. The residences would be left in their current condition. Long term environmental monitoring would be conducted at regular intervals. The total estimated cost of this alternative is $733,000.

- **Dust Alternative 3 and 3A: Specialized Cleaning.** This alternative involves cleaning of the indoor dust by High Efficiency Particulate Air (HEPA) vacuuming, wet wiping, and a second HEPA vacuuming. Soft and possible lead-based paint surfaces will only be HEPA vacuumed. Clearance testing on hard surfaces that are cleaned under this alternative will be performed after specialized cleaning. There will also be educational material distributed for public education about the general dust hazard. The total estimated cost of this alternative is $1,388,000. The cost of this dust alternative is also included in the listed cost estimates for the active soil alternatives below.

  Under Alternative 3A, carpet removal and replacement would be implemented when interior dust specialized cleaning efforts do not meet clearance testing and on a whole will not be time/cost effective. Carpets would be removed and a voucher would be issued to the homeowner for the cost of replacing carpeting.

  If lead-based paint exists at a residence, then elevated levels of lead may occur in the future. Where lead-based paint appears to be a problem, public education information on this hazard will be distributed to residents.

- **Soil Alternative 4: Removal/Revegetation.** This alternative involves removal of residential soil with levels of lead above 650 mg/kg in order to achieve 650mg/kg in a composite clearance sample from the residence. To generate cost estimates and evaluate this alternative, an average four-inch depth of excavation over 80 percent of the area of remediation, and an average six-inch depth of excavation over the remaining area was assumed. The soils would be excavated and replaced with clean soil. Plants and other vegetation would be replaced. Post-remediation sampling would be performed to confirm the achievement of remedial objectives.

  Alternative 4 would be protective of human health and would comply with all ARARs. It would be effective both long- and short-term and could be implemented within a reasonable time using proven technology. It would accomplish both the primary and secondary remedial objectives. The total cost of this alternative is estimated to be $26,349,000.

- **Soil Alternative 5: Removal/Insitu Treatment/Revegetation.** Both alternatives 5A & B involve the removal of the surface soil/vegetation in 'hot spot' areas where preremediation sample results are significantly above the risk-based goal or there are bare spots, then the insitu treatment of the remaining soil as necessary to achieve 650 mg/kg in composite clearance sampling, and revegetation of the surface. Initially, approximately two inches of sod/soil vegetative cover in hot spot areas would be excavated and disposed of. The insitu treatment of the soil below, as necessary, would be accomplished in one of two ways: either by thoroughly tilling in amended agricultural soil or added soil amendments or by mixing chemical substances into the existing soil to make the metal contaminants insoluble. If there is significant soil removal then clean fill could be placed on top of the treated soil and if necessary, the soil would be compacted. Revegetation could be accomplished by hydroseeding, mixing grass seed with the soil amendments, or in certain situations, sod might be utilized. Two weeks of watering would be provided to establish the vegetative cover. A public education and maintenance program would be developed to assist the homeowners in maintenance of the newly-grown vegetative cover. Post-remediation sampling and vegetative cover observation would be performed to confirm the achievement of remedial objectives.

  Amended soil would be tilled into the existing soil under alternative 5A. This alternative would involve essentially the same procedures that were used in the interim action soil cleanups. The total estimated cost of this alternative is $11,121,000.

  Alternative 5B would involve chemically treating insitu soils. Treatment could be with pozzolonic treatment or with another chemical treatment. Such a treatment process immobilizes the metals so that the soil passes the TCLP criteria or the Universal Treatment Standards (UTS) for non-hazardous waste. If this alternative is chosen, treatability studies would be conducted to determine the appropriate chemical mix/quantity for insitu treatment, and to ensure that the treatment will adequately reduce contaminant mobility. The total cost of Alternative 5B is estimated to be $11,786,000.

  Alternatives 5A & B would remove soils that are significantly above cleanup standards and would treat soil that is left in place, as necessary to achieve 650 mg/kg composite clearance sampling. This alternative is protective of human health, and would provide the opportunity for unlimited future land use. It provides acceptable short and long term effectiveness since the remedial goals are achieved. Maintenance of the vegetative cover would further enhance the effectiveness since some of the original soil will be left in place. The remedy can be implemented within a reasonable time using existing technology.

- **Soil Alternative 6: Soil Amendment and Revegetation.** This alternative is similar to the "Neighbor Helping Neighbor" (NHN) Program already in existence. It is different from the NHN Program in that it would provide for pre- and post-remediation sampling and observation, and in that a contractor would perform the remedial activities. Sampling and observation of the vegetative cover would show whether the remedial goals are achieved. Having a contractor perform the work would decrease potential exposure for the residents during soil mixing and would reduce potential variability in the remediation result.

  Agricultural-type soil amendments such as mushroom compost, limestone, fertilizer, and grass seed would be spread across a yard and thoroughly tilled into the soil where conditions do not meet remedial objectives. This would reduce the concentration of contaminants and establish a healthy vegetative barrier to soils below. Revegetation could be accomplished by hydroseeding, spreading grass seed with the soil amendments, or in certain situations, sod might be utilized. Two weeks of watering would be provided to establish the vegetative cover. A public education and maintenance program would be developed to assist the homeowners in maintenance of the newly-grown vegetative cover. Post-remediation sampling and vegetative cover observation would be performed to confirm the achievement of remedial objectives. The main difference between this alternative and Alternative 5A is that no soil would be removed.

  Alternative 6 would add soil amendments and mix the soil to reduce contaminant concentrations at the surface and establish a vegetative barrier. This alternative is protective of human health and would provide the opportunity for unlimited future land use. This alternative provides acceptable short-term effectiveness. Long-term effectiveness is enhanced with maintenance of the vegetative cover, since original soils would be left in place. This alternative can be implemented within a reasonable time using existing technology. The total estimated cost of this alternative is $11,255,000.

The alternative preferred by the USEPA will be presented for public comment. Following a public comment period, the preferred alternative will be evaluated against two additional criteria required by the USEPA's guidelines: public acceptance and state preference. Following this additional evaluation, the USEPA will prepare a Record of Decision setting forth the selected remedy.

1.0 INTRODUCTION AND BACKGROUND INFORMATION

1.1 Project Description

The site is located in Carbon County, Pennsylvania, in the vicinity of the Lehigh Gap and is approximately 15 miles north of Allentown, Pennsylvania. Figure 1-1 shows the site location. The site was included on the National Priorities List (NPL 208) because of elevated levels of heavy metals in the Palmerton Area.

EPA divided the Superfund site into four Operable Units (OUs). OU1 addresses the revegetation of the north face of Blue Mountain. Grass cover has been established on approximately 1,000 acres of Blue Mountain, with approximately 1,000 acres remaining to be revegetated. OU2 consists of remediation of the Cinder Bank. No significant work has been completed on the Cinder Bank. OU4 concerns an area-wide investigation of contamination in the ground and surface waters and includes an ecological risk assessment. Operable Unit #3 (OU3) is the subject of this Feasibility Study.

The Palmerton Zinc Superfund Site Operable Unit #3 (community soils) consists of the Borough of Palmerton, the Village of Aquashicola and other residential areas of Lower Towamensing township exhibiting elevated levels of hazardous substances from the zinc processing activities in Palmerton. For cost estimating purposes, the Palmerton Site OU3 boundaries were defined as the Bowmanstown municipal boundary to the west, the ridge line north of Stony Ridge, the Lehigh River and Aquashicola Creek to the south, and the electric power line right-of-way to the northeast, and the area between Stony Ridge and Aquashicola Creek east to the fork in Little Gap Road. OU3 boundaries and other site features are shown on Figure 1-2.

Preceding this report was the Remedial Investigation (RI) and the Final Risk Assessment Report (FRAR) which were completed by CDM Federal Programs Corp in May 1998. The principal baseline environmental media sources are contaminated soils and dusts. The most significant health risks are to residents in the OU3 area from lead and arsenic in soil and dust. Multiple source and environmental pathways are potentially responsible for these health risks. The FRAR identified two major exposure routes as significant and quantitatively evaluated them:

- **Ingestion by residents of contaminated soils** in home yards, and
- **Ingestion by residents of contaminated house dusts** that result from track-in of residential soils and the deposition of airborne particulates.

The FRAR identified risk-adjusted, site-specific remediation goals for contaminants of concern in soils and indoor dust. When achieved, these goals will prevent health risks to residents from metals contaminated soils and indoor dust. All of the alternatives in this FS are designed such that implementing the lead-based remedy will meet remediation goals for other contaminants of concern.

The goal of this FS is to identify methods which may be implemented to achieve the remediation goals. Because house dust is primarily caused by track-in from outdoors and consists primarily of soil dust, remediation of residential soil is of primary importance. This FS has been developed to evaluate effective methods to achieve and maintain the goals of reducing contaminant concentrations in residential soils and indoor dust in residences within the OU3 boundaries.

1.2 Site Description

The site is located in Carbon County, Pennsylvania, in the vicinity of the Lehigh Gap. It is approximately 15 miles north of Allentown and is located in and around the Borough of Palmerton. Palmerton is approximately 4.5 miles long and generally less than one mile wide. The approximate OU3 area extends from the edge of Bowmanstown in the west to a power line right-of-way east of Aquashicola, and from the Lehigh River and Aquashicola Creek in the south to the ridge line north of Stony Ridge. The OU3 area also includes the area between Aquashicola Creek and Stony Ridge east to the fork in Little Gap Road.

There are two former zinc smelters located separately on east and west sides of the Lehigh Gap where the Aquashicola Creek joins with the Lehigh River. The East Plant is at the eastern end of the Borough of Palmerton, located on the southern side of Aquaschicola Creek at the foot of Blue Mountain. A smoldering residue pile known as the Cinder Bank lies adjacent to the East Plant and along the base of Blue Mountain. The Cinder Bank waste pile is approximately 2.5 miles long and covers approximately 200 acres. The West Plant is located in the western end of the Borough on the northern bank of the Lehigh River.

Both the East and West Plants were formerly operated by the New Jersey Zinc Company. During smelter operations, large amounts of lead, cadmium, zinc, and arsenic were emitted as dust and particulate fallout from stack emissions. Primary zinc smelting was discontinued in 1981. The West Plant is not active. Most of the wastes from the smelters is staged in the East Plant where an electric arc furnace (EAF) dust processing is currently operating..

1.2.1 Land use and population density

The site area is predominantly comprised of rural and semi-rural areas in the southern portion of Carbon County, Pennsylvania. Based on the 1990 U.S. Census data estimates, Palmerton Borough has a population of 5,289 people, and the man to woman ratio is nearly 100:109. The Borough of Palmerton consists of 2,177 households and 1,509 families. Additionally, 581 households were estimated to lie outside the Borough limits but still within the area covered by OU3.

1.2.2 Soils

Soils along the Aquashicola Creek flood plain are deep soils on glacial outwash derived from grey and red rocks. Soils in the valley outside of the Aquashicola Creek flood plain are colluvium found along the base of steep mountains of the Laidig Buchanan Association.

The Laidig soil series (LaB2, LaC2, LaD3, LdD, and LdB) consist of deep, well-drained yellowish-brown to reddish-yellow soils that have a hardpan at a depth of about 34 inches. These soils were formed on colluvial slopes at the bases of steep mountains. Their parent material was weathered from a mixture of gray and red sandstone, conglomerate, siltstone, and shale.

The Buchanan soil series (BcB2, BhB, and BhD) consists of deep, moderately well drained to somewhat poorly drained soils that have a yellowish-brown to strong-brown surface layer. The subsoil is yellowish-brown to dark brown and is somewhat mottled. A hardpan that is 5 to 18 inches thick is at a depth of 20 to 24 inches. The Buchanan soils have formed in colluvium that originated from mixed grayish and reddish sandstone, shale, siltstone, and conglomerate. They occupy the less well-drained lower slopes at the bases of steep mountains.

1.2.3 Site Topography

The Palmerton Area is located in the Appalachian Mountain section of the Valley and Ridge physiographic province, which is characterized by parallel and subparallel ridges and valleys trending roughly northeast to southwest. This type of topography results from the differential erosion by both chemical and physical weathering of tectonically folded rocks. Formations such as sandstones and conglomerates, which are relatively resistant to weathering, form the ridges of Blue Mountain and Stony Ridge. Shales, and in some cases limestones, which are much less resistant to erosion, form the valley bottoms. Elevations of valley bottoms in this area range between 400 to 500 feet above sea level and ridge top elevations range from 600 to 700 feet above sea level on Stony Ridge to greater than 1500 feet above sea level on Blue Mountain.

1.2.4 Climate

A humid, middle latitude, continental climate prevails in the Palmerton area. This type of climate results from repeated invasions and interactions of tropical and polar air masses. The normal successions of high and low pressure systems moving eastward across the United States produce weather changes in the area every few days in the winter and spring and less frequently during the summer and fall. The presence of numerous mountains, ridges and valleys can cause variations in local climate, such as the amount of rainfall due to storm deflections. Precipitation data suggests that Blue Mountain has a rain-shadow effect on precipitation received by Palmerton, as it is not unusual for Palmerton to receive 5 to 7 inches less rain per year than towns located a little farther north. Rainfall is normally plentiful all year but highest in the summer when tropical air masses dominate.

Meteorological data from New Jersey Zinc Company's (NJZ's) Palmerton weather station reports an average annual temperature of 53.4°F (12°C). The lowest temperature ever reported at this station was -13°F (-25°C), and the highest temperature ever reported was 105 degrees F (40.6 degrees C). The frost-free period is generally from May 1 to October 8. The study area normally receives between 43 and 45 inches of precipitation per year. The prevailing wind direction for this area is from the northeast and southwest, averaging eight miles per hour. Winds from the southwest are believed to greatly influence the distribution of stack emissions by flowing through Lehigh Gap and continuing in a northeast direction up the Aquashicola Creek Valley (R.E. Wright, 1988).

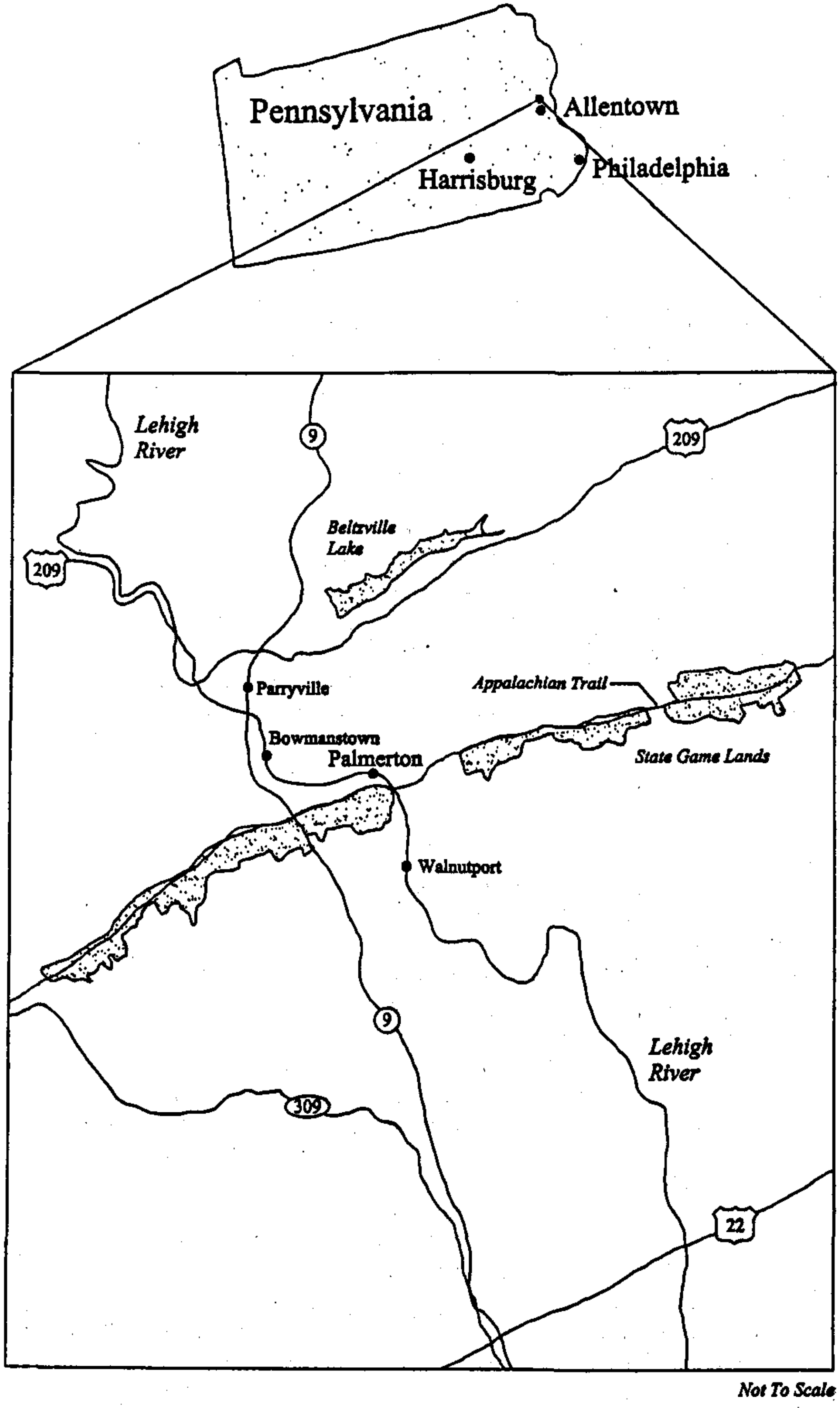

Figure 1-1
General Location Map
Palmerton, Pennsylvania

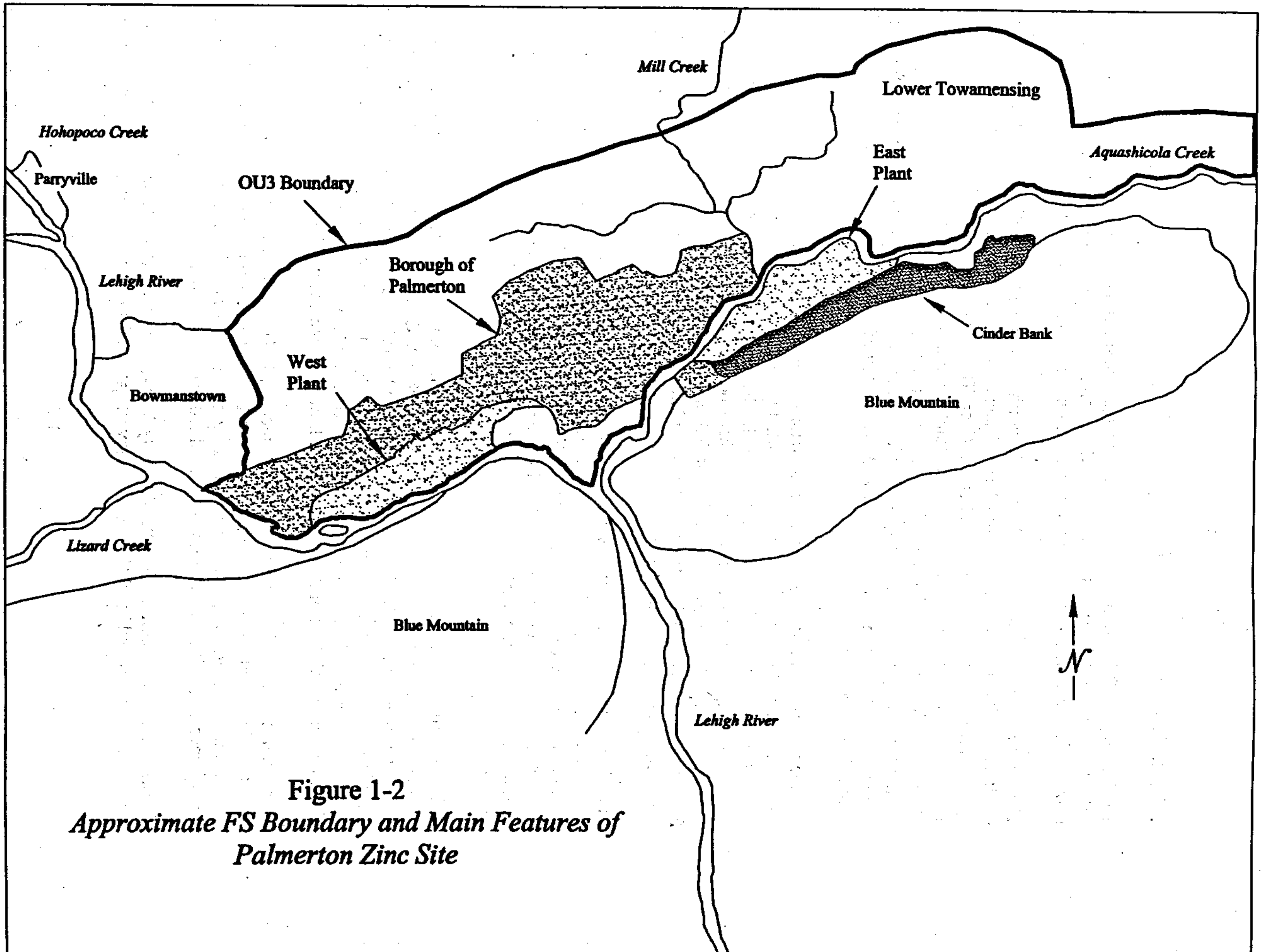

Figure 1-2
Approximate FS Boundary and Main Features of Palmerton Zinc Site

1.3 Site History

The Borough of Palmerton was developed around a zinc smelting operation that was established in 1898 by Stephen Palmer. The Palmerton Zinc complex has two former zinc smelting plants in Palmerton, one on the east side of town and one on the west side of town.

The West Plant was constructed in 1898 on the north bank of the Lehigh River. In 1911, the second smelter (East Plant) was constructed on the south bank of Aquashicola Creek approximately 1.5 miles upstream from its confluence with the Lehigh River. The East Plant and West Plant are connected by a railroad which transported raw and intermediate products of various plant processes. The West Plant used sphalerite, a sulfide ore which contains impurities of cadmium, copper and lead. The zinc sulfide ore yields large amounts of sulfur dioxide during the smelting process. A contact sulfuric acid plant was constructed in 1915 to capture and use roughly 95 percent of the sulfur dioxide produced in roasting the zinc sulfide ores.

Between 1900 and 1970, an estimated 183,000 tons of zinc and 2,400 tons of cadmium were emitted into the air from the smelters (Cimorelli, 1986). Operations were conducted at the smelting plants without significant emission controls until 1954, when an electrostatic precipitator was installed to capture some of the heavymetal containing dusts before they were expelled through the stacks. Additional air pollution controls were installed in 1967, and more were added in the following fourteen years. Peak emissions from the Palmerton Zinc Plant probably occurred between 1949, when sintering of ores began, and 1954 when emission controls were added. (R.E. Wright, 1988)

Until 1980, the zinc company was the primary employer of the area. Since 1980, the facility has engaged in the recovery and processing of zinc and other metals from secondary materials. Neither smelter is currently operating; however, EAF dust is processed at the East Plant. The resulting product is considered a waste by EPA and Pennsylvania Department of Environmental Protection (PADEP), and the processing operation is regulated under RCRA. The West Plant is being demolished.

Airborne emissions from the smelters and wind erosion from the Cinder Bank (an approximately 33 million ton residue pile along the banks of the Aquashicola Creek at the East Plant), have deposited elevated concentrations of cadmium, copper, lead and zinc in the surface soil of surrounding areas. Arsenic also has been released as a result of smelter operations. Elevated concentrations of metals have been found in residential soil and in house dust collected from many locations within the Borough of Palmerton, the Village of Aquashicola, and Lower Towamensing Township.

In addition to the manufacturing activities in Palmerton, the U.S. Atomic Energy Commission used an area of the East Plant for uranium ore storage from 1953 to 1973. The ore was removed in 1973. Oak Ridge National Laboratory (ORNL) performed a comprehensive radiation survey in 1988 that showed the presence of small isolated areas of residual radioactive material.

The draft RI of the Palmerton Zinc Off-Site Study Area was conducted by R.E. Wright Associates, Inc. in 1988, and was revised in 1994 by EPA. It investigated soils in the Palmerton area, excluding the

East and West Plant Site locations. Various other studies were completed to characterize and evaluate the site contamination and human health impacts. EPA conducted an Interim Remedial Action between 1994 and 1997 to address the eminent health threats to residents. The FRAR was completed in 1998 by CDM Federal Programs Corporation.

1.4 Nature and Extent of Contamination

The primary emphasis for OU3 has been on surficial soils in residential yards and household indoor dusts. This is the result of past studies at the Site showing contaminated soils and dusts as the major media contributing to human health risks associated with the contaminants of potential concern (COPCs). The COPCs at the site are arsenic, cadmium, lead, and zinc. Superfund is only authorized to address contamination resulting from the historic site operations, although contamination deriving from lead-based paint may also present a health risk to residents. There is presently a HUD grant program funding lead-based paint cleanups in Palmerton (The Borough and the "Lead-Safe" Home Grant Program). Unfortunately it does not appear that this program will still be in existence when Remedial Action will be Implemented for this OU. Public education information on the hazards of lead based paint will be distributed during any remedial action.

The primary contaminant migration mechanism was airborne deposition of zinc and other metals released from stack and fugitive emissions during the zinc smelting activities and airborne deposition from EAF dust processing activities. Measured concentration ranges for residential yard soil contaminants are presented in Section 2.1 of the FRAR. Data from the residential yards samples show surficial soil concentrations of lead as high as 10,600 mg/kg. Some initial soil survey data in and around Palmerton was analyzed by depth (USEPA, 1986). These analyses indicated that contaminants of concern are concentrated in the surface soils. The soil cores examined went to a depth of 30 centimeters (cm), and results showed that concentration drops rapidly over the top 7.5 cm and less rapidly over the remainder of the 30 cm. Air monitoring information collected during the CDM sampling and summarized in the FRAR indicate that indoor dust concentrations of lead, arsenic, and cadmium were as high as 6,400 mg/kg, 199 mg/kg, and 266 mg/kg, respectively.

A more detailed description of the nature and extent of contamination is presented in Section 2 of the FRAR, and in Sections 1.2 and 4 of the Draft Remedial Investigation (R.E. Wright, 1994).

1.5 Potential Exposure Pathways for Current and Future Onsite Residents

The FRAR identified permanent residents as the group most likely to be significantly exposed to contamination. Contaminant exposure pathway issues are discussed in detail in Section 3 of the FRAR. Two pathways (ingestion of soil and ingestion of indoor dust) are considered potentially complete and possibly significant and were quantitatively evaluated.

Ingestion of soil is a likely significant source of exposure via inadvertent hand to mouth contact. Incidental ingestion of soil through hand to mouth contact is quantitatively evaluated in the risk assessment. Bare soil areas are much more likely to lead to exposure, while little exposure is likely in vegetated areas.

As stated in section 3.1.2 of the FRAR, contaminants released during smelter operations have been detected in interior house dust. Contaminants have probably been transported into houses via direct deposition of smelter emissions and EAF dust processing operations, resuspension and transport of soil particles via the air, or tracking on shoes, clothing, and pets. Incidental ingestion of interior dust through hand to mouth contact is quantitatively evaluated in the FRAR.

Other pathways were deemed not likely to be significant or were evaluated via screening level calculations, so the potential exposure pathways for current and future onsite residents that are considered in this feasibility study include ingestion of house indoor dust and ingestion of soil.

1.6 Feasibility Study Process and Report Organization

The remedial actions that are supported by the FS report are required by CERCLA to:

- Be protective of human health and the environment.
- Attain ARARs (or provide justification for invoking a waiver).
- Be cost effective.
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation as to why it does not.

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions. These statutory considerations include:

- The long-term uncertainties associated with land disposal.
- The goals, objectives, and requirements of the Solid Waste Disposal Act .
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate.
- Short- and long-term potential for adverse effects from human exposure.
- Long-term maintenance costs.

- The potential for future remedial action costs if the alternative remedial action in question were to fail.
- The potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment.

The feasibility study process is used to select activities or processes which, when implemented properly, will clean up the area and meet the remedial action objectives. The format for organization of feasibility studies is determined by the USEPA (USEPA, 1988). A schematic flowchart of the feasibility study is shown in Figure 1-3. In the first steps of the study, data from previous studies are evaluated, and Applicable or Relevant and Appropriate Requirements (ARARs) are determined. Remedial Action Objectives are developed to determine the goals to be accomplished by the remedial action. General Response Actions are developed to identify broad categories of responses that could be implemented to meet the Remedial Action Objectives. Next, the universe of potential remedial technologies and process options are compiled into a list and are "screened" or eliminated based on technical applicability. If the technology or process option is not technically applicable, it is removed from further consideration.

Process options and remedial technologies that survive this screening step are "building blocks" that are put together to form remedial alternatives. The initial remedial alternatives are then screened based upon effectiveness, implementability, and relative cost. Remedial alternatives surviving this screening are evaluated in a detailed process considering the following criteria:

1. Overall protection of human health and the environment
2. Compliance with Applicable or Relevant and Appropriate Requirements
3. Long-term effectiveness
4. Reduction of toxicity, mobility, and volume
5. Short-term effectiveness
6. Implementability, reliability, and constructibility
7. Cost

The first two of the seven criteria are overall protection of human health and the environment, and compliance with Applicable or Relevant and Appropriate Requirements. These are minimum or "threshold" criteria that must be met by all alternatives. The next five criteria are considered to be "balancing" criteria. These are the primary criteria upon which the analysis of alternatives is based.

The remaining alternatives are then compared against each other. From this comparison, the USEPA will select the preferred alternatives for the residential soils and indoor dust remediations. The selection of the preferred alternative(s) will not be presented in the feasibility study document; instead, it is contained in the Proposed Plan. Next, the feasibility study and the Proposed Plan are published and the public is invited to comment. After considering public comments, the final preferred alternatives are selected and the Record of Decision (ROD) prepared.

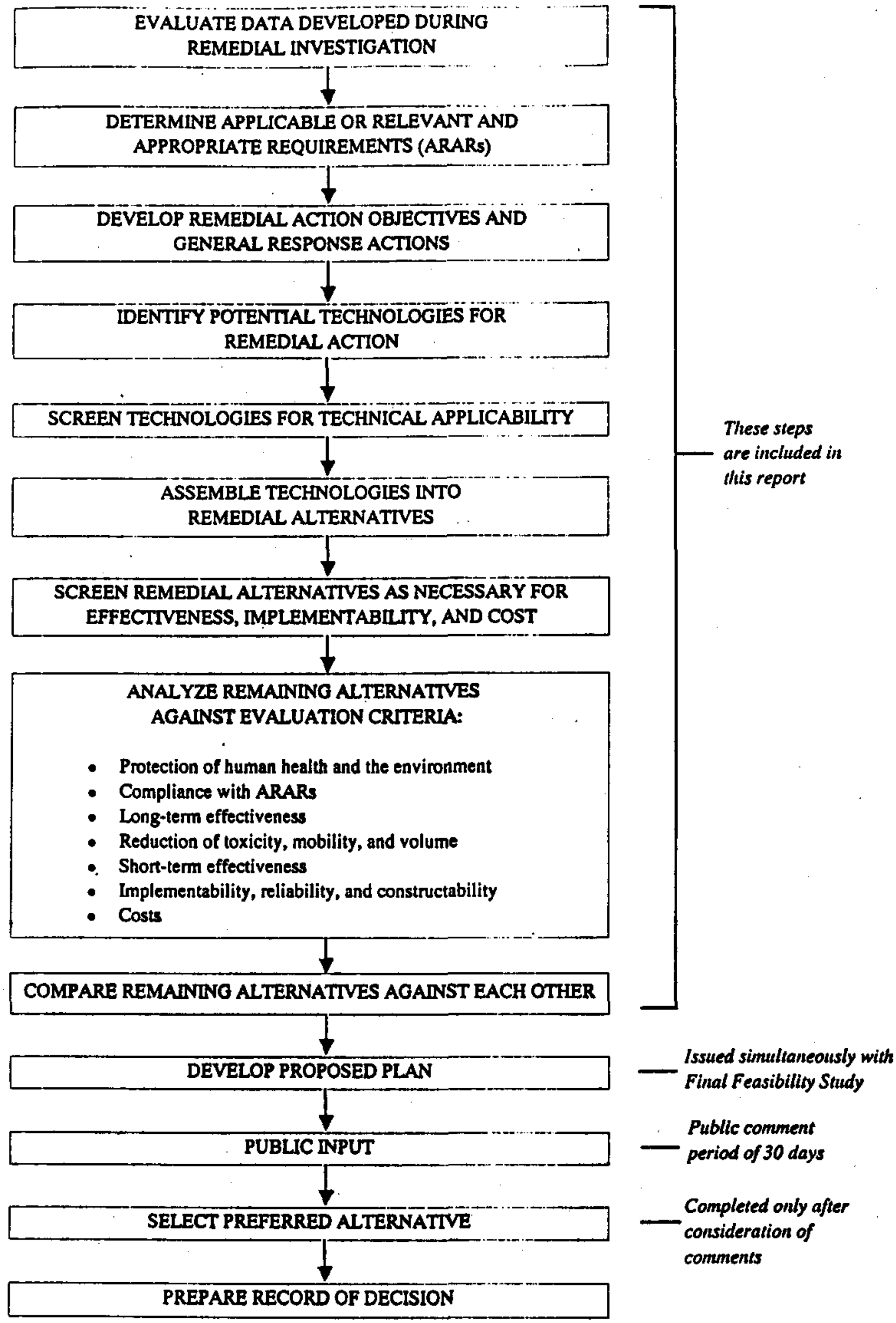

Figure 1-3
Feasibility Study Process

The organization of this feasibility study mirrors the feasibility study process as described above. A description of each of the sections of the report follows:

Section 1--Introduction and Background Information

This section introduces the reader to the reasons for the feasibility study, provides a general description of the feasibility study process, and describes pertinent information such as a description of the site, site history, and nature and extent of contamination.

Section 2--ARARs, Remedial Action Objectives, and General Response Actions

Applicable or Relevant and Appropriate Requirements (ARARs) from the State of Pennsylvania and Federal government are listed in this section. ARARs are summarized and presented in this section since the CERCLA process requires screening of alternatives against these requirements in later sections of the feasibility study. This section also develops the Remedial Action Objectives and the General Response Actions for the Site.

Section 3--Identification and Screening of Technologies

This section presents the first step of the feasibility study process where technologies and process options are presented and screened. Technologies and process options that survive the screening are combined to develop remedial alternatives.

Section 4--Institutional Controls Summary

Institutional controls are regulations or standards put in place to protect the permanence and improve the effectiveness of the selected remedial alternative. Institutional control requirements may be considered as a general response action alone, or combined with other technologies. This chapter summarizes institutional controls.

Section 5--Remedial Alternatives Screening

Initial remedial alternatives are described in this section and then screened. Results of the screening process are presented in tabular format. Remaining remedial alternatives are then listed.

Section 6--Detailed Analysis of Alternatives

This chapter consists of a narrative description of each remaining remedial alternative, including discussions of how the alternatives perform with respect to each of the evaluation criteria. A comparative analysis follows the detailed discussion, which consists of a narrative discussion summarizing the relative performance of the alternatives in relation to one another.

2

2.0 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, AND ARARs

2.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) are site remedial goals specifically designed to address site contamination problems. In order to protect human receptors from contaminated media, the RAOs should define the contaminants of concern, the exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. Contaminant-specific ARARs should form the basis of the Remedial Action Objectives.

EPA has also adapted the site-specific human health protectiveness standards developed in the FRAR as the basis of the Remedial Action Objectives. As previously noted, extensive residential areas have significant levels of metals. The greatest risks to human health are associated with lead exposures.

The FRAR identified the year-round residents of Palmerton as the population that receives the highest exposures. Nine potential exposure pathways were evaluated. The primary mechanisms of exposure were determined to be soil ingestion and indoor dust ingestion. A detailed discussion of all the contaminant pathways and the associated risks is included in the FRAR. Therefore, based on information reported in the FRAR, the following site-specific primary Remedial Action Objective was established:

> *Prevent ingestion of contaminated outdoor soil and/or indoor dust by reducing contaminant concentrations in these media and/or creating a vegetative barrier to the soils to reduce exposure risk and therefore reduce risk at each residence to acceptable levels. A risk-based goal of 650 mg/kg lead in soil and indoor dust will be applied on a residence by residence basis.*

and secondarily allow for unrestricted land use in the future.

2.2 General Response Actions

The Remedial Action Objectives can be achieved through a variety of approaches referred to as General Response Actions. These General Response Actions can be used alone or in various combinations to achieve the Remedial Action Objectives. Potentially applicable General Response Actions for residential soil and indoor dust are listed below.

These General Response Actions encompass a broad range of Remedial Technologies and Process Options. Remedial Technologies are methods for handling specific technical problems and are more specific than General Response Actions. For example, containment (a General Response Action for soil) could be accomplished using a variety of Remedial Technologies such as capping, a vertical or horizontal barrier, surface controls, a sediment control barrier, or dust suppression technologies. Process Options are more specific than Remedial Technologies. For example, dust suppression could be accomplished by application of water, organic agents, polymers, foams, membranes, tarps, or hydroscopic agents (all Process Options).

2.2.1 General Response Actions for Soil

- **Institutional Controls**
  A variety of institutional controls could be adopted to reduce exposure to contaminated residential soils. Requiring dust suppression during construction activities using materials such as water or tarps is one institutional control. It is effective in reducing the mobility of contaminants and thereby reduces inadvertent ingestion by residents. Institutional controls are discussed in section 4.

- **Public Education**
  Actions such as public education through a Health Awareness Program could increase public awareness of potential risks. A public education and maintenance program could assist homeowners in the maintenance of vegetative cover, reducing potential exposure risk.

- **Containment**
  A containment action would place a physical barrier between the residents and the soils. Containment technologies includes capping or covering with a variety of materials such as asphalt, concrete, or chemical sealants, or by covering contaminated soil with clean soil, clay or sod and revegetating the cap.

- **Removal/Replacement**
  Removal activities consist of technologies that excavate soil that is above cleanup standards and haul it away from residential areas to be treated and/or disposed. The excavated areas would then be filled with clean soil and revegetated.

- **Treatment**
  This General Response Action includes appropriate technologies to remove contaminants found in residential soils or to render them non-hazardous.

- **Disposal**
  Disposal actions would be used in conjunction with removal and/or treatment technologies. For example, residential soil removed during remediation could be disposed of at an appropriate landfill.

- **Monitoring**
  This action would be used in conjunction with all technologies and serves two main purposes. Environmental monitoring during site remediation alerts cleanup personnel and residents of unacceptable exposure levels. Second, long-term monitoring following implementation of

remedial actions is an effective way to determine whether or not the Remedial Action Objectives have been met.

2.2.2 General Response Actions for Indoor dust

The Remedial Action Objectives can be achieved through a variety of approaches, referred to as General Response Actions. The following are three potentially applicable General Responses. They can be used alone or in various combinations to achieve the Remedial Action Objectives for Indoor Dust Remediation.

- **Public Education**
  Public education is a means to inform residents of site hazards and of ways to reduce their exposure. These would include wet cleaning procedures for interior hard surfaces, removing shoes prior to entry, placing walk-off mats at the entryways, and other preventive factors.

- **Source Control**
  Source control for the indoor dust hazard is the remediation of the outdoor soil contamination addressed in the rest of this FS. The response to a dust-lead hazard should be accompanied by source control activities. Source control that involves the removal, replacement, or encapsulation of household items or structures is considered outside the scope of the Superfund program.

- **Specialized Cleaning**
  Specialized cleaning is cleaning specifically designed to remove the microscopic particles of lead that contaminate dust as well as reduce overall dust levels. Specialized cleaning is accomplished by vacuuming or washing, or a combination of these two. For example, there can be vacuuming of any loose particles, then a mechanical loosing of particles caught in crevices or stuck on surfaces (with a brush or mop, etc.), and then a removal of the loosened particles by further vacuuming. The procedure prescribed by HUD guidelines includes three steps: HEPA vacuuming, wet washing, and HEPA vacuuming.

- **Carpet Removal/Replacement**
  Carpet Removal/Replacement may be warranted, if after specialized cleaning acceptable levels are not achievable. Vouchers to remove and replace carpet will be given to the home owner after specialized cleaning and clearance testing if acceptable contaminant levels are not achieved. If it becomes apparent that carpet Removal/Replacement is more time/cost effective, on a whole it will be implemented without attempting specialized carpet cleaning first.

2.3 ARARs

The cornerstone of remedial actions undertaken pursuant to the Superfund program lies in the satisfaction of ARARs. These ARARs are the basic standards by which all aspects of hazardous substance, pollutant, and contaminant cleanup are measured. ARARs may be waived by the USEPA only under the following specific conditions, provided that protection of human health and the environment can be ensured (40 CFR Part 300.430(f)(I)(ii)(C)):

1. Compliance with such requirements will have a greater risk to human health and the environment than alternative options;
2. Compliance with such requirements is technically impracticable from an engineering perspective;
3. The selected remedial action will provide an equivalent standard of performance using another approach;
4. The requirement is an inconsistently applied state requirement; or
5. The alternative will not provide a balance between public health and environmental welfare and the availability of funds to respond to existing or potential threats at other sites, taking into account the relative immediacy of the threats (applies only to remedial actions which are not funded by potentially responsible parties).

Remedial action alternatives developed in this feasibility study are presented in relation to whether they satisfy ARARs. Compliance with ARARs and overall protection of human health and the environment are the two minimum, or "threshold," criteria that must be met by all alternatives. There are other criteria that "balance" and "modify" the alternatives that meet the threshold criteria. An evaluation of the alternatives using the balancing criteria is presented in later sections of this feasibility study.

Federal and State ARARs must be complied with during Superfund response actions. In order for a state requirement to be an ARAR, it must meet the following three criteria: 1) It must be a promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law, 2) It must be more stringent than federal requirements, and 3) It must meet the definition of an ARAR.

2.3.1 Definition of ARARs and TBCs

A requirement under other environmental laws may be either "applicable" or "relevant and appropriate," but not both. Identification of ARARs must be done on a site-specific basis and involves a two-part analysis: first, a determination whether a given requirement is applicable; then, if it is not applicable, a determination whether it is nonetheless both relevant and appropriate.

ARARs include promulgated environmental requirements, criteria, standards, and other limitations. Other factors are "To Be Considered" (TBC). TBCs in remedy selection may include nonpromulgated standards, criteria, and advisories, but these are not evaluated pursuant to the formal process required for ARARs. Local ordinances with promulgated criteria or standards are not considered ARARs but may represent TBCs.

2.3.1.1 Applicable Requirements

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site.

2.3.1.2 Relevant and Appropriate Requirements

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that are well suited to the particular site. While not necessarily "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site, relevant and appropriate requirements address problems or situations sufficiently similar to those encountered at the Superfund site that their use is justified.

The determination that a requirement is relevant and appropriate is a two-step process involving determination if a requirement is relevant; and determination if a requirement is appropriate.

In general this involves a comparison of a number of site-specific factors with those addressed in the statutory or regulatory requirement. These may include the characteristics of the remedial action, the hazardous substance present at the site, or the physical circumstances of the site. In some cases, a requirement may be relevant but not appropriate, given site-specific circumstances; such a requirement should not be an ARAR for the site. In addition, there is more discretion in the determination of relevant and appropriate; it is possible for only part of a requirement to be considered relevant and appropriate in a given case. When the analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable.

2.3.1.3 To-Be-Considered Material (TBCs)

There are several different types of requirements with which Superfund actions may have to comply. The classification of ARARs below was developed to provide guidance on how to identify and comply with ARARs; however, some requirements, called "To Be Considered" factors, may not fall neatly into this classification system:

- **Ambient or chemical-specific requirements** are usually health- or risk- based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- **Performance, design, or other action-specific requirements** are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

- **Location-specific requirements** are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations.

2.3.2 Types of ARARs and TBCs

ARARs are generally classified into three groups: chemical-specific requirements; location-specific requirements; and action-specific requirements. While federal standards similar to MCLs do not exist for soil, risk-based concentrations, such as those estimated in the FRAR, are often identified as remediation goals at Superfund sites. These risk-based goals are generally defined as chemical-specific ARARs or To Be Considered cleanup levels.

The State of Pennsylvania ARARs for contaminated soils are the Land Recycling and Environmental Remediation Standards Act, Act 2 of 1995, and the Chapter 250 regulations. Act 2 and Chapter 250 include cleanup standards for contaminated soils including the selection of statewide health standards or site-specific standards that are developed by performing a risk assessment. Chapter 250 Section 401 sets the procedure for developing site-specific cleanup standards for the remediation of hazardous substances.

2.3.2.1 ARARs and TBCs for Residential Soil

Location-Specific Requirements. Most location-specific requirements relate to land use and dictate/regulate activities associated with development and/or construction. Location-specific ARARs may be implemented through local zoning restrictions. Any applicable location-specific requirements are discussed later in this FS, during the evaluation of specific alternative remedial actions. Table 2-2 lists Federal Location-Specific ARARs, and Table 2-3 lists Pennsylvania Location-Specific ARARs.

Action-Specific Requirements. Action-specific requirements applicable to the site are generally encompassed in various operating and discharge permits and emissions limitations. Permits for discharge and air emissions regulate how a facility can be operated. Any applicable action-specific requirements are discussed later in this FS, during the evaluation of specific alternative remedial actions. Tables 2-4 and 2-5 list Federal and State Action-Specific ARARs.

Chemical-Specific Requirements. There are no Federal chemical-specific ARARs for soil. The FRAR recommendations listed in Table 2-1 are TBCs for the Site. The State of Pennsylvania ACT 2 includes medium-specific concentrations (MSCs) for individual chemicals for direct human exposure to soil for residential areas, for non-residential areas, and MSCs for protection of groundwater from soil. MSCs are standards that must be achieved in order to demonstrate attainment of the Statewide health standard. The residential areas have near surface soil contamination with low concentrations of COPCs. The evaluation of MSCs for protection of groundwater also requires determination of buffer distance, groundwater depth, and bedrock configuration, which is not in the scope of the work assignment. Therefore, the MSCs for protection of groundwater are not considered. The residential and nonresidential soil ACT 2 MSCs for the COPCs of Palmerton are listed in Table 2-6. Table 2-7 lists general State Chemical-Specific ARARs.

Table 2-1 Site-Specific Risk-Based Cleanup Levels from the FRAR

COPC	Residential Soil	Residential Indoor Dust
Arsenic	79 mg/kg	32 mg/kg
Lead	650 mg/kg	650 mg/kg

2.3.2.2 ARARs and TBCs for Indoor Dust

The primary contaminant of concern for indoor dust is lead. Lead-contaminated dust means surface dust in residential dwellings contains lead determined by EPA to pose a threat of adverse health effects in pregnant women or young children (USEPA, 1998. Federal Register Vol.63, No. 106, p.30311, June 3). Over the past several years, significant regulatory activity has occurred regarding lead dust and lead-based paint. In 1994, EPA released guidance on the issue. In June of 1998, EPA proposed regulations under Sections 402, 403, and 404 of the Toxic Substances Control Act (TSCA). The existing guidance and the proposed rule, while relevant to the Palmerton Site, may not be applicable. The rule states that the TSCA Section 403 standards should not affect the selection of cleanup remedies at CERCLA response actions or RCRA corrective action facilities. The TSCA Section 403 standards are being developed for different purposes and audiences than CERCLA and RCRA and allow risk and cleanup levels to be narrowly tailored to the individual site with a preference for permanent solutions. Thus, the action levels, cleanup goals, and remedies selected at CERCLA and RCRA sites may differ from those being proposed (USEPA, 1998. Federal Register Vol. 63, No. 106, p.30345, June 3).

Table 2-2 Federal Location-Specific ARARs

Location-Specific	Citation	Prerequisite	Requirement
I. Federal			
A. Applicable Requirement			
1. Property which meets criteria to be included on National Register of Historic Places.	National Historic Preservation Act; 16 U.S.C. 470 et seq.; 40 CFR 6.301(b); 36 CFR Part 800.	Property within the residential areas of the site is included in or eligible for the National Register of Historic Places.	The remedial action will be designed to minimize the effect on historic properties and historic landmarks.
2. Site located within a floodplain.	Protection of Floodplains, Executive Order 11988; 40 CFR § 6.302(b)	Remedial action will take place within a 100-year floodplain.	The remedial action will be designed to avoid adversely impacting the floodplain wherever possible to ensure that the action's planning and budget reflects consideration of the flood hazards and floodplain management.
3. Wetlands located in and around the site.	Protection of Wetlands; Executive Order 11990; 40 CFR § 6. (a)	Remedial actions may affect wetlands.	The remedial action will be designed to avoid adversely impacting wetlands wherever possible, including minimizing wetlands destruction and preserving wetland values.

Table 2-3 Federal Action-Specific ARARs

Action-Specific	Citation	Prerequisite	Requirement
A. Applicable Requirement			
1. Transportation of hazardous materials.	Hazardous Materials And Oil Transportation of Hazardous Materials Regulations; 40 CFR Parts 107, 171, 172	Transportation of hazardous materials in interstate commerce by motor vehicle	107-Prescribes procedures for carrying out laws pertaining to transportation of hazardous materials. 171- Requires registration of persons offering or accepting hazardous material for transport or persons transporting hazardous materials in accordance with applicable requirements. 172 - Designates materials as hazardous and specifies requirements for labeling, packaging, quantity limits, and storage of hazardous materials
2. Threshold Limit Values (TLVs)	Established by American Conference of Governmental Industrial Hygienists (ACGIH).	Releases of airborne contaminants during remedial activities.	TLVs are based on the development of a time weighted average (TWA) exposure to airborne contaminants over an 8-hour work day or a 40-hour work week. TLVs identify levels of airborne contaminants at which health risks may be associated. Since there are no ARARs for several of the contaminants of concern - arsenic, antimony, copper, cadmium, mercury, and zinc - the TLVs should be considered for remedial activities which will cause airborne emission of such chemicals. The TLVs for these contaminants of concern are as follows: Arsenic 100 ug/m^3 Cadmium 10 ug/m^3 Lead 50 ug/m^3 Zinc: ZnCl = 1,000 ug/m^3, Zinc Oxide: fume = 5,000 ug/m3 dust = 10,000 ug/m^3

Table 2-4 State of Pennsylvania Action-Specific ARARs

Action-Specific	Citation	Prerequisite	Requirement
I. Air			
A. Applicable Requirement			
1. Fugitive Dust.	25 PA Code§123.1, §123.2	Emission of airborne contaminants.	The remedial action must take all reasonable actions to prevent particulate matter from becoming airborne including, but not limited to, the application of water, chemicals, oil, or asphalt to control dust, and prompt removal of earth or other excavated material that has been transported by earth moving equipment, erosion by water, or other means. The remedial action may not permit fugitive particulate matter to be emitted into the outdoor atmosphere if the emissions are visible at the point the emissions pass outside property lines.

3

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This chapter presents the initial steps of the multi-step process for developing cleanup alternatives. This multi-step process is specified by the USEPA's guidance document for feasibility studies (USEPA, 1988) to ensure that a consistent, systematic process is followed at all Superfund sites in developing and evaluating potential remedial solutions. In addition, the multi-step process ensures that all potentially feasible alternatives are identified for each site. The steps of the process covered in this chapter include:

- *Identify potential technologies and screen them for technical applicability.* This step involves identifying all potential technology types and sub-types (such as chemical treatment, thermal destruction, removal and replacement, etc.) that are available, then screening out technologies and process options if they cannot be technically implemented at this site.

- *Evaluate process options and develop Remedial Alternatives.* This step evaluates the process options within each technology type retained from the initial screening. A second screening of potential technologies and process options is performed, based on effectiveness, implementability, and relative cost. Lastly, the retained technologies and process options are combined into complete alternatives.

3.1 Screening of Remedial Technologies and Process Options

A general list of all technologies and associated process options was used during the technical screening step. Technologies and process options were eliminated solely on the basis of technical applicability. If a process option was not potentially applicable to site conditions or the Remedial Action Objective, it was eliminated from further consideration. If all process options of a particular Remedial Technology were eliminated, then that entire Remedial Technology was eliminated from further consideration. The retained Soil and Dust Remedial Technologies and process options from the technical screening, along with a brief description of each process option, are presented in Tables 3-1 and 3-2, respectively.

Table 3-1 Description of retained Remedial Technologies and Process Options for Soil following technical screening

SOIL REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION
Institutional Controls	Deed Notices	Deed notices issued for property within potentially contaminated areas for informational purposes. May require notifying potential buyers of contamination. This information would be available to prospective land purchasers and lending institutions.
	Fences	Security fences installed around contaminated areas to limit access.
	Sod/Grass Requirements	Requires maintenance of vegetative cover to reduce potential contaminant mobility.
	Excavation Regulations	Regulations promulgated to address dust control during construction and to require reestablishment of protective barrier.
	Health Intervention Program	Personal health and hygiene aids in the prevention of ingestion and inhalation of potentially contaminated dust and soil.
Public Education	Public Education	Education programs to keep information about the contamination and protective barriers in the public eye (brochures/pamphlets/newspaper articles, etc.).
Relocation of Residents	Temporary	Move residents to a motel or apartment. Pay for most additional out-of-pocket expenses for a finite period of time.
	Permanent	Move residents to a new residence. Pay for out-of-pocket moving costs, temporary housing and meals, utility connections, mortgage purchase, and closing cost.
Capping	Soil	Clean soil placed over contaminated areas.
	Clay	Compacted clay placed over contaminated areas. Clay should be covered by at least a foot of silty sand or sandy soil to maintain the integrity of the clay cap.
	Synthetic Membranes	Synthetic membrane placed over prepared soil or geotextile surface that is over a contaminated area. The membrane is seamed by a variety of methods. The membrane must be compatible with the wastes present.

	Sprayed Asphalt	Sprayed asphalt is placed over contaminated areas and covered with soil or opaque reflective paint to protect the asphalt from ultraviolet light and to retard oxidation.
	Asphaltic Concrete	Asphalt for paving grades or special blends mixed with well graded, crushed aggregate, placed over contaminated areas.
	Concrete Cap	Concrete placed over prepared contaminated area. Fill settlement must be evaluated in considering concrete cap design.
	Multilayered Cap	Cap may be composed of natural soils, soil admixtures, clay, synthetic membranes, spray-on asphalts, asphaltic concrete, or Portland cement concrete and placed over contaminated areas.
	Chemical Sealants/ Stabilizers	Water-dispersible emulsions and/or resins placed over contaminated areas to form a crust that reduces water and wind or dust erosion. Most are nontoxic to plants and animals. Temporary cover only.
Horizontal Barriers	Chemical Barrier	Acid or base layer to promote favorable speciation and reduce contaminant mobility.
Surface Controls	Surface Sealing	Cover materials and seal techniques implemented to stabilize contaminated soil and to prevent surface water infiltration, control erosion, and isolate and contain the soils. Similar to capping.
	Soil Stabilization	Chemical stabilizers sprayed on bare soils or mulches to coat, penetrate, and bind together the particles. Chemical stabilizers include latex emulsions, plastic films, oil-in-water emulsions, and resin-in-water emulsions.
	Revegetation	A systematic revegetation plan includes selection of a suitable plant species, seedbed preparation, seeding/planting, mulching and /or chemical stabilization, fertilization, and maintenance. This technology includes hydroseeding.
Dust Suppression	Water	Water sprayed over area of concern to prevent dust generation and migration during construction.
	Organic Agents/ Polymers/Foams	Organic agents/polymers/foams sprayed over area of concern to prevent dust/vapor generation.
	Membranes/Tarps	Membranes or tarps are spread over area of concern to prevent dust/vapor generation.
Excavation/Backfill	Soils Removal and Replacement	Excavation of contaminated soils. Backfill with clean soil.

	Sod Removal and Replacement	Brittle wastes stressed by impact beyond their elastic limit and broken by heavy, slow moving equipment are removed and replaced.
Chemical Treatment	pH Adjustments	Soil removed. Acid or base mixed into soils to promote favorable speciation and reduce contaminant mobility.
	Washing	Soil removed. Water or acid solutions added to contaminated soils washing out specific contaminants.
Insitu Treatment	Deep Tilling	Tilling mixes the contaminated surface soils with clean subsoils, reducing contaminant concentrations at the surface.
	Vitrification	Graphite electrodes placed in a square array. Electric current passes through electrodes, creating high temperature that melt the soil or waste solids into a block of glass-like material. Experimental process option.
	pH Adjustments	Acid or base mixed into soil insitu to promote favorable speciation and reduce contaminant mobility.
	Pozzolanic Agents	Pozzolanic agents or polymer admixtures added to and mixed directly into soil to produce a concrete-like solid. The resultant solidified soil is less susceptible to erosion.
	Agricultural Soil Amendments	Fertilizer and other lawn-type amendments added to and mixed directly into soil. Promotes vegetative growth that can reduce erosion and help provide a barrier to soils that are above cleanup standards. Added material reduces contaminant concentrations at the surface.
Temporary Storage	Waste Storage	Waste piles are temporarily stored onsite during remedial activities until permanent treatment or disposal.
Offsite Thermal Treatment	Smelting	Heavy metals removed from contaminated materials or vitrified into non-soluble slags at a commercial smelter.
Offsite Solidification, Fixation, Stabilization	Pozzolanic Agents	Soil removed. Lime and fine-grained silicious material added to soils to produce a concrete-like solid.
Offsite Disposal	Waste Repository	Excavated soils defined as nonhazardous wastes are permanently disposed of in a non-RCRA landfill. Landfills cannot accept liquid wastes.

Monitoring		Short- and/or long-term monitoring is implemented to record and note any changes in site conditions and contamination levels.

Table 3-2 Description of retained Remedial Technologies and Process Options for Interior Residential Dust following technical screening

DUST REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION
Public Education	Public Education	Education programs to keep information about contamination in the public eye and educate on methods to reduce exposure/contamination (brochures, pamphlets, newspaper articles, etc.).
Source Control (separate from controlling outside soil contamination)	Carpet cleaning	Professionally clean carpet using wet methods and a detergent-based cleaning solution such as sodium hexametaphosphate. Dry cleaning is not an option, as it has been shown to possibly increase the dust loading on the surface of old carpets.
	Carpet Removal	Determine with clearance testing if cleaned carpet meets the cleaning standard. Provide voucher to residences where clearance testing indicated contaminants above acceptable limits. Carpet will be removed and vouchers used to replace carpets.
Specialized Cleaning	Vacuuming	Using a HEPA filtration system vaccuum.
	Washing	Using an additive to coat lead particles for removal, such as cleaners containing tri-sodium phosphate. Cleaners that solubilize lead are not recommended in homes that contain lead-based paint, as they may cause the paint to break down and strip.
	Vacuuming/ Washing/ Vacuuming	Using a HEPA filtration system vacuum and an appropriate washing additive.

3.2 Evaluation of Process Options

Following the technical screening, the retained process options were evaluated on the basis of effectiveness, implementability, and relative cost. The primary focus of this second screening step was effectiveness, with less concern placed on implementability and relative cost.

The following primary factors were emphasized to evaluate effectiveness:

- The potential effectiveness of the process option to meet the Remedial Action Objective.
- The effectiveness of the process option in protecting human health during and after remedial activities.
- How proven and reliable the process option is at similar sites under similar conditions.

In evaluating implementability, the following primary factors were emphasized:

- Availability of necessary resources or supplies.
- Viability of implementing unusual or innovative remedial technologies.
- Expected reaction by residents to implementation of the process option.

Relative cost estimates were compared for process options within each Remedial Technology. Cost played a limited role in screening at this point in the evaluation. However, if a particular process option was equal in effectiveness to similar options within a Remedial Technology, yet more costly, it was eliminated from further consideration. The relative cost evaluation was completed on the basis of engineering judgement gained through past experience at other Superfund/CERCLA sites.

Table 3-3 provides a summary of this evaluation process. Screening comments are included that describe why process options were eliminated.

Table 3-3 Second Screening of Remedial Technologies and Process Options for Soil and Dust

SOIL TECHNOLOGY	PROCESS OPTION	SCREENING COMMENT
Institutional Controls	Deed Notices	Retained.
	Fences	Eliminated- not viable for residential properties.
	Sod/Grass Requirements	Eliminated- not viable for residential properties.
	Excavation Regulations	Eliminated- not viable for shallow contamination in multiple residential properties.
Public Education	Public Education	Retained.
Relocation of Residents	Temporary	Eliminated- not necessary for small volume excavation.
Capping	Soil	Retained.
	Clay	Eliminated- not applicable for residential yards without major grade changes.
	Synthetic Membranes	Eliminated- not cost effective or viable for multiple residential yards.
	Sprayed Asphalt	Eliminated- not viable for multiple residential yards.

	Asphaltic Concrete	Eliminated- not cost effective or viable for multiple residential yards.
	Concrete Cap	Eliminated- not viable for residential yards.
	Multilayered Cap	Eliminated- not cost effective for multiple residential yards, requires major grade changes.
	Chemical Sealants/ Stabilizers	Eliminated- temporary cover only.
Horizontal Barriers	Chemical Barrier	Retained.
Surface Controls	Surface Sealing	See capping.
	Soil Stabilization	Eliminated.
	Revegetation	Retained.
Dust Suppression	Water	Retained.
	Organic Agents/ Polymers/Foams	Eliminated-more expensive than other processes.
	Membranes/Tarps	Retained.
Excavation/Backfill	Soils Removal and Replacement	Retained.
	Sod Removal and Replacement	Retained.
Chemical Treatment	pH Adjustments	Retained.
	Washing	Eliminated-more expensive than other processes.
In Situ Treatment	Deep Tilling	Retained.
	Vitrification	Eliminated-more expensive than other processes, and non-implementable at this site.
	pH Adjustments	Retained.
	Pozzolanic Agents	Retained.
	Agricultural Soil Amendments	Retained.
Temporary Storage	Waste Storage	Retained.
Offsite Thermal Treatment	Smelting	Eliminated-more expensive than other processes.
Offsite Solidification, Fixation, Stabilization	Pozzolanic Agents	Retained.
Offsite Disposal	Waste Repository	Retained.
Monitoring		Retained.

DUST TECHNOLOGY	PROCESS OPTION	DESCRIPTION
Public Education	Public Education	Retained.
Source Control (separate from controlling outside soil contamination)	Carpet cleaning	Retained.
Specialized Cleaning	Vacuuming	Eliminated - alone, it may not meet the RAO.
	Washing	Eliminated - alone, it may not meet the RAO.
	Vacuuming/ Washing/ Vacuuming	Retained.
	Carpet Removal and Replacement	Retained.

3.3 Development of Remedial Alternatives

The Remedial Technologies and Process Options retained up to this point are building blocks that can be put together to form a variety of remedial alternatives. The primary goal of each alternative is to address the Remedial Action Objectives for the site. In addition, the development of alternatives was influenced by the following suggestions from the RI/FS Guidance Document (USEPA, 1988):

- To include treatments that permanently reduce the mobility, toxicity, or volume of contaminants. That is, the range of treatment alternatives developed should, if possible, vary in the degree of reliance on long-term management of untreated wastes.
- To include permanent solutions to the maximum extent practicable.
- To include innovative treatment technologies and/or resource recovery technologies to the maximum extent practicable.
- To include one or more containment alternatives that involve little or no treatment of hazardous contaminants.
- To include a no action alternative.

CERCLA requires that treatment alternatives and permanent solutions are to be emphasized whenever possible[1]. However, treatment alternatives may be prohibitively expensive at sites that involve large quantities of low-level contaminated wastes. For such sites, it is often not possible to develop a complete range of applicable alternatives that satisfy the above criteria. The retained Process Options in Table 3-3 were combined to assemble an initial set of remedial alternatives for soil and a set of remedial alternatives for indoor dust. The remedial alternatives are further described in Section 5.

[1] CERCLA § 121(b)(1).

3.3.1 Soil Remedial Alternatives

1. No Action.
2. Long-term Monitoring/Institutional Controls
3. Capping (Soil, six inch or twelve inch, Surface Controls-revegetation, Monitoring).
4. Removal/Revegetation (Excavation/Backfill, Waste Repository, Dust Suppression via water or tarps, Surface Controls- revegetation).
5. Removal/Insitu Treatment/Revegetation ('Hot Spot' Excavation, Backfill, Waste Repository, Dust Suppression via water or tarps, Insitu Treatment - Agricultural amendments or Chemical amendments, Surface Controls-revegetation,).
6. Soil Amendment and Revegetation (Dust Suppression via water or tarps, Insitu Treatment- agricultural soil amendments and tilling, Surface Controls-revegetation, Monitoring).

3.3.2 Indoor Dust Remedial Alternatives

1- No Action
2- Long-term Monitoring/Public Education
3- Specialized Cleaning (Outside residential soil source control then Vacuum-Wash-Vacuum, and public education)
3A- Carpet Removal/replacement

Table 3-4 Assembling Remedial Alternatives for Soil

Technology Type		Remedial Action Alternatives*					
General Response	**Process Option**	**1**	**2**	**3**	**4**	**5**	**6**
No Action	No Action	!					
Institutional Controls	Deed Notice	!	!	!			
Public Education	Public Education		!	!		!	!
Containment	Soil Cap			!			
	Dust Suppression			!	!	!	!
	Revegetation			!	!	!	!
Removal	Soil Removal			!	!	!	
Treatment	Pozzolanic Chemical Amendment or other Chemical Treatment					!	
	Agricultural Amendments					!	!
	Tilling					!	!
Offsite Disposal	Waste Repository			!	!	!	
Monitoring	Environmental Monitoring	!	!	!			

*Remedial Action Alternatives:

1 - No Action
2 - Long-term Monitoring/Institutional controls
3 - Capping
4 - Removal/Revegetation
5 - Removal/Insitu Treatment/Revegetation
6 - Soil Amendment and Revegetation

4

4.0 INSTITUTIONAL CONTROLS SUMMARY

This chapter defines and describes institutional controls as they could relate to this site. Institutional controls are regulations and procedures implemented during and after remedial activities to assure the long-term viability of the remedial actions taken. These regulations and procedures are generally implemented and enforced by federal, state, or local government entities. In this FS, institutional controls are considered as both a standalone remedial alternative and as part of other alternatives.

The remedial action selected must consider the possible future activities on the residential properties. If soils above cleanup standards are left in place, activities such as excavation associated with public and private utility projects, gardening, landscaping, and home remodeling can result in exposure to and transport of contaminants into residential yards and homes. The institutional controls include several alternative approaches to maintaining or re-establishing proposed barriers.

4.1 Approaches to Institutional Control

4.1.1 Physical Control Strategies

Application of physical control strategies to OU3 would include the maintenance of vegetative cover for any alternative that would leave some or all contaminants in place.

If contaminants are left in place with no treatment (soil alternatives 1, 2, and 3 *only*), then monitoring of future construction/excavation activities would be required. A permitting system (see 4.1.2.3) could be put in place to track these activities. Dust controls and monitoring would be required during excavation, and field inspections would be required to ensure compliance with permit provisions. Proper disposal of excavated soil would be required, as would re-establishment of any vegetative or soil cap barrier.

An additional physical control strategy that would help to reduce the possibility of track-in dust would be to allow residents to select new doormats which could be provided as part of the remediation.

4.1.2 Administrative Control Strategies

Along with physical control requirements, administrative or regulatory control measures must be undertaken to ensure that barrier maintenance is carried out and that recontamination of residences via track-in dust does not occur. A variety of techniques are available and can be applied if the proper public agencies are equipped to see that plans are carried out.

4.1.2.1 Public Education

Getting information to the public through a variety of media is important. The methods that could be undertaken include:

- **Pamphlets** - Pamphlets are short informational handouts developed to inform Palmerton residents about the nature of contamination and means to reduce exposure.

- **Brochures** - Brochures are more detailed technical handouts designed to focus on a target population, such as construction workers or real estate professionals who may have special needs dealing with a barrier maintenance program.

- **Continuing multi-media involvement** - Using general newspaper and multi-media resources, such as continued education, press releases, and public presentations may be useful in providing remediation updates and emphasizing ongoing maintenance practices.

- **Health Awareness Program** - Depending on the remediation alternative chosen, it may be necessary to conduct periodic seminars on potential hazards of the site contaminants and means to protect against them.

4.1.2.2 Title and Deed Notifications

Title and Deed Notifications are a means to provide additional information to real estate purchasers. This would require provision of deed notices or information to be conveyed upon title transfer that would be recorded in the county real property records.

4.1.2.3 Permitting

If contaminants are left in place with no treatment (soil alternatives 1, 2, and 3 *only*), then a permit for excavation activities that could increase exposure to contaminants could be required. Field inspections would be required to ensure compliance with permit provisions (dust control and monitoring during excavation, proper disposal of any excavated soil, re-establishment of soil cap or vegetative barrier).

4.2 Appropriate Government Entities

The choice of the proper governing entities and delivery systems that meet the needs of a lasting institutional controls program must reflect both local political realities and authority granted by federal, state, and local statutes. The governing entities considered for administration of the institutional controls include:

- **Federal Government-USEPA** - The USEPA has broad authority in federally-sponsored environmental programs but must restrict its activities to those expressly set forth in federal statutes. Overall cleanup of the Superfund site is to be supervised by the USEPA, but current statutes do not provide any day-to-day managerial authority once cleanup is accomplished.

- **Pennsylvania Department of Health and Pennsylvania Department of Environmental Protection(PADEP)** - PADEP has been involved in regulation of health-sensitive community systems affecting water, wastewater treatment, and solid waste management.

- **Municipal Government/Township** - The local municipal jurisdictions are limited to their municipal boundaries and do not extend beyond these boundaries, except by agreement with the county or other municipal entities. Since the Borough of Palmerton is relatively small in size, and the OU3 boundaries extend into parts of other municipalities, its capacity to administer a significant control program may be limited.

4.3 Implementation Costs and Considerations

The costs to implement institutional controls fall into several categories:

- **Administration** - This includes the costs to enact and enforce the controls. It would include costs to place and maintain deed restrictions, perform record-keeping, administer community education (see below), and to maintain enforcement of the controls.

- **Community Education** - This includes the costs to provide education for residents about how to reduce potential hazards associated with OU3.

The costs for institutional controls are included in the annual operation and maintenance costs presented in Appendix A.

Key elements of an institutional controls program for this site include:

- **Coordination of Public Institutions** - Effective administration of an institutional controls program for OU3 will require shared authority and resources. The local administrations can play an important role in the deed restriction or delisting procedures. PADEP can administer the effort with inspection and records maintenance, and enactment of regulations, where necessary, across jurisdictional boundaries.

- **Educational Programs** - Educational programs may be developed to keep information about indoor dust minimization and maintenance of vegetative cover in the public eye, and to help the public recognize when or if disruption of the barrier requires attention or caution. Distribution of information may be provided through pamphleting, brochures, and general media exposure.

- **Title and Deed Notification** - Administrative and record keeping procedures must be clearly defined and communicated to effectively administer the site.

- **Funding** - A mechanism to perpetually fund all aspects of an institutional controls program needs to be established from the outset.

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5.0 REMEDIAL ALTERNATIVES SCREENING

This section presents the intermediate steps in the multi-step process for developing and evaluating remedial alternatives. The steps included in the process are:

- *Description of Remedial Alternatives.* The six remedial alternatives for soil and the remedial alternatives for indoor dust developed at the conclusion of Section 3 are further described.

- *Screening of Remedial Alternatives.* The alternatives are screened on the basis of effectiveness, implementability, and cost. The alternatives that survive this screening are then carried into the next section for the final steps in the evaluation process.

5.1 Description of Initial Remedial Alternatives

SOIL ALTERNATIVE 1: No Action

The No Action Alternative is included in the evaluations for use as a baseline against which the action alternatives can be compared. As its name implies, no remedial action or environmental monitoring would be implemented with this alternative.

SOIL ALTERNATIVE 2:Long Term Monitoring/ Institutional Controls

This alternative includes environmental monitoring of residential area soils without implementing any remedial actions. Residential area soils would be sampled, tested and evaluated at regular intervals. Institutional controls would include deed notices, public education, and monitoring. Deed notices would be issued for properties within OU3 to inform potential buyers and lenders of the property status. The public education program would consist of brochures, pamphlets, and newspaper articles to keep information concerning the operable unit in the public eye.

SOIL ALTERNATIVE 3: Capping

Alternative 3 would involve removal the sod and upper soil layer (assume two inches of removal), then covering the remaining yard soil with clean soil, and revegetation. Removed soils and sod would be disposed offsite. For the screening cost estimate of this alternative it has been assumed that an average of only two inches of sod/soil will be removed and disposed. The clean soil and vegetative cover would form the barrier needed to protect the residents from being exposed to elevated metals in the soils. Institutional controls would be implemented to ensure the long term integrity of the cap.

Two versions of this alternative were considered: a thin cap consisting of six inches of replacement fill, and a thicker cap consisting of twelve inches of replacement fill. The thin cap and the thick cap would raise the existing grade by four inches and ten inches respectively, considering the removal of two inches of sod and upper soil. The thin (6-inch) cap could be penetrated by such common occurrences as a digging dog, a home owner planting bulbs, or a child with a stick. It would therefore be insufficient to provide a viable cap barrier in the residential area.

The floor elevation of many houses may not allow the yard grade to be raised significantly. Therefore, implementation of the thin cap or the thick cap alternatives would require evaluation of the grades of each residence to be remediated and the impacts of raising the grades on the residence and on drainage. Implementation of either cap alternative would also raise the grade and create an increased potential for erosion and eventual re-exposure of material above cleanup standards.

SOIL ALTERNATIVE 4: Removal/Revegetation

This alternative involves removal of all residential soil above the cleanup standard in order to achieve maximum protection of human health. To generate cost estimates and evaluate this alternative, an average four-inch depth of excavation over 80 percent of the area of remediation, and an average six-inch depth of excavation over the remaining area was assumed. Excavated soils would be replaced with clean soil. Plants and other vegetation would be replaced. With this alternative, all residential soil above the lead action level of 650 mg/kg would be excavated. Soil, sod, shrubs, trees, and any other materials that are removed would be tested to determine proper disposal. For cost estimating purposes, 95% of the waste is assumed to go to a municipal landfill and 5% is assumed to go to a permitted hazardous waste landfill. Post-remediation confirmation sampling would be performed to confirm the achievement of remedial objectives.

SOIL ALTERNATIVE 5: Removal/Insitu Treatment/Revegetation

Alternative 5 initially involves the removal of surface soil in 'hot spot' areas where pre-design sample results are found to be high or there are bare spots. The removal would be geared toward reducing over all risk to acceptable levels. Approximately two inches of sod/soil vegetative cover in these areas would be excavated and disposed of offsite. Remediation of the underlying or surrounding soil would be accomplished if necessary to achieve 650 mg/kg in clearance composite sampling in one of two ways. Alternative 5A involves thoroughly tilling in agricultural soil amendments, and Alternative 5B would use some type of added chemical treatment. Much of the contaminants would be removed under these alternatives, but some would be treated insitu. Vegetative cover would be installed after treatment. Post-remediation confirmation sampling and vegetative cover observation would be performed to confirm the achievement of remedial objectives and for delisting of this operable unit.

Under alternative 5A, soil in areas of high contamination would be excavated and disposed of offsite. If necessary to achieve 650 mg/kg in clearance composite sampling, pre-amended soil would then be tilled into the remaining soil, or agricultural soil amendments such as limestone, fertilizer, and clean topsoil would be tilled in. If necessary, the soil would be compacted. Finally, the surface would then be revegetated by seeding or sodding. The area would then be watered for two weeks to help establish the new lawn cover.

Alternative 5B would involve using chemical treatment of the insitu soils. Treatment could be with Pozzolonic treatment or with another chemical treatment. Such a treatment process immobilizes the metals so that the soil passes the toxicity characteristic leaching procedure (TCLP) criteria or the

Universal Treatment Standards (UTS) for non-hazardous waste. If this alternative is chosen, treatability studies would be conducted to determine the appropriate chemical mix/quantity for insitu treatment, and to ensure that the treatment will adequately reduce contaminant mobility. Clean soil would be added if a large amount of soil was removed, and the surface would be revegetated. The area would then be watered for two weeks to help establish the new lawn cover

SOIL ALTERNATIVE 6: Soil Amendment and Revegetation

This alternative is similar to the existing "Neighbor Helping Neighbor" (NHN) program. It is different from the NHN Program in that it would provide for pre- and post-remediation sampling and observation, and in that a contractor would perform the remedial activities. The sampling and the vegetative cover observation would show whether or not the remedial goals have been achieved. Having a contractor perform the work would decrease potential exposure for the residents during soil mixing and would reduce potential variability in the remediation result.

This alternative would include spreading and tilling agricultural soil amendments such as fertilizer, limestone, etc. into the existing soil. The soil amendment and mixing process would mix shallow existing soil with less contaminated soil below, and with added uncontaminated material. The area would then be revegetated either through incorporation of grass seed with the amendments, or hydroseeding, or in certain situations sod may be utilized. Two weeks of watering would be provided to establish the vegetative cover. A public education and maintenance program would be developed to assist the homeowners in maintenance of the newly-grown vegetative cover.

Alternative 6 would not include any removal of existing soil. Post-remediation confirmation sampling and vegetative cover observation would be performed to confirm the achievement of remedial objectives and for delisting of this operable unit.

DUST ALTERNATIVE 1: No Action

The No Action Alternative is included in the evaluations for use as a baseline against which the action alternatives can be compared. As its name implies, no remedial actions would be implemented.

DUST ALTERNATIVE 2: Long Term Monitoring/Public Education

Periodic monitoring of interior dust samples would be conducted at regular intervals under this alternative. No remedial action would be implemented. Public education about the dust lead hazard would be used to minimize exposure. The public education program would consist of brochures, pamphlets, and newspaper articles to keep information concerning the contamination in the public eye. The purpose would be to keep the public aware of the threat and promote practices which could reduce the exposure risks. The public education program would describe the hazard and steps to be taken to minimize the threat. Such steps would include items such as cleaning procedures for lead, carpet replacement, entryway mats to reduce track-in soil, etc.

DUST ALTERNATIVE 3: Specialized Cleaning

This alternative would include public education, as in the previous alternative. Source control would be addressed by remediating the residential yard soil, as discussed in this FS. The interior dust specialized cleaning protocol would include three steps: HEPA vacuuming, wet washing, and HEPA vacuuming. Clearance testing would be performed to confirm that the specialized cleaning was successful.

Under Alternative 3A, carpet removal and replacement would be implemented when interior dust specialized cleaning efforts do not meet clearance testing and on a whole will not be time/cost effective. Carpets would be removed and a voucher would be issued to the homeowner for the cost of replacing carpeting.

5.2 Screening of Initial Remedial Alternatives

At this point in the evaluation process, the initial remedial alternatives were screened on the basis of effectiveness, implementability, and cost. Comparisons among similar remedial alternatives were made.

When evaluating relative effectiveness, the following primary factors were emphasized:

- Short-term effectiveness of the remedial alternative in protecting human health; and
- Long-term effectiveness of the remedial alternative in protecting human health.

When evaluating implementability, the following primary factors were emphasized:

- Technical feasibility of the remedial alternative; and
- Administrative feasibility of the remedial alternative.

Relative cost estimates were made based upon order-of-magnitude quantity estimates and unit costs, and past engineering experience.

Evaluation of the seven- initial soil and three initial indoor dust remedial alternatives is summarized in Table 5-1. Screening based upon the above criteria resulted in the rejection of Soil Alternatives 2 and 3, and Dust Alternative 2, as explained in the screening comments section of the table. The following alternatives were retained for final evaluation:

Soil Alternative 1	No Action
Soil Alternative 2	Long Term Monitoring/Institutional Controls
Soil Alternative 4	Removal Revegetation
Soil Alternative 5	Removal/Insitu Treatment/Revegetation
Soil Alternative 6	Soil Amendment and Revegetation
Dust Alternative 1	No Action
Dust Alternative 2	Long-term Monitoring/Public Education
Dust Alternative 3	Specialized Cleaning

These remedial alternatives represent a range of practicable actions. Soil and Dust Alternative 1, No Action, was retained to provide a baseline for comparison against the action alternatives. Soil Alternative 4 offers a complete removal of the material above the risk-based cleanup level. Soil Alternative 5 would greatly reduce the threat to human health and would remove part of the material above the risk-based cleanup level. Soil Alternative 6 was retained to represent a treatment technology option which would greatly reduce the threat to human health without removing material above the risk-based cleanup level. Dust Alternative 3 was retained as an alternative which would greatly reduce the threat to human health by removing indoor dust above the risk-based cleanup level.

Table 5-1 Screening of Initial Remedial Alternatives

Alternative (a)	Effectiveness in Reducing Threat to Human Health	Implementability	Estimated Costs (b)			Screening Comments
			Capital	O&M and Sampling Present Value	Total Present Worth(c)	
1-No Action	Does not reduce threat to human health.	Not applicable.	$0	$0	$0	Retained as a comparison to action alternatives
2-Long term monitoring Institutional Controls	Effective in moderately reducing threat to human health by administratively limiting exposure. Short- and long-term effectiveness depends on compliance with institutional controls.	Technically and administratively feasible.	$0	$733,000	$733,000	Retained.
3A-Capping (6-inch cap)	Short-term threats can be controlled through use of construction controls (dust suppression, etc.). Long-term effectiveness accomplished through barrier technologies that address recontamination from underlaying materials.	Administratively feasible, but not implementable for residential areas. The floor elevation of houses may not allow the yard grades to be raised.	$16,357,000	$378,000	$16,736,000	Rejected; technically not feasible.
3B-Capping (12-inch cap)	Short-term threats can be controlled through use of construction controls (dust suppression, etc.). Long-term effectiveness accomplished through barrier technologies that address recontamination from underlaying materials.	Administratively feasible, but not implementable for residential areas. The floor elevation of houses may not allow the yard grades to be raised by as much as 12 inches.	$21,614,000	$378,000	$21,993,000	Rejected; technically not feasible.
4-Removal/ Revegetation	Short-term threats can be controlled through use of construction controls (dust suppression, etc.). Long-term effectiveness accomplished through removal of all soils above 650 mg/kg lead from the residential yards.	Technically and administratively feasible.	$26,298,000	$51,000	$26,349,000	Retained.

Alternative (a)	Effectiveness in Reducing Threat to Human Health	Implementability	Estimated Costs (b)			Screening Comments
			Capital	O&M and Sampling Present Value	Total Present Worth(c)	
5A-Removal/ Agricultural Treatment/ Revegetation	Short-term threats can be controlled through the use of construction controls (dust suppression, etc.). Long-term effectiveness is accomplished through reduction of contaminant concentration in the soil and the establishment and maintenance of a vegetative barrier.	Technically and administratively feasible.	$11,070,000	$51,000	$11,121,000	Retained.
5B-Removal/ Chemical Treatment/ Revegetation	Short-term threats can be controlled through the use of construction controls (dust suppression, etc.). Long-term effectiveness is accomplished through reduction of overall contaminant concentration and leachability of contaminants from the soil, as well as the establishment and maintenance of a vegetative barrier.	Technically and administratively feasible.	$11,735,000	$51,000	$11,786,000	Retained.
6-Soil Amendment and Revegetation	Short-term threats can be controlled through the use of dust suppression methods. Long-term effectiveness is accomplished through reduction of contaminant concentration in the soil and the establishment and maintenance of a vegetative barrier.	Technically and administratively feasible.	$11,204,000	$51,000	$11,255,000	Retained.

(a) These summary costs include both the Soil and the Interior Dust Remediation. Alternative 1 lists costs for the No Action Alternative for both media. Alternative 2 lists costs for Lont Term Monitoring and Institutional Controls for Soil and Household Dust Alternative. The remaining alternatives list costs for the described soil alternative combined with the active dust alternative, Dust Alternative 3. The active dust alternative adds approximately $1,666,000 in capital costs to Alternatives 3 through 6.
(b) Costs are approximated based on assumptions of soil areas and depths requiring remediation..
(c) Assumes a four percent discount rate of ongoing costs for 30 years.

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6.0 DETAILED ANALYSIS OF ALTERNATIVES

6.1 Introduction

This section includes the final steps of the multi-step evaluation process. The alternatives that remain following the screening process presented in the previous section are described more fully. The two-step detailed analysis of these alternatives is then presented, which provides the relevant information needed to allow decision makers to select a residential soil remedy and a indoor dust remedy. First, each alternative is assessed against the evaluation criteria described in this chapter. Secondly, the results of this assessment are arrayed to compare the alternatives against each other based upon the criteria. This approach to analyzing alternatives is designed to provide decision makers with sufficient information to adequately compare the alternatives, select appropriate remedies, and demonstrate satisfaction of the CERCLA remedy selection requirements in the Record of Decision (ROD).

Evaluation criteria have been developed by the USEPA to address the CERCLA requirements and considerations listed above, and to address the additional technical and policy alternatives (USEPA, 1988). These evaluation criteria serve as the basis for conducting the detailed analyses and for subsequently selecting an appropriate remedial action. The first seven of the criteria are addressed in this FS:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, and volume
5. Short-term effectiveness
6. Implementability, reliability, and constructability
7. Costs

The first two of the criteria are minimum or "threshold" criteria that must be met by all alternatives. The next five criteria are considered to be "balancing" criteria. These are criteria upon which the analysis of the alternatives in this FS are based. The criteria are described in detail later in this section. Criteria for state and community acceptance are deferred until after the public comment period. They are considered to be "modifying" criteria in that they may modify the final remedy selection at the site.

This section consists of a narrative description of each alternative, including discussions of how the alternatives perform with respect to each of the evaluation criteria. The comparative analysis that follows the individual analyses summarizes the relative performance of the alternatives in relation to one another.

6.2 Detailed Description of Alternatives

This section presents a detailed description of each of the remedial action alternatives that remained following the screening process of Section 5. The alternatives represent a range of distinct waste management strategies that address the human health and environmental concerns associated with OU3 residential soils and indoor dust. The primary components of each of the final remedial soil action alternatives are summarized in Table 6-1.

Table 6-1 Summary of Final Remedial Action Alternatives for Soil

General Response	Remedial Action Technologies	Remedial Action Alternatives*				
		1	2	4	5	6
Institutional Controls	Deed Notice	!	!			
Public Education	Public Education				!	!
Containment	Revegetation			!	!	!
	Dust Suppression			!	!	!
Removal	Soil Removal and Replacement			!	!	
Insitu Treatment	Agricultural Amendments (5A)				!	
	Chemical Treatment (5B) or				!	
	Pozzolanic (5B)				!	
	Tilling				!	!
Disposal	Waste Repository			!	!	
Monitoring	Environmental Monitoring	!	!			

*Remedial Action Alternatives: *1 - No Action* *2 Long term Monitoring/ Institutional Control*
5 - Removal/Insitu Treatment/Revegetation 4 - Removal/Revegetation
6 - Soil Amendment and Revegetation

6.2.1 Common Components of Soil Alternatives

The remaining alternatives share some common components. All would use dust suppression and revegetation. Soil removal and replacement would be required for Alternatives 4 and 5. Public education would be used for Alternatives 5 and 6. Although the description of these remedial components is not repeated in the discussions for each alternative, differences in their planned implementation are identified where appropriate. Each of these common components is discussed below.

6.2.1.1 Dust Suppression During Remediation

Dust suppression measures would be implemented throughout the remediation process to reduce exposure of workers and residents to airborne contaminants. Dust suppression would include:

- Watering of residential yard areas prior to excavation activities.
- Continued watering during excavation, as necessary.
- Placement of tarps or covers over excavated materials.
- Use of tarps or covers over truck beds to reduce blowing dust and spillage during transportation to the waste repository.
- Daily cleanup of any spilled or tracked soils from sidewalks, roadways, etc.

Appropriate air monitoring would be conducted to identify the occurrence of contaminant migration during remedial activities. Any exceedance of the standards would result in immediate implementation of additional dust suppression measures or a shutdown of construction activities.

6.2.1.2 Soil Removal and Replacement

Two of the alternatives include at least partial removal of residential soil above the cleanup level and replacement with clean soil. This would be completed using appropriately-sized construction equipment, such as small front-end loaders, bobcats, dump trucks, or dump trailers. Some manual excavation and finishing is anticipated to adequately remove and replace soil in areas that are difficult to work with machines. Although the depth of removal is anticipated to be shallow, underground utilities may have to be marked or cleared prior to excavation, and excavation near utilities will have to be undertaken according to established regulations and safety procedures.

6.2.1.3 Waste Repository

Disposal of contaminated soil is subject to land disposal restrictions (LDR), generally when it contains a listed hazardous waste or when it exhibits a characteristic of hazardous waste (63 FR 28602, May 26, 1998). Based upon current EPA guidance, soil and dust removed from site residential properties under OU3 is not considered to contain RCRA listed waste K061, and is therefore not subject to RCRA requirements, including LDRs. Refer to Appendix E for the appropriate guidance document and memos regarding this determination.

The disposal of excavated soil and dust from the site remediation activities will be determined by whether or not it passes the Toxicity Characteristic Leaching Procedure (TCLP) for lead. If excavated materials passes the TCLP, then they will be disposed of in a non-hazardous landfill.

If excavated materials do not pass the TCLP, then they will be disposed of at a Subtitle C hazardous landfill. The nearest Subtitle C hazardous waste landfill is in Model City, N.Y. The disposal site is licenced and constructed to meet the closure requirements of RCRA that were determined to be relevant and appropriate. Those RCRA closure requirements (40 CFR 264.310) consist of the following: 1) an impermeable cover to minimize migration of precipitation through the repository; 2) long-term management involving site and cover maintenance and groundwater monitoring; and 3) institutional controls such as land-use and site access restrictions.

6.2.1.4 Tilling

Previous site data has indicated that the highest levels of contaminants are concentrated in the top few inches of surface soils. Tilling mixes contaminated surface soils with clean subsoils, reducing contaminant concentrations at the surface. Addition of clean material in the form of soil amendments which are tilled into the soil can also reduce contaminant concentrations.

6.2.1.5 Revegetation

Revegetation would be accomplished following tilling and/or top soil cover activities. After spreading and grading, clean fill would be revegetated. The lawn areas of remediated yards would be revegetated with sod or hydroseeded with native grasses. Native grasses require less maintenance and are more tolerant of the local climatic conditions. Cost estimates are developed on the assumption that one-half of the area will be resodded and one-half the area will be reseeded. To the maximum practical extent, all yard landscaping would be returned to its original condition.

Supplemental watering would be required to effectively re-establish vegetation. Specific water requirements for establishing vegetation would depend on temperature, humidity, precipitation, duration of watering, frequency of watering, number of spigots available, area to be remediated, number of residential yards to be remediated at any given time, and types of sprinklers used. When possible, existing residential spigots would be used to supply water to establish new vegetation. Sprinklers would be moved periodically to evenly water the planted areas. Cost estimates in this FS include two weeks of lawn watering provided for the residential areas.

6.2.1.6 Public Education

The public education program would consist of pamphlets, brochures, general media exposure, and information about program requirements. The primary purpose would be to keep the public informed about soil or dust contamination and to communicate good maintenance practices, for example, the need to maintain the vegetative cover to reduce potential exposures.

6.2.2 Extent of Remediation

For all of the alternatives, the areal extent of remediation would be the same. For each residential yard, the exact nature of the remediation would have to be considered on a case-by-case basis. In general, the following areas would be remediated in each residential yard as necessary to achieve Remedial Action Objectives.

- Sod/lawn areas
- Alleys (if unpaved) to the extension of the lot lines
- Planters, beds, and other landscaped areas

- Garden areas
- Unpaved driveways
- Garages with dirt floors
- Storage areas

In short, remediation would occur in any area within and adjacent to the residential yard where residents could potentially come in contact with soils above the cleanup levels. Areas that currently provide a barrier from the underlying soils (such as paved sidewalks and driveways) would not require remediation.

6.2.3 Residential Soil Alternatives

6.2.3.1 Soil Alternative 1: No Action

The No Action Alternative provides a baseline for comparing against other alternatives. The Site would be left in its current condition identified in the FRAR.

6.2.3.2 Soil Alternative 2: Long Term Monitoring/Institutional Controls

The Long Term Monitoring /Institutional Controls alternative provides for monitoring of the Site in its current condition. Because no remedial activities would be implemented with the Long Term Monitoring Alternative, long-term human health and environmental risks from residential soils at the Site would be essentially the same as those identified in the FRAR:

- Significant health risks to residents associated with exposure to ingestion of contaminated soil.
- Ingestion of contaminated soil resulting in unacceptable carcinogenic risk to residents.

Institutional controls would be used and environmental monitoring would be conducted under the Long Term Monitoring/Institutional Controls Alternative. The use of institutional controls would consist of deed notices, public education, and post-remedial administration. Deed notices would be used to inform potential buyers of existing property characteristics. Post-remedial administration would include coordinating deed restrictions, addressing public concerns, record keeping, and coordinating all other ongoing maintenance/monitoring issues.

Continued monitoring is suggested by the EPA RI/FS Guidance Document (USEPA, 1988) if contaminated materials are left in place. Monitoring is required under CERCLA Section 121(c) if contaminated materials are left in place. Therefore, environmental monitoring of residential soil and indoor dust is anticipated to be continued at the site for an indefinite period for Alternative 1. The purpose of the monitoring would be to detect changes in environmental conditions over time and assess risks to residents. When reasonable, monitoring would be performed at prior sampling locations to provide a basis for historical comparisons. Appendix C provides the sampling protocols for residential soil sampling for lead.

6.2.3.3 Soil Alternative 4: Removal/Revegetation

This alternative includes a combination of the following technologies:

- Removal/replacement of soils
- Revegetation
- Dust suppression during construction
- Disposal of excavated materials

This alternative involves removal of all residential soil above the risk-based cleanup standards. An average depth of four inches over 80 percent of the area of remediation, and six inches over 20 percent of the area, is assumed to generate cost estimates and evaluate this alternative. For residential yards, all soils above the cleanup level would be excavated and replaced with clean soil. The final depth of excavation would be determined on a site-by-site basis from confirmation sampling in the base of excavated areas. With this alternative, all residential soil above the action level would be excavated. Selection of sampling strategy and depth of soil removal would be a function of the remedial design/remedial action process. Special care would have to be taken during excavation near foundations, basements, and utilities to avoid damage to existing structures and facilities.

Soil, sod, and any vegetation or other materials that are removed would be disposed based on TCLP test for lead. If the material passes TCLP, it would be disposed at a non-hazardous landfill. Otherwise it could be treated until it passes TCLP or disposed of in a Subtitle C hazardous waste landfill. For cost estimating purposes, 95% of the material was assumed to pass TCLP. Appropriate construction equipment would be used for each area depending on site requirements. The soil would be transported by an approved waste hauler, and dust would be controlled using methods described previously.

The excavated area would be filled with clean soil and revegetated. The clean soil used to replace the excavated soil would meet landscaping specifications. The revegetation of the clean fill would be in the form of mixing or spreading grass seed with the fill, hydroseeding with native grasses or in certain situations, placing sod. To the maximum practical extent, yard landscaping would be returned to its original condition.

After remediation, confirmation soil samples would be taken to determine if remedial objectives were met. This sampling would provide the data necessary to show whether there is any further health threat.

6.2.3.4 Soil Alternative 5: Removal/Insitu Treatment/Revegetation

This alternative would use a combination of the following technologies:

- Soil/sod/vegetative cover removal
- Dust suppression
- Disposal of excavated materials
- Insitu Treatment

- Soil cover/Revegetation
- Public education

Alternative 5 involves first the removal and disposal of the surface soil in "hot spot"and bare areas, then the insitu treatment of remaining soils as necessary to achieve 650 mg/kg in clearance composite sampling then the possible addition of clean replacement fill, and finally revegetation of the surface.

Initially, approximately two inches of sod/soil vegetative cover in selected hot spot or bare areas, as determined by predesign sampling, would be excavated and disposed of. Dust suppression measures as previously described would be used during remedial activities. The insitu treatment of remaining soil as necessary would be accomplished by mixing either pre-amended soil or agricultural-type amendments (alternative 5A) or chemical substances (alternative 5B) into the soil. It is anticipated that the mixing would go to a depth of approximately four inches. Since contaminants are concentrated at the surface, this mixing is anticipated to reduce the concentration of contaminants at the surface. Additionally, alternative 5B would add amended soil which would further reduce the bulk contaminant concentration.

If necessary, additional clean fill would be placed to return the land to original grade. Surface revegetation would be in the form of hydroseeding with native grasses, mixing grass seed into the soil amendments, or sod could be used. Two weeks of watering would be provided to establish the vegetative cover. A public education and maintenance program would be developed to assist the homeowners in maintenance of the newly-grown vegetative cover. To the maximum practical extent, yard landscaping would be returned to its original condition.

For alternative 5B treatability studies would be conducted to determine the appropriate chemical mix/quantity for insitu treatment, and to ensure that the treatment will adequately reduce contaminant mobility. For cost estimation purposes, it has been assumed that insitu treatment would be of a volume of material ranging to an average depth of four inches. Treatability studies would determine the appropriate chemical mix/quantity for treatment to ensure that contaminant mobility would be adequately reduced. The chemical treatment process would immobilize the metals so that the soil passes toxicity characteristic leaching procedure (TCLP) criteria or the Universal Treatment Standards (UTS) for non-hazardous waste.

Upon completion of remediation activities under either alternative 5A or 5B, confirmation samples would be taken and vegetative cover observation would be performed to assess whether remedial objectives were met. This sampling would provide the data necessary to show whether there is any further health threat.

6.2.3.5 Soil Alternative 6: Soil Amendment and Revegetation

This alternative would use a combination of the following technologies:

- Dust suppression
- Treatment via soil amendments and mixing
- Establishment of vegetative cover

- Environmental monitoring
- Public education

This alternative is similar to the "Neighbor Helping Neighbor" program already in existence. It is different from the NHN Program in that it would provide for pre- and post-remediation sampling and vegetative cover observation, and in that a contractor would perform the remedial activities. Sampling and the vegetative cover observation would show whether the remedial goals are achieved. Having a contractor perform the work would decrease potential exposure for the residents during soil mixing and would reduce potential variability in the remediation result.

Soil amendments such as mushroom compost, limestone, fertilizer, and grass seed would be spread across a yard and thoroughly tilled into the soil to a depth of approximately four to six inches. This would reduce the concentration of contaminants and establish a healthy vegetative barrier to soil below. Revegetation might also be accomplished by hydroseeding, or sodding. Two weeks of watering would be provided to establish the vegetative cover. A public education and maintenance program would be developed to assist the homeowners in maintenance of the newly-grown vegetative cover. The main difference between this alternative and alternative 5 is that no soil would be removed. An important concern with this alternative is dust suppression during remediation.

The precise mix of amendments and depth of mixing would be based on the soil characteristics determined from predesign sampling. The amendment formula may vary from residence to residence. The depth of mixing would be determined based on chemical and physical site characteristics and soil conditions. After remediation, confirmation soil samples would be taken and observation on the succes of the vegetative cover would be preformed to determine if remedial objectives are me.

6.2.4 Indoor Dust Alternatives

6.2.4.1 Dust Alternative 1: No Action

The No Action Alternative provides a baseline for comparing against other alternatives. The indoor dust would be left in its current condition. Because no remedial activities would be implemented with the No Action Alternative, long-term human health and environmental risks from indoor dust would be essentially the same as those identified in the FRAR:

- Significant health risks to residents associated with exposure to ingestion of contaminated house dust.
- Ingestion and inhalation of arsenic and cadmium contaminated dust resulting in unacceptable carcinogenic risk to residents.

6.2.4.2 Dust Alternative 2: Long Term Monitoring

Environmental monitoring would be conducted under this Alternative. The purpose of the monitoring would be to detect changes in environmental conditions over time. Environmental monitoring would occur for lead in the indoor dust media. Where reasonable, sampling locations would be consistent with previous sample collections to provide a basis for historic comparisons. Appendix C provides the sampling protocols for residential dust sampling for lead.

6.2.4.3 Dust Alternative 3 and 3A: Specialized Cleaning

This alternative includes a combination of actions:

- Source control
- Specialized cleaning
- Clearance testing
- Public education
- Carpet Removal/Replacement

The residential yard soil source would initially be remediated before indoor dust remediation begins at a specific residence. Source control would be accomplished via one of the active soil alternatives presented in this FS.

For interior hard surfaces, the specialized cleaning is comprised of an initial HEPA vacuuming, then a wet wipe using a substance such as 5% Tri Sodium Phosphate to help remove any lead dust present, then a final HEPA vacuum. For soft surfaces, only HEPA vacuuming is performed. Upholstered and rugged items are vacuumed at a rate of one square yard per minute in two steps, in opposing directions. The specialized cleaning does not include cleaning of decorative or personal effects, closet and cabinet contents, or HVAC interior duct work.

Clearance testing would be performed after the specialized cleaning to confirm the success of the remedial action. The clearance testing would be performed by a party independent of the person or organization that performed the cleaning. Testing would be according to the same procedures used in the Borough and the "Lead-Safe" Home Grant Program. Sampling should occur at least one hour after completion of the specialized cleaning, including cleanup. Clearance testing protocols are included in Appendix C. If clearance testing results are unsuccessful, carpet removal and replacement actions would be implemented. Under Alternative 3A, carpet removal and replacement would be implemented when interior dust specialized cleaning efforts do not meet clearance testing and on a whole will not be time/cost effective. Carpets would be removed and a voucher would be issued to the homeowner for the cost of replacing carpeting.

The cost estimates were developed using prices for wipe sampling and assuming an average of 11 samples to be taken per residence. It was also assumed that remediation of a residence would be accomplished in an average of two days, such that only short-term temporary relocation of residents would be necessary.

Public education would be implemented to promote practices that would reduce the possibility of any future exposure to contaminants. This would include education on general hazard awareness and on hazard avoidance techniques.

6.3 Detailed Alternative Evaluation

The feasibility process concludes with an evaluation of the four alternatives for residential soil and three alternatives for indoor dust to determine whether statutory and regulatory criteria developed by the USEPA are satisfied. The analysis proceeds through the evaluation of alternatives, first individually then comparatively, against the seven criteria prescribed by the USEPA.

The first two evaluation criteria are statutory requirements that must be addressed in the Record of Decision (ROD) and therefore are applicable to each alternative.[2] The remaining five criteria are "balancing" criteria and form the technical, cost, and institutional considerations upon which the evaluation is based, and aid in the distinction between alternatives. The evaluation criteria are described in detail below.

1. Overall Protection of Human Health and the Environment - At a minimum, Superfund requires selection of a remedial action that is protective of human health and the environment. Each alternative must provide an adequate measure of protection, as well as address concerns regarding long- and short-term effectiveness and compliance with ARARs.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) - Compliance with federal and state ARARs or the appropriate invocation of a waiver for ARARs is also a minimum requirement under Superfund. Section 2 lists the Pennsylvania Department of Environmental

[2]CERCLA §121(d)(1) and §121(d)(2).

Protection and the Federal ARARs for the OU3 area residential soils and indoor dust. This evaluation discusses the most significant ARARs pertinent to each alternative, and identifies whether the alternative is expected to comply with these ARARs.

3. Long-Term Effectiveness - Superfund requires selection of a remedial action that implements permanent solutions to the maximum extent practicable. It also requires consideration of the long-term effectiveness of a proposed solution prior to remedy selection. This assessment will evaluate each alternative's potential for long-term effectiveness in protecting public health and the environment. More specifically, the evaluation involves an assessment of the adequacy and reliability of the controls selected to manage treated and untreated wastes, and to determine the magnitude of residual risks remaining to human health and the environment after remedy implementation.

4. Reduction of Toxicity, Mobility, Volume, Persistence, and Propensity to Bioaccumulate - Superfund prefers selection of remedial actions that, through treatment, permanently and significantly reduce the volume, toxicity or mobility of hazardous substances, pollutants, and contaminants. It also mandates assessment of the persistence of the hazardous substances and their potential to bioaccumulate.[3] Metal contaminants such as arsenic and lead cannot be destroyed or changed to relatively inert substances. Only the form or state of these elements can be changed and, therefore, the mass of contaminants will remain unchanged regardless of treatment processing steps (with the exception of volatization). Therefore, the alternatives discussed in this feasibility study do not reduce the toxicity of the metal constituents in residential soil.

5. Short-term Effectiveness - This criterion examines the short-term potential for adverse health effects resulting from human exposure during implementation of each remedial action alternative.

6. Implementability, Reliability, and Constructibility - Federal regulations also recommend an assessment of an alternative's implementability, reliability, and constructibility from a technical or engineering perspective (e.g., availability of technology and local expertise; technical feasibility). The USEPA further requires consideration of implementability from an administrative standpoint (e.g., coordination and support from other agencies, ability to secure the required permits, construction right-of-ways, etc.).

7. Cost - In addition to other requirements, Superfund requires selection of a cost-effective remedy, including consideration of long-term operation and maintenance costs. USEPA guidelines recommend that costs be developed with an accuracy of plus 50 percent to minus 30 percent. Cost estimates developed in the analysis of alternatives include both capital and annual costs. Capital costs include both direct and indirect costs, including construction, non-construction, and overhead. Annual costs are those necessary to ensure the continued effectiveness of the selected remedy following construction, including: operation, maintenance, insurance, taxes, administrative, disposal, environmental monitoring, disposal area monitoring, and periodic site review costs. All future costs are reduced to present worth values to allow comparison of individual remedial alternatives. Present worth costs evaluate expenses over time by discounting future costs to a common base year.

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[3]CERCLA §121(B)(1).

The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. Assumptions of soil volumes were made to develop the cost estimates. The residential areas to be remediated and the depth of contamination will be determined after predesign sampling. As a result, the final project costs will vary from the estimates presented here and throughout this feasibility study. Because of these factors, funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

In addition to the evaluation criteria established by the USEPA, Superfund also requires the use of alternative treatment and resource recovery technologies to the extent practicable.[4] Remedial actions incorporating the use of alternative treatment technologies or resources recovery technologies are identified as such during the individual analysis.

The evaluation of remedial alternatives in this section is based on the remedial actions delineated in Section 5. The comprehensive level of detail at this stage is conceptual, not full design. Design details and cost estimates will be refined during the remedial design period that follows the ROD.

6.3.1 Individual Analysis of Soil Alternatives

This section provides an analysis of each of the alternatives relative to the seven evaluation criteria described above. Each analysis begins with a short description of the alternative being considered, followed by a criterion-by-criterion evaluation of the alternative. The first two criteria, overall protectiveness and compliance with ARARs, are addressed in terms of the comprehensive impact of the alternative. The remaining five criteria address independent aspects of the alternative and are described separately.

6.3.1.1 Soil Alternative 1: No Action Alternative

Alternative 1 is the No Action Alternative required by the National Contingency Plan (NCP, 40 CFR Part 300, 1990). The No Action Alternative is commonly used as a baseline alternative; it does not include any remediation activities or Community Awareness Programs.

6.3.1.2 Soil Alternative 2: Long Term Monitoring/Institutional Controls

The evaluation of this alternative considered only cost and the two primary evaluation criteria, overall protection and compliance with ARARs. Except for cost, the remaining criteria are applicable solely to the effectiveness and implementability of remediation technologies and therefore were not considered for this alternative.

Overall Protection of Human Health and the Environment - As previously stated, no remediation actions would be undertaken as part of Alternative 2. Subsequently, there would be no reduction in the risk or increase in protectiveness of human health and the environment. As a result of processes

[4]CERCLA §121(B)(1).

such as entrainment of dust by winds, erosion, construction, and utility maintenance activities, the risks to human health and the environment would likely increase over time if left unmitigated. Although site soils have been contaminated through a variety of mechanisms, studies have established that the current primary mechanism responsible for observed surficial soil contamination appears to be airborne deposition of contaminated dusts from fugitive dusts sources in and adjacent to the residential areas. Under this alternative, environmental monitoring of indoor dust and residential soils would be conducted to evaluate changes of contaminant concentrations in media of concern.

Compliance With ARARs - Without sampling and/or remediation, the residential soils operable unit would not comply with any of the state and federal ARARs. Concentrations of contaminants in soil and indoor dust would remain above the risk based remedial objectives. Local residents would continue to be exposed to unacceptable concentrations in soils and dust that exceed the risk-based action levels.

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs for all alternatives are shown in Table 6-2. The present worth cost estimated for Alternative 2 is $733,000. Present worth was calculated using a 4 percent discount rate and a 30 year project life.

6.3.1.3 Soil Alternative 4: Removal/Revegetation

Alternative 4 is an alternative that comprehensively addresses removal of soils above the risk-based cleanup level, in order to eliminate risks to human health and the environment. The components of this alternative include:

- Removal of soils and vegetation until a composite sample of the entire area is below the established action levels for lead. An average depth of four inches over 80% of the area and six inches over 20% of the area was used for cost estimates.
- Replacement of excavated soils with clean soil, as necessary.
- Revegetation.
- Disposal of excavated soil and vegetation. Materials would be tested for the TCLP criteria for lead to determine whether they could be disposed of at a non-hazardous landfill.
- Dust control measures during construction.
- Confirmation sampling.

Locations of buried utility lines would be identified ahead of time by contacting Pennsylvania One Call System, Inc. (800-242-1776). Because of the anticipated shallow depths of excavation, it is unlikely that buried utility lines (i.e., sewer, water, telephone) would be encountered. However, if a utility line is encountered, each line would need to be supported as soil is removed and replaced to avoid rupture from displacement or lack of support.

With appropriate implementation, this alternative can reliably achieve the Remedial Action Objectives. Increased risk to the surrounding environment and community during construction would be minimized by appropriate construction safety standards.

Overall Protection of Human Health and the Environment - Alternative 4 would remove all soil above the cleanup level. The overall protection of human health and the environment afforded by this alternative will be achieved if post-remediation sampling shows that remedial goals have been met. The potential for residential soil to be a source of house dust contamination in the future would be eliminated.

Compliance with ARARs - Excavation and disposal of soils/vegetation, placement of clean soil, and revegetation of the residential areas will meet State and Federal ARARs and TBCs pertinent to this operable unit. Designated construction precautions will reduce potential fugitive dust generation during remedial work.

Long-Term Effectiveness - Alternative 4 addresses identified risks at the Site by using measures intended to remove them. Soils above the risk-based cleanup standards would be excavated and disposed of at a landfill. Clean soil would be placed to return the property to its original grade. A vegetative cover could be grown to help protect and preserve the integrity of the fill. Long-term effectiveness would be dependent upon the extent that the areas of soil above the cleanup level are fully identified and excavated.

Reduction of Toxicity, Mobility, Volume, Persistence, and Propensity to Bioaccumulate - The primary component of Alternative 4 is the removal of significant quantities of soils which are above the cleanup level. This removal would substantially reduce the health risks associated with residential soils. The volume of soil would increase through bulking during excavation. The mobility of contaminants would be reduced since the soil would be placed in a landfill. The toxicity, persistence, and propensity to bioaccumulate of the contaminants would remain unchanged.

Short-Term Effectiveness -The excavation of soil could generate dust. Short-term health risks from dust would be minimized through construction dust controls and monitoring. Remediation contractors would be exposed to risks associated with inhalation and ingestion of contaminated particulates during remediation. Therefore, remediation workers would be required to use appropriate protective equipment to control these exposures. Other hazards to remediation workers relate to standard construction risks. These would be addressed using standard safety practices.

Implementability, Reliability, and Constructibility - Major construction difficulties are not anticipated as part of this alternative. The expertise, labor force, supplies, and equipment needed to effectively implement this alternative are readily available. The proposed remedial effort is not a new technology, and implementation and constructability of this alternative would use standard construction practices. Implementation would be accomplished on a residence-by-residence basis. Small, maneuverable power equipment and some hand tools would be used. Environmental monitoring of construction areas would be initiated and maintained throughout the construction process. Future modifications of properties for new construction or buried utility maintenance can be accomplished reliably without creating new health risk factors if this alternative is implemented

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs are shown in Table 6-2. The present worth cost estimated for Alternative 4 is $26,349,000.

6.3.1.4 Soil Alternative 5: Removal/Insitu Treatment/Revegetation

The components of Alternative 5 include:

- Removal of "hot spots" and bare area soils to a depth of two inches.
- Disposal of excavated surface soil/sod/vegetation.
- Insitu treatment of soils above the cleanup level to a depth of six inches below original grade as necessary to achieve 650 mg/kg in clearance composite samples by tilling or otherwise mixing amendments into the soil. Alternative 6A would us agricultural type soil amendments, and alternative 6B would use pozzolonic or other types of chemical additives. Additional topsoil would be placed as needed in areas where soil was removed.
- Dust control measures during remediation.
- Revegetation with resodding or reseeding, including two weeks of lawn watering to establish vegetation.
- A public education and maintenance program.
- Confirmation sampling and vegetative cover observation.

Alternative 5 would remove soils that are significantly above cleanup standards as determined by predesign sampling and would treat soil that is left in place as necessary to achieve 650 mg/kg in clearance composite sampling. It is similar to the work which was performed during the Interim Action. Addition of uncontaminated amendments or chemical treatments to the soil profile and mixing with less contaminated soil below will reduce the percentage of contaminants at the surface and aid the establishment of a vegetative barrier to the underlying soils. The alternative would result in reduced risks to human health and the environment through reduced concentration and mobility of metal contaminants in soils and dust. Post-remediation sampling and vegetative cover observation would be performed to confirm the achievement of remedial objectives.

Overall Protection of Human Health and the Environment - The overall protection of human health and the environment afforded by this alternative will be achieved if post-remediation sampling shows that remedial goals have been met. Removal of 'hot spot' areas would significantly decrease the chance of COPC ingestion. The insitu treatment of remaining soils as necessary would reduce the contaminant concentrations and achieve the RAO. The treated soil will be immediately under the vegetative cover.

Compliance with ARARs - Excavation and disposal of soils/vegetation, insitu treatment, placement of clean soil, and revegetation of the residential areas will meet State and Federal ARARs and TBCs pertinent to this operable unit. Designated construction precautions will reduce potential fugitive dust generation during remedial work.

Long-Term Effectiveness - Alternative 5 uses technologies intended to limit or remove the health and environmental risks presented by the site. Long-term effectiveness is enhanced by achievement of reduced levels of contaminants and maintenance of the vegetative cover.

Reduction of Toxicity, Mobility, Volume, Persistence, and Propensity to Bioaccumulate - This alternative would remove and dispose offsite the top two inches of soil and contaminants in areas where soils are significantly above the cleanup level. The establishment of a vegetative barrier and the insitu mixing of surface soil with soil amendments and underlying soils is intended to reduce the accessibility and mobility of the metals. The insitu treatment of remaining soils with this alternative will reduce the toxicity of the soils overall.

The insitu chemical treatment (Alternative 5B) of the remaining soils which are above the cleanup level would decrease the leachability of the metal contaminants. Successful implementation of this alternative would reduce the potential for exposure to humans, animals, and plants with shallow root systems, thereby further reducing the opportunity for exposure and bioaccumulation of lead in humans or other biological receptors.

Short-Term Effectiveness - The excavation of shallow soils and the insitu mixing of soils could generate dust. However, this risk can be minimized by use of appropriate construction dust controls. Remediation contractors would be exposed to risks associated with inhalation and ingestion of contaminated particulates during remediation. In light of these risks, remediation workers would be required to use appropriate protective equipment to control these exposures. Other hazards to remediation workers relate to standard construction risks. These would be addressed using standard safety practices.

Implementability, Reliability, and Constructibility - Major construction difficulties are not anticipated as part of this alternative. It would involve stripping away and disposing of some surface soil, mixing amendments or chemicals into the underlying soil, placing and compacting clean soil as needed, and revegetating the surface. The expertise, labor force, equipment, and materials needed to effectively implement this alternative are readily available. The actual alternative implementation would be accomplished on a residence-by-residence basis. Small, maneuverable power equipment and some hand tools would be used. Environmental monitoring of construction areas would be initiated and maintained throughout the construction process.

The implementation of alternative 5B would be slightly more complex. A pilot test would be necessary to establish the proper chemical/soil ratios to mix. Establishment of the vegetative cover would increase the reliability of this alternative.

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs are shown in Table 6-2. The present worth cost estimates are $11,121,000 for alternative 5A, and $11,786,000 for alternative 5B.

6.3.1.5 Soil Alternative 6: Soil Amendment and Revegetation

The components of Alternative 6 include:

- Insitu mixing of surface soil, underlying clean soil, and soil amendments to a depth of four to six inches.
- Dust control measures during remediation.
- Revegetation with grass seed in the soil amendments, hydroseeding, or sod in certain situations. Revegetation includes two weeks of lawn watering to establish vegetation.
- A public education and maintenance program.
- Confirmation sampling and vegetative cover observation.

Alternative 6 involves the addition to and mixing of common soil amendments with yard soil. This alternative is similar to the existing "Neighbor Helping Neighbor" (NHN) Program, which provides mushroom compost, limestone, fertilizer, and grass seed to residents for their yards. It is different from the NHN Program in that it would provide for pre- and post-remediation sampling and observation, and in that a contractor would perform the remedial activities. The sampling would show whether the remedial goals are achieved. Having a contractor perform the work would decrease potential exposure for the residents during soil mixing and would reduce potential variability in the remediation result.

Addition of uncontaminated amendments to the soil profile and mixing with less contaminated soil below will reduce the percentage of contaminants at the surface, and aid the establishment of a vegetative barrier to the underlying soils. The alternative would result in reduced risks to human health and the environment through reduced concentration and mobility of metal contaminants in soils and dust. This is similar to alternative 5A, but without any soil removal.

Overall Protection of Human Health and the Environment - The overall protection of human health and the environment afforded by this alternative will be achieved if post-remediation sampling shows that remedial goals have been met. The treated soil will be immediately under the vegetative cover. If the vegetative cover barrier is maintained indefinitely, there is little potential for contaminants to be mobilized through mechanisms such as wind and water erosion or soil tracking into households (and thereby into the indoor dust exposure pathway).

Compliance with ARARs - Soil amendment, mixing, and revegetation of the residential areas will provide compliance with the State and Federal ARARs and TBCs pertinent to this operable unit. Designated construction precautions will reduce potential fugitive dust generation during remedial work.

Long-Term Effectiveness - Alternative 6 uses technologies intended to limit or remove the health and environmental risks presented by the site. Long-term effectiveness is enhanced by achievement of reduced levels of contaminants and maintenance of the vegetative cover.

Reduction of Toxicity, Mobility, Volume, Persistence, and Propensity to Bioaccumulate - The establishment of a vegetative barrier and the insitu mixing of surface soil with soil amendments and underlying soils is intended to reduce the accessibility and mobility of the metals. The insitu treatment of this alternative will reduce the toxicity of the soils overall but will not change the persistence of onsite residual contaminants. The insitu treatment would increase the volume of soil due to the addition of the soil amendments and mixing with underlying soil.

Short-Term Effectiveness - The insitu mixing of soils could generate dust. However, this risk can be minimized by use of appropriate construction dust controls. Remediation contractors would be exposed to risks associated with inhalation and ingestion of contaminated particulates during remediation. In light of these risks, remediation workers would be required to use appropriate protective equipment to control these exposures. Other hazards to remediation workers relate to standard construction risks. These would be addressed using standard safety practices.

Air monitoring data would be collected during residential property remediation. Dust would be suppressed during remediation by keeping the soils moist so that no significant short-term threat or contaminant mobilization occurs during remediation activities.

Implementability, Reliability, and Constructability - Major construction difficulties are not anticipated as part of this alternative. The expertise, labor force, supplies, and equipment needed to effectively implement this alternative are readily available. Environmental monitoring of construction areas would be initiated and maintained throughout the remediation process. Under this alternative, no material would be disposed of offsite. Establishment of the vegetative cover would increase the reliability of this alternative.

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs are shown in Table 6-2. The present worth cost estimated for Alternative 6 is $11,255,000.

6.3.2 Individual Analysis of Dust Alternatives

This section provides an analysis of each of the dust alternatives relative to the seven evaluation criteria described above. Each analysis begins with a short description of the alternative being considered, followed by a criterion-by-criterion evaluation of the alternative. The first two criteria, overall protectiveness and compliance with ARARs, are addressed in terms of the comprehensive impact of the alternative. The remaining five criteria address independent aspects of the alternative and are described separately.

6.3.2.1 Dust Alternative 1: No Action Alternative

The No Action Alternative is included in the evaluations for use as a baseline against which the action alternatives can be compared. As its name implies, no remedial actions would be implemented.

6.3.2.2 Dust Alternative 2: Long Term Monitoring/Public Education

Environmental monitoring would be conducted under this Alternative. No remdedial action would be implemented. The purpose of the monitoring would be to detect changes in environmental conditions over time. Environmental monitoring would occur for lead in the indoor dust media. Where reasonable, sampling locations would be consistent with previous sample collections to provide a basis for historic comparisons. Appendix C provides the sampling protocols for residential dust sampling for lead. Additionally, a public education program would be implemented to minimize exposure to lead dust.

The evaluation of this alternative considers only cost and the two primary evaluation criteria; Overall Protection of Human Health and the Environment and Compliance with ARARs. Except for cost, the remaining criteria are applicable solely to the effectiveness and implementability of remediation technologies and therefore were not considered.

Overall Protection of Human Health and the Environment - As previously stated, no remediation actions would be undertaken as part of Alternative 2. Except for the actions taken as a result of Public Education Program, there would be no reduction in the risk or increase in protectiveness of human health and the environment. Since this alternative will not include soil remediation, processes such as entrainment of dust by winds, erosion, construction, and utility maintenance activities would likely increase the risks to human health over time.

Compliance With ARARs - No major ARARs apply to this remedy. Local residents would continue to be exposed to unacceptable concentrations in dust that exceed the risk-based action levels.

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs for all alternatives are shown in Table 6-2. Present worth was calculated using a 4 percent discount rate and a 30 year project life.

6.3.2.3 Dust Alternative 3 and 3A: Specialized Cleaning

Alternative 3 includes a combination of actions:

- Source control
- Specialized cleaning
- Clearance testing
- Public education

The residential yard soil source would initially be remediated before indoor dust remediation begins at a specific residence. Source control would be accomplished via one of the active soil alternatives presented in this FS.

The interior dust specialized cleaning protocol for Dust Alternative 3 would include three steps: HEPA vacuuming, wet washing, and HEPA vacuuming. If clearance testing results are unsuccessful, Alternative 3A will be implemented. Under Alternative 3A, carpet removal and replacement would be performed when interior dust specialized cleaning efforts do not meet clearance testing on a whole will not be time/cost effective. Carpets would be removed and a voucher would be issued to the homeowner for the cost of replacing the carpeting.

Overall Protection of Human Health and the Environment - Alternative 3 and 3A would remove the dust in the residence and would afford the greatest protection to human health and the environment.

Coupled with the successful remediation of the residential soil, house dust contamination would be eliminated via the tracking pathway and education on risk posed by lead based paint.

Compliance with ARARs -The specialized cleaning and, if necessary, the removal/replacement of carpet will meet State and Federal ARARs and TBCs pertinent to this operable unit. Precautions during cleaning and carpet removal/replacement will be taken to reduce the potential of fugitive dust generation.

Long-Term Effectiveness-Alternatives 3 and 3A utilize would measures intended to remove the risks of lead contaminated dust exposure. The specialized cleaning would remove the dust and clearance sampling will be performed to assure successful removal. The long-term effectiveness would be dependent upon the success of the residential soil remediation to prevent future house dust contamination from that pathway and the success of the education on risk posed by lead based paint.

Reduction of Toxicity, Mobility, Volume, Persistence, and Propensity to Bioaccumulate - The primary component of Alternatives 3 and 3A is the removal/cleaning of the contaminated dust. This removal/cleaning would substantially reduce the health risks associated with residential dust. The volume of dust would remain essentially the same although is will be removed. The mobility of the dust would be reduced since the dust will be placed in a landfill for disposal. The toxicity, persistence, and propensity to bioaccumulate of the contaminants would remain unchanged.

Short-Term Effectiveness - The cleaning and removal of carpet may generate dust requiring vacuuming after removal. Short-term health risks from this dust would be minimized through controls and monitoring. Remediation contractors would be exposed to risks associated with inhalation and ingestion of contaminated partiulates during cleaning. Therefore, workers would be required to use appropriate personal protective equipment to minimize these exposures. Other hazards generally related to standard construction risks would be addressed using standard safety practices.

Implementability, Reliability, and Constructibility - Major construction difficulties are not anticipated as part of this alternative. The expertise, labor force, supplies, and equipment needed to effectively implement this alternative are readily available. The proposed remedial effort is not a new technology, and implementation and constructability of this alternative would use standard construction practices. Implementation would be accomplished on a residence-by-residence basis. Environmental monitoring of construction areas would be initiated and maintained throughout the construction process.

Cost - Detailed cost estimates, including the assumptions used, are given in Appendices A and B. A summary of the capital and operations and maintenance costs are shown in Table 6-2. These costs are incorporated in the costs for the soil remediation.

Table 6-2 Summary Costs for Soil and Household Dust Remedial Alternatives

Item	Soil/Dust Alternative 2 Long-Term Monitoring /Institutional Control (soil &			Soil Alternative 4 Removal/Revegetation		
	Capital Cost	Annual O&M Cost	30 Year Sampling*	Capital Cost	Annual O&M Cost	5 Year Sampling
Home yard remediation	$0			$17,223,328		
Operations & Maintenance		$24,000	$412,343		$10,000	$0
Interior Dust remediation**	$0			$1,031,923		
Health & Safety (10%)	$0			$1,825,525		
Engineering Services (10%)	$0			$1,825,525		
Subtotal	$0	$24,000	$412,343	$21,906,301	$10,000	$0
Plus 15% Contingency	$0	$3,600	$61,851	$3,285,945	$1,500	$0
Total Costs	$0	$27,600	$474,194	$25,192,000	$11,500	$0
Plus O&M Present Value	$477,000			$199,000		
lus Sampling (Present Value)*	$256,034			$0		
Total Worth	$733,000			$25,391,000		

Item	Soil Alternative 5A Removal/Agricultural treatment/revegetation			Soil Alternative 5B Removal/Chemical treatment/revegetation			Soil Alternative 6 Soil amendment and revegetation		
	Capital Cost	Annual O&M Cost	30 Year Sampling	Capital Cost	Annual O&M Cost	5 Year Sampling	Capital Cost	Annual O&M Cost	5 Year Sampling
Pilot test	***			***					
Home yard remediation	$6,585,026			$4,901,495			$6,678,190		
Operations & Maintenance		$10,000	$0		$10,000	$0		$10,000	$0
Interior Dust remediation**	$1,558,905			$1,031,923			$1,031,923		
Health & Safety (10%)	$814,393			$593,342			$771,011		
Engineering Services (10%)	$814,393			$593,342			$771,011		
Subtotal	$9,772,716	$10,000	$0	$7,120,101	$10,000	$0	$9,252,136	$10,000	$0
Plus 15% Contingency	$1,465,907	$1,500	$0	$1,068,015	$1,500	$0	$1,387,820	$1,500	$0
Total Costs	$11,239,000	$11,500	$0	$8,188,000	$11,500	$0	$10,640,000	$11,500	$0
Plus O&M Present Value	$199,000			$199,000			$199,000		
lus Sampling (Present Value)*	$0			$0			$0		
Total Worth	$11,438,000			$8,387,000			$10,839,000		

Notes
1) O&M present value is calculated by holding annual costs fixed and using a 4% inflation rate for 30 years.
2) Total costs, O&M present value, and total worth are rounded to the nearest $1,000.
t discounted to present value here.
Alternative 2 is assumed to have annual sampling rounds over 30 years; Alternatives 4, 5A/5B, and 6 are assumed to pass confirmation testing and be delisted.
** Costs for the active dust alternative are added to all of the active soil alternatives. Alternative 2 is Long-term Monitoring for both the Soil and Dust Alternatives.
*** Alternative 5B pilot test costs are included in the treatment process price quote, which is part of the home yard remediation costs. There are no pilot for other alternatives.

6.3.3 Comparative Analysis of Soil and Dust Alternatives by Criteria

A comparative analysis of alternatives using each of the evaluation criteria is presented in this section. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to the other alternatives. A separate evaluation of the alternatives is presented under the heading of each criteria. Alternatives are discussed and compared in order of decreasing performance.

6.3.3.1 Protection of Human Health and Environment

Soil Alternatives
Protection of human health and the environment is addressed to varying degrees by the four proposed alternatives. Alternative 1 is the No Action Alternative. As proposed, it would have no effect on the site; therefore, it does not address any of the identified concerns.

When implemented properly, Alternatives 4, 5 and 6 all address the concerns of reducing residential exposure to soil above the risk-based cleanup level, and of reducing residential soil as a source for contaminated house dust. Post-remediation sampling and observation will show whether the remedial goals have been met. The long-term risks associated with residual contaminant concentrations are equitably addressed by Alternatives 4, 5 and 6. However, Alternatives 4 & 5 would remove the most contaminated soils there by providing greater long term risk reduction. The short-term exposure of Alternative 4 could be less than Alternatives 5 and 6, because it is possible that Alternative 4 would generate less dust from excavation activities than Alternatives 5 and 6 would generate from the tilling and mixing activities. Alternatives 4, 5, and 6 are all anticipated to require a similar duration of time to be completed.

None of the alternatives would alter the toxicity or persistence of the soil contaminants. Alternative 5B involves insitu treatment of soils that would reduce the mobility of metals due to leaching.

Permanence of remedial actions is the greatest for Alternative 4 with its complete removal of soils above the cleanup level. Alternative 5 would also remove soils which are significantly above the cleanup level. Both Alternatives 5 and 6 rely on soil mixing/treatment, soil amendments and establishment and maintenance of a vegetative barrier to reduce potential exposure.

Dust Alternatives
Alternative 1 is the No Action Alternative. As proposed, it would have no effect on the site; therefore, it does not address any of the identified concerns.

Alternative 3 will remediate the indoor dust. Alternative 3 would not alter the toxicity or persistence of the contaminants. Permanence of the solution would result from removing the dust only after the outside residential soil source is remediated. The short-term exposure risk would be negligible if the remediation workers are properly trained and use the correct cleaning equipment and procedures. Alternatives 3 is anticipated to require less a few days per residence to be completed, unless carpet removal and replacement is warranted after specialized cleaning efforts prove ineffective in meeting Remedial Action Objectives.

6.3.3.2 Compliance with ARARs

Soil Alternatives

Alternative 1, the No Action Alternative, does not meet the ARARs. Alternatives 4, 5, and 6 would meet Federal and State of Pennsylvania ARARs and TBCs.

Dust Alternatives

The No Action Alternative does not meet the ARARs. Alternative 3 and 3A would comply with ARARs.

6.3.3.3 Long Term Effectiveness

Soil Alternatives

The residual risk increases from lowest to highest in the following order of alternatives:. 4, 5, 6, and 1 (No Action Alternative). Alternative 4 would result in the least amount of residual risk because all soil identified as above the cleanup level would be removed to ensure that future exposure to residents does not occur. Although alternatives 5 and 6 do not reduce residual risk to the same level as Alternative 4 through soil removal, they would achieve the remedial objectives in the long term if the vegetative barrier is established and maintained. However 5 does remove the most contaminated soils.

Environmental monitoring would vary according to the degree of protectiveness incorporated within the remedial alternatives. Alternative 1 would include annual environmental monitoring to check for changes in contaminant levels with time.

Dust Alternatives

Alternative 1 would not remediate dust above the cleanup level, and would therefore not be effective. Alternative 3 would effectively remediate the dust. Based on effective source control of the residential yard source, this alternative would be effective for the long term.

6.3.3.4 Reduction of Toxicity, Mobility, Volume, and Persistence

Soil Alternatives

The No Action Alternative would not have any effect on these criteria. For Alternative 4, all soil above the cleanup level would be removed and replaced with clean fill. Alternatives 5 and 6 incorporate insitu treatment as part of the remedial action, including tilling in soil amendments (5A and 6) or chemical additives (5B) and mixing with the underlying soils.

Both Alternatives 5 and 6 use a vegetative barrier to help isolate the treated soils from direct human exposure and from erosion/mobilization by wind and rain. Therefore contaminant mobility would be reduced by all of the action alternatives. Alternatives 4 and 5 would also reduce the mobility of the contaminants by disposing of excavated soil in a landfill. The chemical treatment with Alternative 5B is proven to reduce contaminant mobility due to leaching. None of the alternatives proposes to change the toxicity or persistence of the contaminants.

Soil treated insitu under alternatives 5 and 6 would have a volume or "bulking" increase from the incorporation of additives to the soil. These additives are part of the effort to reduce the hazard or toxicity of the media. Depending on the chemical process used, a volume increase of five to twenty percent is anticipated for Alternative 5B. The amount of volume increase from tilling under Alternatives 5A and 6 is unknown, but will be significant, possibly greater than twenty percent. Bulking would occur as a result of both adding mass to the soil and from reducing the soil density during mixing of the amendments into the soil. Recompaction of insitu treated soil could reduce much of the change in volume from bulking. Excavated soil volumes would also increase from bulking due to the excavation and disturbance. The bulking of excavated soil is estimated to be approximately 10 percent.

Dust Alternatives
Alternative 1 would not remediate the dust which is above the cleanup level. Alternative 3 would not reduce the toxicity, volume, or persistence of contaminants in the dust. The mobility of the contaminants would be reduced since the cleanup waste generated would be properly disposed of in a landfill.

6.3.3.5 Short Term Effectiveness

Soil Alternatives
Most of the active remedial actions are similar in the technologies proposed for implementation. Exposure to fugitive dust generated by the remedial activities is the common short term risk. Localized releases of potentially contaminated dust during remediation would be minimized by standard dust control techniques. Protection would be enhanced by dust monitoring during construction activities. For all of the action alternatives, construction contractors would need protection against dermal and respiratory exposure to the dust while working in contaminated areas. Protective clothing and respirators or dust masks would help control this risk.

If appropriate dust control measures are implemented properly, all three of the action alternatives would have similar short-term effectiveness. Timewise, all three alternatives are estimated to be roughly comparable. None of the action alternatives is expected to substantially adversely affect the communities during remediation. Each alternative could also include prioritizing residential yards of sensitive subpopulations in order to remediate the highest risks early in the remedy and enhance short-term effectiveness.

Dust Alternatives
Alternative 1 would not remediate the dust, and would therefore not be effective. Alternative 3 would achieve short term effectiveness.

6.3.3.6 Implementability, Reliability, and Constructibility

Soil Alternatives

The activities proposed as part of the action alternatives are well-developed, non-complex technologies. There are not great differences between the methods involved in completing the proposed remedial activities. The action alternatives involve removal of various depths of soil and vegetative cover and/or insitu treatment of soil, then placement and maintenance of replacement soil and revegetation. All of the activities are technically feasible, and none require complicated technical expertise. All have similar levels of effort.

All of the action alternatives will require predesign sampling to establish if remediation is necessary and to determine the extent of remediation. Additional sampling to confirm the effectiveness of the remedy will have to be performed in all of the action alternatives. Public education and maintenance of the vegetative cover would be important for Alternatives 5 and 6, but would slightly increase the difficulty of their implementation.

None of the soil action alternatives are difficult in terms of constructibility. Alternative 4 involves shallow soil removal, placement of clean fill as necessary, and revegetation. Alternative 5 involves selected areas of shallow soil removal, soil amendment if necessary, mixing and revegetation. Alternative 6 involves soil amendment, mixing, and revegetation. Since Alternative 6 would remove no surface soils, dust suppression during the insitu mixing activities would be very important. All of these procedures can be accomplished with ordinary construction/agricultural equipment.

Vegetative maintenance and care would be up to the residents of the remediated areas after the selected alternative is implemented. Maintenance requirements for the alternatives are varied. Because alternative 4 removes all soil above the risk criteria, long-term success of the revegetation is not of critical importance. Both alternatives 5 and 6 incorporate a healthy lawn as a barrier to the underlying treated soil. Vegetative maintenance/erosion prevention is important for both of these alternatives however, Alternative 6 is the most sensitive to vegetative maintenance/erosion prevention requirements because it removes no existing soil and the vegetative cover is the only physical barrier between residents and the underlying amended soil.

Post-remediation sampling and observation will show whether the remedial objectives have been accomplished for all of the action alternatives. However, because no future maintenance would be necessary for Alternatives 4, it would be the most reliable as a solution. Long-term success and maintenance of the vegetative barrier is critical to the effectiveness of Alternatives 5 and 6. Alternative 1 is a no action alternative and is not considered for this criteria. Ongoing environmental monitoring and institutional controls in Alternative 2 would be the most extensive and complicated.

Dust Alternatives

Alternative 1 is a no action alternative and is not considered for this criteria. Alternative 3 would follow well-established protocols and would be easily implementable.

6.3.3.7 Cost

Soil and Dust Alternatives
For cost comparison purposes, the soil and dust alternatives are combined. Alternative 1 is a No Action alternative for both the soil and the dust. The remaining alternatives combine the active soil alternative with Dust Alternative 3, the only active dust alternative.

Prior to any of the active remediation activities, a predesign sampling program must be conducted at each residence in the areas to be remediated to determine whether and to what extent remediation is necessary. This cost will remain the same irrespective of which alternative is chosen. The predesign sampling costs are not included in any of the alternative cost estimates. Section 7.1 discusses and lists the predesign per sample costs.

The cost comparisons between alternatives are straightforward. Comparing present worth costs, alternative 4 is the most expensive. The other action alternatives are all similar in cost. Alternative 1: No Action, has no cost associated with it. Alternative 1 is used as a baseline to compare the other alternatives. Alternative 2: the monitoring alternative, is the least expensive action alternative, but it would have ongoing monitoring costs that could extend past the period assumed by the present worth analysis (see below) and would not be protective.

The feasibility study cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The areal extent, depth and concentration of soil contamination which greatly influences the cost estimates would be determined at each residence from predesign sampling. Detailed cost evaluations and the assumptions used are presented in Appendices A and B. A summary of the costs for the alternatives are shown in Table 6-2. A cost sensitivity analysis and discussion is presented in Section 6.4 to illustrate the effects that changes in specific assumptions might have on the costs.

Capital costs are those required to initiate and construct the remedial action. Typical capital costs include construction equipment, labor and materials expenditures, engineering services, health and safety, and construction management costs. Operations and maintenance (O&M) costs are ongoing expenses necessary to ensure the continued effectiveness of a remedial action. Included in O&M costs for this alternative are such items as implementation of institutional controls, community awareness initiatives, and administrative costs. A 15 percent contingency is added to both the total capital and total operations and maintenance costs.

Present worth analysis is a method of evaluation of expenditures that occur during different time periods. By discounting all alternative costs to a common year (Year 0), the true costs for different alternatives can be compared. The present worth represents the amount of money in today's dollars needed to cover all the expenditures associated with an alternative. The cost estimates use a four percent discount rate for a period of up to 30 years. This implies that inflation outpaces O&M costs by four percent per year. Five years of O&M costs are included for the alternatives that are anticipated to result in delisting. The analysis does not evaluate any ongoing O&M costs for periods past 30 years for any of the alternatives.

6.4 Cost Sensitivity Analysis

A sensitivity analysis evaluates the effects on project costs caused by variations in the assumptions associated with scope, design, implementation, and operation. These assumptions depend on the accuracy of the data developed during the remedial investigation and this feasibility study. The effects on the cost of a specific action can be observed by varying the assumptions and noting the effect on the estimated costs.

Many of the underlying cost assumptions for the alternatives are similar. In these cases, the cost sensitivity of each alternative to these items will be similar. One such example is that cost estimates for the alternatives were developed based primarily on a per residence basis. Therefore, all of the alternatives have a similar cost sensitivity to a change in the number of residences included.

The major assumptions which drive the costs for the various soil alternatives are:

- the cost of disposal for excavated material (affects alternatives 4 and 5);
- the percent of excavated material that goes to a hazardous waste landfill (alternatives 4 and 5);
- the percent of overall area that contains "hot spots" to be excavated (alternative 5);
- the cost of insitu treatment or soil amendments (affects alternatives 5 and 6).
- areal extent of remediation (yard size and number of residences - all alternatives)

Table 6-3 shows the effect that varying some of the underlying assumptions has upon the present worth costs of the various alternatives. Three assumptions are varied for a total of 18 different possible combinations. The line representing the main cost estimate is highlighted. The assumptions and variations used were:

1. Number of residences to be remediated. Varied -/+ 30 percent from the main assumption (727 to 1,039 to 1,351).
2. Disposal cost for excavated material. Varied -/+ 10 percent from the $46 per ton nonhazardous cost used in the main estimate ($41.40 and $50.60).
3. Depth of remediation. The main estimate assumed that remediation will go to a four-inch depth. Costs were varied to see the result of a two-inch depth of remediation.

There is no change in the cost estimate for the No Action alternative when any of these assumptions are changed. Alternative 6 exhibits some variability based on an increase/decrease in the number of residences to be remediated and the depth of treatment (changes in disposal costs do not affect this alternative). Alternatives 5A and 5B exhibit slightly less variability. Alternative 4 exhibits the most sensitivity to changing the areal extent, depth of contamination, and disposal costs.

In addition, costs were developed to examine the effect of changing the assumptions of five percent of excavated material going to a hazardous waste landfill for alternatives 4, 5A, and 5B. Costs were also developed to examine the effect of changing the "hot spot" size for alternatives 5A and 5B. All other assumptions were held the same as in the main cost estimate (highlighted in Table 6-3). The resulting costs were:

Variation from changing the percentage of excavated material sent to a hazardous waste landfill (main estimates assume 5%).

	0%	5%	10%
Alternative 4	$25,326,000	$26,349,000	$27,371,000
Alternative 5A	$11,098,000	$11,121,000	$11,145,000
Alternative 5B	$11,255,000	$11,786,000	$11,809,000

Variation from changing the percentage of "hot spot" areas to be excavated as a part of the overall area to be remediated in alternatives 5A and 5B (main estimates assume 5%).

	5%	20%	40%
Alternative 5A	$11,121,000	$12,239,000	$13,729,000
Alternative 5B	$11,786,000	$12,683,000	$13,880,000

No cost sensitivities were examined for the various indoor dust alternatives since there was only one active remedy considered.

A detailed discussion of the cost estimate assumptions can be found in Appendix A. The sources of materials and the associated unit prices have been established in 1999 dollars. Since both the quantities and unit prices are reasonably well established, the cost sensitivity of these items is the same as the estimating accuracy of +50 percent to -30 percent.

Table 6-3 Cost Estimate Sensitivity Analysis

Variation in # of residences	Variation in depth of treatment	Variation of nonhaz disposal cost	Present Worth Cost Estimate (000s)			
			Alternative 4	Alternative 5A	Alternative 5B	Alternative 6
1351	4"	$41.40	$32,903	$14,415	$15,280	$14,620
	4"	$46.002	$34,246	$14,446	$15,310	$14,620
	4"	$50.60	$35,588	$14,476	$15,341	$14,620
	2"	$41.40	$23,818	$13,475	$11,091	$14,350
	2"	$46.00	$24,673	$13,506	$11,121	$14,350
	2"	$50.60	$25,527	$13,536	$11,152	$14,350
1039	4"	$41.40	$25,316	$11,098	$11,763	$11,255
	4"	$46.002	$26,349	$11,121	$11,786	$11,255
	4"	$50.60	$27,381	$11,145	$11,810	$11,255
	2"	$41.40	$18,330	$10,375	$8,541	$10,279
	2"	$46.00	$18,986	$10,398	$8,565	$10,279
	2"	$50.60	$19,643	$10,422	$8,588	$10,279
727	4"	$41.40	$17,729	$7,781	$8,246	$7,891
	4"	$46.002	$18,452	$7,797	$8,262	$7,891
	4"	$50.60	$19,174	$7,814	$8,279	$7,891
	2"	$41.40	$12,841	$7,275	$5,992	$7,208
	2"	$46.00	$13,300	$7,291	$6,008	$7,208
	2"	$50.60	$13,760	$7,308	$6,025	$7,208

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7.0 PREDESIGN SAMPLING

BVSPC was assigned to include predesign sampling cost estimates in the FS report.

Predesign sampling will be conducted to establish the residences to remediate and establish the depths and extent of contamination of the residences. Present cost estimates of the action alternatives are based on gross estimates of number of residences, areas, and depths of contamination. EPA will decide on the number of samples to be taken prior to the remedial design. Each predesign soil sample will be analyzed for lead.

Before implementing any of the action alternatives, a predesign sampling program to determine the areal extent, depth and concentration of soils above the cleanup level at each residence must be conducted. This sampling could be conducted sitewide prior to remedial action. USEPA will decide on the location and frequency of the predesign sampling. Appendix C includes costs for metals analysis of soil and indoor dust. Costs increase for accelerated turnaround times (TAT). Estimated per sample costs are $83 per soil sample, and $160 per dust sample. Predesign sampling cost data is provided in Appendix C.

8

8.0 REFERENCES

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Appendix A

APPENDIX A
Alternative Cost Estimates and Description

Palmerton Zinc Feasibility Study Cost Estimate Description

GENERAL

Based on the most recent census data, it was determined that a total of 2,177 residences are located in Palmerton. Based on visual observation, a total of 581 residences located outside of the Borough of Palmerton but inside the boundary of OU3 were counted. Costs for active remediation alternatives were developed per residence for both soil and interior dust. Future costs for operations and maintenance were projected for up to thirty years and were discounted to present value based on an average inflation rate of four percent.

SOIL REMEDIATION

For the soil remediation, it was assumed that one half of the 2,177 Palmerton residences would qualify for remediation, with the exception of 202 that were cleaned during the interim action. It was assumed that one-half of the residences outside of Palmerton but still within the OU3 boundaries would qualify for remediation. Of the residences that would qualify for remediation, it was assumed that 9 of 10 would agree to be included. Cost estimates were developed on a per residence basis.

For the average residence, the total square footage of outside soil areas to be remediated was estimated to be approximately 8,170 square feet. This is the average Palmerton lawn area for Neighbor Helping Neighbor participants, as stated in the Neighbor Helping Neighbor Program Summary. This area is similar to a weighted average estimate developed for residences outside of Palmerton.

The cost for soil removal by machine was estimated to be $12.00 per cubic yard. It was also assumed that 10% of the soil removal at residences would be performed by hand, at a cost of $50.00 per cubic yard. Environmental controls during construction activities were estimated to cost $200 per residence. For the action alternatives, confirmation soil samples would be taken during the construction activities in order to provide confirmation that the remedial objectives have been met. A per sample cost of $123 was assumed, based on a 48 hour turnaround time.

For disposal and treatment costs, one cubic yard of soil (in place) was converted to 1.49 tons based on a soil weight of 110 pounds per cubic foot. Non-hazardous disposal costs were estimated as $46 per ton based on landfill cost estimates. It was assumed that 95% of the excavated soil would be disposed of in a nonhazardous landfill. It was assumed that 5% of the excavated soil would be disposed of in a hazardous landfill. Hazardous disposal costs (Alternatives 4 and 5) were based on a $141.00 per ton estimate (quoted by the Model City, NY Subtitle C Landfill) that included transportation, stabilization, disposal, taxes and fees.

All soil remediation estimates were based on an average excavation/contamination depth of four inches. Labor requirements were developed from discussions on the interim action efforts. For cost estimation purposes, it was assumed that an 'average' yard would require 2.5 days of labor with a three man crew to till and amend the soils (alternatives 5A and 6).

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Since a variety of revegetation methods would be allowed, and in certain instances sod might be used, revegetation costs for the action alternatives (4, 5A, 5B, and 6) were determined for both seeding/mulching/watering and placing sod/watering. Note that labor costs are included in these assumed costs. An assumption was made that 75% of the area would be seeded and the remaining area would be sodded, and a composite cost of $0.12 per square foot was used. Watering was assumed to continue for a period of two weeks in order that the vegetative cover is sufficiently established.

RESIDENTIAL SOIL ALTERNATIVES

Alternative 2 - Costs for this alternative assume that ongoing environmental monitoring soil sampling would be performed at 10% of the OU3 area residences over a five year period, continuing for thirty years. This translates into sampling residential soil and interior dust at 2% of the residences per year. The cost per dust sample would be $166 and for soil samples would be $85, including labor, shipping, and analysis costs.

Alternative 4 - A four-inch removal depth was assumed for Alternative 4, with an additional two inches of removal (achieving a total six-inch depth) over 20% of the remediated area. The cost of clean replacement topsoil fill was estimated at $24.23 per cubic yard. Confirmation sampling during remediation is necessary under this alternative to determine the actual depth of excavation and to measure the cleanup levels. Confirmation soil sampling costs were estimated to be $123 per sample, with 12 samples obtained per residence. Since this alternative would achieve the risk-based cleanup goals and result in delisting of OU3, ongoing environmental monitoring is assumed not to be required.

Alternative 5A - This alternative involves the removal and disposal of 'hot spot' or bare areas where predesign sample results indicate that lead levels are significantly above the cleanup level, then mixing of the remaining soils with preamended clean soil, and establishment of a new vegetative barrier. An average removal depth of the top two inches of soil was assumed. Amended soil costs were estimated as $20 per cubic yard. Alternative 5A also assumes that six confirmation soil samples would be taken. Since this alternative would achieve the risk-based cleanup goals and result in delisting of OU3, ongoing environmental monitoring is assumed not to be required.

Alternative 5B - This alternative involves the removal and disposal of 'hot spot' or bare areas where predesign sample results indicate that lead levels are significantly above the cleanup level, then treatment/mixing of the remaining soils with chemical amendments, and establishment of a new vegetative barrier. An average removal depth of the top two inches of soil was assumed. The cost for in situ chemical treatment of the remaining soil was estimated to be $30.00 per ton, including labor. Estimates ranging from $15 to $30 per ton were obtained from two vendors, and a literature search indicated that $30 per ton was a representative cost for chemical treatment. Alternative 5B assumes that six confirmation soil samples would be taken. Since this alternative would achieve the risk-based cleanup goals and result in delisting of OU3, ongoing environmental monitoring is assumed not to be required.

Alternative 6 - This alternative assumes a cost of $0.17 per square foot cost for the soil amendments. Other costs include equipment, setup, and labor and were estimated as $0.36 per square foot. Based on the average lot size this would be $2,941 for an average residence. Revegetation costs for this alternative are assumed to be identical to those for Alternative 5A. Alternative 6 also assumes that six confirmation soil samples would be taken. Since this alternative would achieve the risk-based cleanup goals and result in delisting of OU3, ongoing environmental monitoring is assumed not to be required.

DUST REMEDIATION

For interior household dust, it was assumed that 50% of the total number of OU3 residences would require remediation. This yields a total of approximately 1,376 residences.

A cleaning cost of $650 per residence for specialized cleaning (Dust Alternative 3) was used to calculate overall project costs. Cost estimates ranging from $650 to $1,000 per residence were obtained from three companies that clean homes containing lead dust. This cost was based on performance of HEPA vacuuming/wet wiping/HEPA vacuuming on all interior hard surfaces and window sills and wells, and HEPA vacuuming of rugs and upholstered items. An average of 1,350 interior square feet was assumed, not including carpet removal, HVAC Interior Duct work, or cleaning of personal or decorative items or closets and cabinets. A cost for dust cleaning in 1995 was also found in an EPA document, and was lower than the contractors' estimates. The low cost in the contractors' range of prices was used for this FS in order to be slightly conservative. The contractors' estimates were for cleaning a single residence and did not incorporate the potentially large discount that would be given for performing work on many residences under a large contract.

An estimated was made of the cost to temporarily relocate residents to an apartment in the area while the interior cleaning is performed. An average of two days to clean a residence was assumed. Developed costs include meals, a portion of a monthly apartment rental, and an apartment cleaning cost. The total average cost per household is estimated as $178.20.

Costs were developed for interior dust sampling for Dust Alternative 3. This sampling would be for confirmation sampling after cleaning. On average, eleven wipe samples would be taken at a cost of $10.00 each. The estimated total confirmation sampling cost per residence including collection, shipping, and analysis is $223.67. If necessary based upon confirmation sampling, dust alternative 3A will be initiated and assumes that approximately 690 residence would require the carpet removal and replacement.

Because outdoor contaminated soil is a potential source of indoor dust (existing lead paint is a separate issue), the frequency of the ongoing environmental monitoring of household dust is linked to the alternative chosen for soil remediation. Annual environmental sampling is anticipated in connection with Soil/Dust Alternative 2 and no further monitoring is associated with soil Alternatives 4, 5A, 5B, or 6.

For Soil/Dust Alternative 2 OU3 ongoing environmental monitoring would be conducted. A decision to use vacuum sampling for the cost estimates was made because previous rounds of sampling were collected in that manner. The total cost per residence for vacuum sampling as was done previously was estimated to be $166.00. The cost includes analysis of one vacuum cassette sample per residence (as was done in the CDM 1991 sampling event); it is assumed that the sample would be a composite from several areas of the house. If translation of the composite concentration value to a composite house "loading" value is desired, a careful record of the vacuum sampling should be kept.

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
DETAILED COST ESTIMATE
ALTERNATIVE 2: Long-Term Monitoring /Institutional Control (soil & dust)

Total Costs (not per-residence) — Total residences in OU3: 2,738

ITEMS	QUANTITY*	UNITS	UNIT PRICE	AMOUNT
Monitoring Sampling				
Soil sampling costs per year*	55	res./year	$85.00	$4,654.60
Dust sampling costs per year*	55	res./year	$166.00	$9,090.16
			TOTAL PER YEAR	$13,744.76

General alternative O&M costs (not per residence)

Part-time administrator, overhead	1	per year	$24,000.00	$24,000

* Note that sampling is done at one in ten residences, once every 5 years for 30 years
Therefore the per year quantity number above is 2% of the total number of residences.

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES IN PALMERTON
ALTERNATIVE 4: Removal/Revegetation
estimated number of residences in Palmerton to be remediated 778
ce to be remediated 8,170 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Soil removal by machine (0-4")	99.9	c.y.	$12.00	$1,198
Soil removal by hand (0-4")	11.1	c.y.	$50.00	$555
Environmental controls	1.0	per res.	$200.00	$200
Topsoil fill for residences	111.0	c.y.	$24.23	$2,688
Seeding/Sodding	8,170	s.f.	$0.12	$974
watering for 2 weeks	8,170	s.f.	$0.05	$409
excavated soil treatment and disposal- municipal landfill	156.5	tons	$54.42	$8,518
excavated soil treatment and disposal- haz waste landfill	8.2	tons	$141.00	$1,162
Confirmation sampling	12	per res.	$123.00	$1,476
		SOIL TOTAL PER RESIDENCE		$17,179
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling - analysis	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

General alternative O&M costs (not per residence)

Public education and post-cleanup administration	1	per year	$10,000.00	$10,000

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PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES OUTSIDE PALMERTON
ALTERNATIVE 4: Removal/Revegetation
estimated number of residences outside of Palmerton to be remediated 252
ce to be remediated 7,185 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Soil removal by machine (0-4")	87.8	c.y.	$12.00	$1,054
Soil removal by hand (0-4")	9.8	c.y.	$50.00	$488
Environmental controls	1.0	per res.	$200.00	$200
Topsoil fill for residences	97.6	c.y.	$24.23	$2,364
Seeding/Sodding	7,185	s.f.	$0.12	$857
watering for 2 weeks	7,185	s.f.	$0.05	$359
excavated soil treatment and disposal- municipal landfill	137.6	tons	$54.42	$7,490
excavated soil treatment and disposal- haz waste landfill	7.2	tons	$141.00	$1,021
Confirmation sampling	12	per res.	$123.00	$1,476
			SOIL TOTAL PER RESIDENCE	$15,309
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling - analysis	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
			DUST TOTAL PER RESIDENCE	$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

AR303054

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES IN PALMERTON
ALTERNATIVE 5A: Removal/Agricultural treatment/revegetation
estimated number of residences in Palmerton to be remediated 778
ence to be remediated 8,170 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Sod removal by machine (0-2")	2.3	c.y.	$12.00	$27
Sod removal by hand (0-2")	0.3	c.y.	$50.00	$13
Amended soil fill	50.4	c.y.	$20.00	$1,009
labor for spreading and tilling amended soil	60.0	man hours	$49.50	$2,970
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	6	per residence	$123.00	$738
Seeding/Sodding	8,170	s.f.	$0.12	$974
watering for 2 weeks	8,170	s.f.	$0.05	$409
excavated soil treatment and disposal- municipal landfill	3.6	tons	$54.42	$194
excavated soil treatment and disposal- haz waste landfill	0.2	tons	$141.00	$26
		SOIL TOTAL PER RESIDENCE		$6,559
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

General alternative O&M costs (not per residence)

Public education and post-cleanup administration	1	per year	$10,000.00	$10,000

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PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES OUTSIDE PALMERTON
ALTERNATIVE 6A: Removal/Agricultural treatment/revegetation
estimated number of residences outside of Palmerton to be remediated 252
ence to be remediated 7,185 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Sod removal by machine (0-2")	2.0	c.y.	$12.00	$24
Sod removal by hand (0-2")	0.2	c.y.	$50.00	$11
Amended soil fill	44.3	c.y.	$20.00	$887
labor for spreading and tilling amended soil	52.8	man hours	$49.50	$2,612
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	6	per residence	$123.00	$738
Seeding/Sodding	7,185	s.f.	$0.12	$857
watering for 2 weeks	7,185	s.f.	$0.05	$359
excavated soil treatment and disposal- municipal landfill	3.1	tons	$54.42	$170
excavated soil treatment and disposal- haz waste landfill	0.2	tons	$141.00	$23
		SOIL TOTAL PER RESIDENCE		$5,881
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES IN PALMERTON
ALTERNATIVE 6B: Removal/Chemical treatment/revegetation
estimated number of residences in Palmerton to be remediated 778
ence to be remediated 8,170 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Sod removal by machine (0-2")	2.3	c.y.	$12.00	$27
Sod removal by hand (0-2")	0.3	c.y.	$50.00	$13
Replacement topsoil fill for residences	2.5	c.y.	$24.23	$61
Insitu treatment (RMT process)	146.0	ton	$25.00	$3,651
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	*6*	*per residence*	$123.00	$738
Seeding/Sodding	8,170	s.f.	$0.12	$974
watering for 2 weeks	8,170	s.f.	$0.05	$409
excavated soil treatment and disposal- municipal landfill	3.6	tons	$54.42	$194
excavated soil treatment and disposal- haz waste landfill	0.2	tons	$141.00	$26
		SOIL TOTAL PER RESIDENCE		$6,293
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

General alternative O&M costs (not per residence)

Public education and post-cleanup administration	1	per year	$10,000.00	$10,000

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PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES OUTSIDE PALMERTON
ALTERNATIVE 5B: Removal/Chemical treatment/revegetation
estimated number of residences outside of Palmerton to be remediated 252
ence to be remediated 7,185 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Sod removal by machine (0-2")	2.0	c.y.	$12.00	$24
Sod removal by hand (0-2")	0.2	c.y.	$50.00	$11
Replacement topsoil fill for residences	2.2	c.y.	$24.23	$54
Insitu treatment (RMT process)	128.4	ton	$25.00	$3,211
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	6	per residence	$123.00	$738
Seeding/Sodding	7,185	s.f.	$0.12	$857
watering for 2 weeks	7,185	s.f.	$0.05	$359
excavated soil treatment and disposal- municipal landfill	3.1	tons	$54.42	$170
excavated soil treatment and disposal- haz waste landfill	0.2	tons	$141.00	$23
		SOIL TOTAL PER RESIDENCE		$5,647
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES IN PALMERTON
ALTERNATIVE 6: Soil amendment and revegetation

estimated number of residences in Palmerton to be remediated 778
e to be remediated 8,170 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Soil Amendments	8,170	s.f.	$0.17	$1,362
Labor	60.0	man-hours	$49.50	$2,970
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	6	per residence	$123.00	$738
Seeding/Sodding	8,170	s.f.	$0.12	$974
watering for 2 weeks	8,170	s.f.	$0.05	$409
		SOIL TOTAL PER RESIDENCE		$6,652
DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
		DUST TOTAL PER RESIDENCE		$1,002
5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

General alternative O&M costs (not per residence)

Public education and post-cleanup administration	1	per year	$10,000.00	$10,000

PALMERTON ZINC SITE
RESIDENTIAL SOIL FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE FOR HOMES OUTSIDE PALMERTON
ALTERNATIVE 6: Soil amendment and revegetation
estimated number of residences outside of Palmerton to be remediated 252
ce to be remediated 7,185 s.f.

ITEMS TO REMEDIATE	QUANTITY	UNITS	UNIT PRICE	AMOUNT
SOIL				
Soil Amendments	7,185	s.f.	$0.17	$1,197
Labor	52.8	man-hours	$49.50	$2,612
Environmental controls	1.0	per res.	$200.00	$200
Confirmation sampling	6	per residence	$123.00	$738
Seeding/Sodding	7,185	s.f.	$0.12	$857
watering for 2 weeks	7,185	s.f.	$0.05	$359
			SOIL TOTAL PER RESIDENCE	$5,963

DUST				
Interior dust cleaning	1	per res.	$650.00	$650
Confirmation wipe sampling	11	avg. per res.	$10.00	$110
Confirmation wipe sampling - labor, shipping	1	avg. per res.	$113.67	$114
temporary relocation cost per residence	1	per res.	$128.20	$128
			DUST TOTAL PER RESIDENCE	$1,002

5 year sampling:				
Soil sampling costs	0	res./year	$85.00	$0
Dust sampling costs	0	res./year	$166.00	$0

General alternative O&M costs (not per residence)

Public education and post-cleanup administration	1	per year	$10,000.00	$10,000

PALMERTON ZINC SITE
RESIDENTIAL SOIL FOCUSED FEASIBILITY STUDY
PER-RESIDENCE DETAILED COST ESTIMATE
ALTERNATIVE 3A: Carpet Removal/Replacement

estimated number of residences to be remediated	690
otage per residence	1,350 s.f.

ITEM	QUANTITY	UNITS	UNIT PRICE	AMOUNT
Carpet Removal/Replacement per residence Includes removal/disposal of old carpet, installation of new, mid-quality carpet, and installation of 1/2-inch, 6lb. padding.	1350.0	s.f.	$4.48	$6,048
Carpet Removal/Replacement total	690.0	residence	$6,048.00	$4,173,120

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Retained Residential Soil/Interior Dust Alternatives	Total Present Value Cost Estimate
1 No Action	$0
2 Long-Term Monitoring /Institutional Control (soil & dust)	$733,000
4 Removal/Revegetation	$25,391,000
5A Removal/Agricultural treatment/revegetation	$11,438,000
5B Removal/Chemical treatment/revegetation	$8,387,000
6 Soil amendment and revegetation	$10,839,000

Appendix B

APPENDIX B
Alternative Cost Estimate Data

PALMERTON ZINC SITE
OU3 FEASIBILITY STUDY
COST ESTIMATE ASSUMPTIONS
See attached source memos

Boxed values are required inputs; other numbers are calculated

Source	RESIDENTIAL SOIL			
	Common data for alternatives			
	Conversion from cubic feet to tons			
BV assumption	1 cubic foot in place	=	110	pounds
	then 1 cubic yard in place (2,000 pounds = 1 ton)	=	1.49	tons
	1 cubic yard	=	27	cubic feet
	Assumptions for net present value calculations			
BV assumption	Inflation will be this percentage		4.0%	
	present value of a future amount calculated for this many years		30	
	Areas in the Borough of Palmerton			
1990 Census data	Number of residences to be screened		2,177	
EPA comments	multiplied by % agreeing to be included		90%	
on technical memo.	multiplied by the estimated % above cleanup level		50%	
OSC report	Minus residences remediated during interim action		202	
	Equals estimated number of residences to be remediated		778	
10/98 NHN Summary	estimated average yard size per residence to be remediated		8,170	s.f.
p.4	Estimated borough residential area to be remediated		6,356,260	s.f.
	Areas outside the Borough of Palmerton			
BV memo 3/30/99	smaller lots		130	
	medium lots		346	
	large lots		25	
BV memo 3/30/99	Total number of residences to be screened outside borough		561	
	multiplied by % agreeing to be included		90%	
	multiplied by the estimated % above cleanup level		50%	
	Minus residences remediated during interim action		0	
	Equals estimated number of residences to be remediated		252	
	estimated average lot sizes per residence to be remediated		8,170	s.f.
	smaller lots 50 ft. x 100 ft., 30% open land to be remediated		1,500	s.f.
	medium lots 100 ft. x 100 ft., 60% open		6,000	s.f.
	large lots 300 ft. x 200 ft., 90% open		54,000	s.f.
	Estimated total residential yard area outside borough		3,621,000	s.f.
	Estimated residential yard area to be remediated outside borough		1,810,500	s.f.
	Avg. estimated per residence yard area to be remediated		7,185	s.f.
	Total OU3 estimated number of residences to be remediated		1,030	
	Total OU3 estimated area to be remediated		8,166,760	s.f.
	Alternatives 4, 5, and 6 - Environmental controls during construction			
BV estimate	Environmental controls		$200.00	per res.
	Alternatives 4, 5, and 6 - confirmation sampling costs			
see sheet 'sample'	Per sample cost for soil samples (48 hour TAT)		$123.00	
	This many soil samples per residence (Alt. 4 confirmation)		12	
	This many soil samples per residence (Alt. 5 confirmation)		6	
	This many soil samples per residence (Alt. 6 confirmation)		6	
	Alternatives 4, 5, and 6 - Revegetation costs			
Means '98 p.5-19	Seeding (also includes mulching and watering)		$0.04	s.f.
Means '98 p.5-19	Place and water sod		$0.36	s.f.
EPA comments	Percentage of seeded area v. sodded area		75%	
	Composite cost for seeding/sodding		$0.12	
BV estimate	cost for watering for 2 weeks		$0.05	s.f.
	(assume residents will water new grass/sod on their properties after this)			
	Alternatives 4, 5, and 6 - Operations and Maintenance			

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BV estimate	Public education and post-cleanup administration (brochures, publications, correspondence, site visits, etc.)	$10,000.00	per year
	Alternatives 4 and 5 - Soil removal and fill replacement		
BV estimate	Assume this % of resid. soil will have to be excavated by hand	10%	
	Soil or Sod removal cost by machine	$12.00	c.y.
	Soil or Sod removal cost by hand	$50.00	c.y.
BV estimate	Percentage of disposal going to municipal landfill v. haz waste	95%	
Chrin Bros. LF cost	Municipal Landfill disposal cost per ton	$46.00	per insitu soil ton
	Dump truck size	8	c.y.
BV estimate	Cost per truck, includes 22 mile transport	$100.00	each
	(transportation cost -22 miles)	$8.42	per ton
	Total non-haz transport & disposal cost	$54.42	per ton
CWM Chemical Serv. Model City estimate	Haz Waste Landfill - Subtitle C disposal cost at Model City, NY (includes transportation and stabilization)	$141.00	per insitu soil ton
	Alternative 4		
BV estimate	The average depth of contamination/excavation is	4	inches
BV estimate	Deeper depth of contamination is	6	inches
BV estimate	and will have to go to deeper depth over this % of the total area	20%	
Means '98	Topsoil Fill for residences	$24.23	c.y.
Unit Costs p. 5-18	This includes cost of clean fill and all placement (some hand work, spreading, transportation, compaction)		
	Alternatives 5A and 5B:		
BV estimate	% of total yard area that will have 'hot spots' to be excavated	5%	
	This alternative will first remove 'hot spot' topsoil to this depth	2	inches
	and the total depth of remediation will be:	4	inches
	Alternative 5A		
Estimate from phone survey of area vendors	cost of top of the line amended agricultural soil	$20.00	per cubic yard
BV assumption	Spread amended soil to one-half contamination depth	2	inches deep
	therefore one cubic yard of amended soil will cover	162	square feet
Means '98	Labor	$49.50	per laborer/hour
	estimated rate of progress	136.17	s.f. per hour
BV modified EPA OSC estimate	3 man crew, 5 days to excavate, till, amend, and sod avg. boro resid.	3	man crew
	amendment and tilling	2.5	days
		60	man-hours
		0.01	man-hours per s.f.
	total labor cost for all except excavation & sodding	$0.36	per square foot
	Alternative 5B		
RMT cost estim.	Insitu treatment by tilling or discing or otherwise mixing into the soil was given a cost estimate based on a per ton charge. With the depth and unit weight assumptions above, each square foot treated in option 5B will be approximately	0.018	tons
RMT cost est.	RMT stabilization process soil + added weight factor	105%	
BV estimate & RMT cost est.	Pozzolanic stabilization soil + added weight factor	120%	
	(no excavation bulking factor used since these calc.s and disposal costs are all weight-based, not volume-based)		
RMT cost est.	onsite RMT chemical process stabilization cost (does not include excavation, transport, or disposal)	$25.00	per ton
Contractor's estimates	onsite Pozzolanic process stabilization cost (does not include excavation, transport, or disposal)	$30.00	per ton
	Alternative 6		
	Depth of contamination is	4	inches
BV estimate	Soil Amendments - fertilizer, amended soil, etc.	$0.17	s.f.
Means '98	Labor	$49.50	per laborer/hour
	estimated rate of progress	136.17	s.f. per hour
BV modified EPA OSC estimate	3 man crew, 5 days to excavate, till, amend, and sod avg. boro resid.	3	man crew
	amendment and tilling	2.5	days
		60	man-hours
		0.01	man-hours per s.f.

	total labor cost for all except sodding	$0.36	per square foot
	Alternative 2 Operations and Maintenance		
BV estimate	Part-time administrator	$10,000.00	per year
BV estimate	Office Overhead	$5,000.00	per year
BV estimate	Office size	600	s.f.
BV estimate	Office space	$15.00	per s.f./year
	Total Alternative 1 O&M	$24,000.00	
	Alternative 2		
	Post-remediation sampling for Environmental Monitoring		
	Assume this many soil samples per residence (monitoring)	10%	One in ten homes
see sheet 'sample'	Per sample cost for soil samples (2 week TAT)	$85.00	
	sample once every 5 years	20%	times per year
	Environmental sampling will be performed for 30 years.		
	These values are not discounted to present worth (conservative assumption is that monitoring costs keep pace with inflation).		
	Assume this many dust samples per residence (monitoring)	10%	One in ten homes
	Per sample cost for dust samples (see interior dust section below)	$166.00	
	sample once every 5 years	20%	times per year

<u>Source</u>	<u>INTERIOR DUST</u>		
	Number of residences to be screened	2,738	
	Estimated % above cleanup level	50%	
	Number of residences to be remediated	1,369	
	Alternative 4 - HEPA vacuum/wet wipe/HEPA vacuum (hard surfaces), HEPA vacuum soft surfaces.		
EPA, 6/3/98 Federal Register, V.63, No. 106, p. 30322 Low end of average	Cost per residence for dust cleaning, in 1995 dollars is $391 adjusted for 1998 dollars, at 2% inflation	$415	
DHG phone memo of 11/18/98	After talking to several contractors and getting a per residence quote from them for cleaning, the range was $650-$850. This price range does not include a discount for the large number of residences. The lower end of this range was chosen for cost estimates rather than the $415 EPA estimate in order to still be conservative.	$650	
	Dust confirmation sampling - Specialized cleaning dust alternative 3		
Exide lab cost	analysis of wipe (load) sample for lead	$10.00	per sample
JLS phone memo of 3/3/99	average number of wipe samples per residence	11	samples
BV estimate	technician labor cost to take, log, and package samples	$50.00	per hour
BV estimate	gather this many samples an hour, including logging & packing	6	per hour
	estimated shipping cost per sample	$2.00	
	Cost per residence for confirmation sampling labor & shipping	$113.67	
	Dust sampling - environmental monitoring (Alternative 2)		
BV estimate	cost for vacuum sampling three 25x25 cm areas (includes labor, sample prep, shipping)	$86.00	
NEIC phone memo	concentration analysis cost	$80.00	per sample
CDM final trip report of Sampling Fall 1991 p.13	assume this many vacuum cassette samples per residence	1	
	Total dust sampling predesign cost	$166.00	per residence
	Temporary relocation of residents during cleaning		
JLS phone memo of 3/3/99	smaller houses take one day to clean; larger three days		
	assume 2 days to clean on average		
	Monthly apartment cost for relocation of residents	$573.00	incl. phone & cable
	per each stay	$40.00	cleaning cost
	Meals & incidental costs per day	$50.00	per residence
	Assume will have to relocate each residence for	2	days
	total cost per household	$128.20	
assumption	Number of residences to have carpet removal/replacement	690	
carpet costs memo	Average interior area per residence	1,350	s.f.

02/02/2000	Average cost for old carpet removal and mid-quality carpet installation	4.48 s.f.

Palmerton OU3 Feasibility Study
Sampling cost estimate

Boxed cells are inputs

Source	RESIDENTIAL SOIL		
	Confirmation soil sampling costs during construction		
BV estimate	2 samplers at	$50	per hour
BV estimate	can do this many samples	12	per day
BV estimate	workday of	8	hours
BV estimate	shipping costs	$80	per day
JLS memo 11/18/98	analysis cost (48 hour TAT)	$83	per metal
	for lead	1	metals
	Total per day cost	$1,476	
	per sample cost		$123

Source	RESIDENTIAL SOIL		
	Long term monitoring soil sampling costs		
BV estimate	2 samplers at	$50	per hour
BV estimate	can do this many samples	12	per day
BV estimate	workday of	8	hours
BV estimate	shipping costs	$80	per day
JLS memo 11/18/98	analysis cost (2 week TAT)	$45	per metal
	for lead	1	metals
	Total per day cost	$1,020	
	per sample cost		$85

BLACK & VEATCH
Philadelphia Office

PROJECT MEMORANDUM

Palmerton OU3 Feasibility Study
Re: 3-31-99 Site Visit/FS cost estimates

B&V Project No. 47102.108
April 1, 1999

To: File

From: Sean Cook

David Graff and I visited the Palmerton OU3 site on 03/31/99 to estimate the number and size of residences falling within the boundary of OU3 but outside of the limits of the Borough of Palmerton. The total estimate was 581 residences.

An attempt was made to estimate the average size of the potential 'average' residential yard area. Residential yard areas were tallied as large, medium, and small. Assumptions were made for the sizes of these yard areas; a small lot was 50 x 100 feet, with 30% actual yard area, or 1,500 s.f.; a medium lot was designated as 100 x 100 feet, with 60% actual yard area, or 6,000 s.f.; and a large lot was designated as 200 x 300 feet, with 90% actual yard area, or 54,000 s.f.

Of the 581 residences counted, 27 had large yard areas, 414 had medium areas, and 140 had small areas. Based on the assumptions above, this works out to be 4,152,000 s.f. total for 581 residences, or 7,954 s.f. per residence.

This is similar to the average lot size of 8,170 s.f. listed in the NHN documents for work accomplished within Palmerton. In both cases the average is significantly larger than the median yard size because of a few large properties.

To be consistent, the cost estimates will use the NHN average lot size for all residences in OU3.

Palm-OU3/FS/033199trip.wpd

[redacted]

INTEGRATED TECHNICAL SERVICES, INC.

April 19, 1999

Mr. Girma Mergia, P.E.
BLACK & VEATCH
601 Walnut Street - Suite W
Philadelphia, PA 19106-3307

Fax: (215) 928-1780

Reference: New Jersey Zinc Project - US EPA - Palmerton, PA

Dear Girma:

Good morning. It was a pleasure meeting with you on Tuesday, March 30th at your Philadelphia offices.

Regarding the upcoming project at Palmerton, PA, ITS would welcome the opportunity to be included on the bidders list.

We understand the scope of the work to include the following:

- -2,000 residences in the vicinity of the site will have approximately 146 tons of soil per residence containing heavy metal residues to be remediated.
- -Top 2" will be excavated and removed to an off-site RCRA treatment facility.
- -Four inches of soil underlying, will be treated with an on-site Pugmilll to pass TCLP and will be replaced as clean fill.
- -Clean fill material as borrowed will replace the 2" taken off.

<u>Estimate Project Costs</u>:

-Offsite disposal of D008, 4, 6, soils. . . . . $120.00-$140.00/ton range
-On-site treatment . . . . $20.00-$30.00/ton range

-Mobilization/demobilization on a case by case basis

-All equipment to be provided by ITS.

We greatly appreciate this opportunity to quote and to work for Black and Veatch.

Sincerely,
INTEGRATED TECHNICAL SERVICES, INC.

MEB/clc

Martin E. Brubaker
Vice President

MEB/clc
c:\meb\b&v0408.gm

August 11, 1998

Mr. Girma Mergia, P.E., CGWP
Black & Veatch
601 Walnut Street
Suite 850W
Philadelphia, PA 19106-3307

RE: RMT's Metals Treatment Technologies

Dear Mr. Mergia,

RMT sent a letter to you on August 5, 1998 with an opinion of our cost to perform the upcoming metals remediation work in Palmerton, Pennsylvania. This letter clarifies the assumptions we made and the scope of our work that we described in the August 5, 1998 letter.

Assumptions

- There will be on the order of 1,000,000 tons of soil to be treated (2,000 homes with 300 to 700 tons of soil per home).
- The soil will be excavated by others and staged at a centralized treatment area.
- RMT will not be involved in the excavation and transportation of the soil to the treatment area, the transportation and disposal of the treated material, or the restoration of the homes.
- RMT will not be involved in any federal permitting, such as obtaining a RCRA TSD permit or delisting the waste.

Scope of Work

- RMT will perform treatability testing on the soil, supply treatment chemical, mix the treatment chemical into the soil, and perform treatment verification testing on the soil. Our price includes incidental items directly associated with the chemical mixing process, such as preparation and implementation of a health and safety plan, dust control, and air monitoring..
- On projects of this magnitude, we would expect to treat 5,000 to 10,000 tons of soil per day. Our processing rate will be dependent on the available working area and rate at which the soil can be supplied to us.

I hope this letter answers your questions. Please call if you want additional information or if you have further questions.

Sincerely,
RMT/Four Nines

Erick G. Johnson
Business Development Manager

cc: M. Warner - MSN
L. Tickanen - MSN
M. Budin - PHL

RMT.

Fax Transmittal Cover Sheet

RMT, Inc.
527 Plymouth Road, Suite 406
Plymouth Meeting, PA 19462
Tel. (610) 834-0490 • Fax (610) 834-1469

Project Name: Palmerton Site
Project No.: **Date:** 8/5/98 **No. of Pages:** 4

Recipient	Company Name	Fax No.	Telephone No.
Mr. Girma Mergia	Black & Veatch	215-928-1780	215-928-2227

Name of Sender: Erick Johnson

Following is my response to your request that I provide you with a written summary of our discussion regarding your project and our Metals Treatment Technologies, and provide you with a +/- 50% cost estimate for the application of our technology to your project. In addition to forwarding this fax, I have mailed you the original letter.

August 5, 1998

Mr. Girma Mergia, P.E., CGWP
Black & Veatch
601 Walnut Street
Suite 850W
Philadelphia, PA 19106-3307

RE: RMT's Metals Treatment Technologies

Dear Mr. Mergia,

Thank you for the time you spent with me discussing RMT's proprietary metals treatment technologies (MTT) and Operable Unit # 3 (OU#3) at the Palmerton Site. This letter addresses your request that I provide you with a written summary of our discussion regarding your project and our MTT, and provide you with a +/- 50% cost estimate for the application of our technology to your project.

BACKGROUND

Black & Veatch is under contract with the USEPA Region III to complete a feasibility study for OU# 3 at the Palmerton Site. OU#3 involves soil contamination at approximately 2,000 homes in Palmerton. The contaminated soil is presently designated as K061 listed waste. The maximum depth of contamination is two feet. The soil contaminants of concern and their corresponding compositional ranges are: arsenic 0 - 60 ppm, cadmium 0 - 680 ppm, lead 1 - 10,000 ppm, and zinc 10 - 56,000 ppm. A risk assessment for OU#3 has established the contaminant risk levels as follows: total arsenic at 79 ppm, total cadmium at 130 ppm, and total lead at 650 ppm. All soil containing arsenic, cadmium, or lead compositional levels above the established risk levels must be removed from the site.

RMT'S METAL TREATMENT TECHNOLOGY

RMT has developed MTT to render metal-bearing wastes nonhazardous. The treatment chemistries cause chemical changes and render the metals virtually insoluble. The MTT process involves the blending of chemical substances with metal-bearing waste or contaminated soil or debris. The resulting material passes the Toxicity Characteristic Leaching Procedure (TCLP) criteria for nonhazardous waste and other regulatory standards, including the Universal Treatment Standards (UTS). RMT's metals treatment technologies are effective for a wide range of metals, including arsenic, cadmium, chromium, copper, lead, mercury, and zinc. Please note that our technology does not include delisting of a listed waste. Since the contaminated soil is designated a K061 waste, final disposition of the MTT treated waste to a hazardous verses a nonhazardous landfill is an issue that needs to addressed with the USEPA Region III.

RMT, INC. — PHILADELPHIA
527 PLYMOUTH ROAD, SUITE 406 — PLYMOUTH MEETING, PA — 19462-1068
610/834-0490 — 610/834-1469 FAX

AR303076

COST SAVINGS

For most applications, stabilization and solidification stand apart as being the only cost-competitive solutions. When just the cost of chemicals are compared, RMT's MTT and solidification are typically very similar. However, when total costs are compared, MTT provides several significant financial advantages over solidification. These advantages are summarized below.

> Lower Bulking Rates - The MTT chemicals are typically added at rates of 1 percent to 10 percent by weight. In contrast, solidification additives are typically added at rates of 10 percent to 50 percent, and can be as high as 200 percent. The higher bulking rates translate into proportionately higher transportation and disposal costs.
>
> Easier Chemical Application - The application cost with RMT's metal treatment technologies is generally about one-half the cost of solidification. Solidification chemicals usually consist of a fine powder with a high pH. A pugmill or other enclosed structure is typically required to control dusting provide adequate mixing. The equipment has relatively high mobilization and operating costs, and the processing of the solidified material is difficult.
>
> In contrast, the MTT chemicals can be mixed in a wide variety of ways, including trackhoes, discers, and enclosed structures. The chemicals can be sized or wetted to control dusting, and the near-neutral pH reduces exposure concerns. All of this leads to higher throughput at lower daily costs.

OU#3 APPROACH AND PRICE

During our meeting, we discussed a couple of methods by which the MTT chemical can be mixed into the contaminated soil at OU#3. One possibility is to excavate the contaminated soil and transport it to one or more staging areas on site. The MTT chemical would be mixed into the contaminated soil at the staging area(s) and subsequently transported to a landfill. Alternately, the MTT chemical can be mixed into the contaminated soil in situ with tilling equipment, discers, or backhoes, then excavated and transported to a landfill. Regardless of the mixing method employed, our technology does not require moisture addition or a curing period.

Based on what we know of the quantity and nature of the material, our price for treatability, chemical, mixing, and oversight is likely to be $15 to $25 per ton. Please recognize that these figures are preliminary, and we would need to perform a treatability study on the material to determine the optimal chemical dosage and final pricing.

Please call if you want additional information or if you have any questions.

Sincerely,
RMT/Four Nines

Erick G. Johnson
Business Development Manager

cc: M. Warner - MSN
L. Tickanen - MSN
M. Budin
M. Duner
A. Chowdhury

August 17, 1998

Sean Cook
Black & Vetech
601 Walnut St.
Suite 850
Philadelphia,, PA 19106

This price quotation represents PRELIMINARY pricing for this project. Final numbers will be issued and forwarded TWO BUSINESS DAYS before the formal bid due date.

Re: Unknown - Palmerton, PA

Dear Sean Cook:

CWM Chemical Services, L.L.C. is pleased to provide you with pricing for disposal per your request. Based upon the information you provided, the following summarizes our quotation.

DESCRIPTION / ESTIMATED QUANTITY OF WASTE

1. Soil w/Lead & Arsenic / 10000 ton(s)
2. Soil w/Lead & Arsenic / 10000 ton(s)

DISPOSAL FACILITY:

CWM Chemical Services, L.L.C.
1550 Balmer Road
Model City, NY 14107

DISPOSAL CHARGES	TAXES
1. $138.00 per ton(s) - Stabilization --> Bundled price includes taxes and transportation.	Included in bundled pricing.
2. $65.00 per ton(s) - Stabilization	6.00% local tax 7.00% NY State sales tax $16/ton NY State Treatment Tax

Disposal Note: Prices based on standard recipe and sample with profile.

TRANSPORTATION/DEMURRAGE

1. Transportation included in bundled pricing; using Dumps; with a minimum of 22 ton load

2. Transportation not quoted

Liners: Included with CWM transportation.
Demurrage: $85.00 per hour after first hour free with CWM transportation
Other Fees: $3.00 per ton PA Hazardous Waste Transport fee

APPROVAL/ANALYTICAL FEES

1. Waived
2. Waived

SPECIAL CONDITIONS:

Waste must meet acceptability criteria at the site and comply with local, state and federal regulations, as well as the sites permit requirements. Pricing is contingent upon site and sample evaluation.

The disposal charges are based solely on the information available at this time and are good for thirty (30) days from the date of this letter. Additional information may be required prior to approval.

Payment must be received within thirty (30) days of invoicing. Payments received after thirty (30) days will accrue interest at the rate of 1.5% per month.

Following site approval, we will reconfirm your pricing and send you the appropriate Supplemental Information Document for signature.

CWM Chemical Services, Inc. wishes to thank you for allowing us to quote on your disposal needs. Please do not hesitate to contact me at the phone number below with any questions you may have or if you require any further assistance.

Sincerely,

Pat Ludwig
(716)754-0451
Customer Service Representative

cc:

Palmerton Residential Lead Dust Clean-Up Work

Summary Phone Memo

David H. Graff **November 13, 1998**

After conversing with multiple agencies that pursue lead abatement work, the following protocol for cleaning household dust, containing lead, was created to meet the potential variety of circumstances that can arise at Palmerton.

Controlled Environmental Systems were the most cooperative and informative for cleaning homes contaminated with lead dust. The following circumstances were presented to CES:

Average Home ....1350sq.ft.
No carpet removal....................
No Decorative Items............
No Personal Items................
No HVAC Interior Duct Work.......
No Closets/ Cabinets or contents thereof........

Cleaning Procedure will involve the cleaning of all interior hard surfaces and window sills and wells following:

...Hepa Vacuumed
...followed by a wet wiping with 5% Tri Sodium Phosphate,
...a second Hepa Vacuuming.

This three step process is the prescribed cleaning method as detailed by HUD and the CDC to remediate lead dust levels to acceptable permissible exposure levels.

All upholstered and rugged items will be Hepa Vacuumed at a rate of one square yard per minute in a two step process, in opposing directions.

The cost per household unit ranges from $650 - $850.

A lower cost can be given when a number of units can be assigned to the agencies.

The same procedure was presented to Delta Removal Incorporated and their cost ranges from $800 - $1000 per household unit. This cost will greatly reduce with a number of units assigned to the agency with exact details on home sizes and contents inside to clean around. The agency is over estimating in order to lower costs, later.

Currently waiting for Bristol Environmental Inc. to call and give an estimate for the same scenario as described in the beginning.

Controlled Environmental Systems

• 301-303 N. York Road, Suite 104 • Warminster, PA 18974
• (215) 957-2500 • FAX (215) 957-2796
2300

November 11, 1998

Mr. David Graff
Black & Veach
Curtis Center
Ste. 850N
601 Walnut Street
Phila., Pa. 19106

Re: Lead Dust Cleaning
Palmerton, Pa.

Dear Mr. Graff,

Our Interior Scope of Services are as follows:

All interior hard surfaces; including window sills and wells; will be Hepa Vacuumed followed by a wet wiping with 5% Tri Sodium Phosphate and concluded with a second Hepa Vacuuming. This three step process is the prescribed cleaning method as detailed by HUD and the CDC to remediate lead dust levels to acceptable permissible exposure levels.

All upholstered and rugged items will be Hepa Vacuumed at a rate of one square yard per minute in two steps, in opposing directions.

Exclusions:

Decorative and personal items, HVAC interior duct work, closet & cabinet contents.

Cost of Service. . . .$ $650 — $850 per unit

$800 – $1000 From Delta Removal Inc.

BLACK &VEATCH Special Projects Corp.
Philadelphia Office

MEMORANDUM

USEPA Region III
Palmerton OU-3

B&V Project 47102.112
March 3, 1999

This memorandum will address the following:

- Lead-solubilizing cleaners
- Cleaning time for one home
- Costs of clearance sampling

When cleaning residences to remove lead dust, the Palmerton Environmental Task Force (PETF) does not recommend the use of lead-solubilizing cleaners to remove lead dust in homes where lead-based paint is present. Many lead-solubilizing cleaners contain chemicals that can break down lead-based paint and cause it to strip. The PETF recommends the use of cleaners that contain tri-sodium phosphate (TSP) as an alternative to lead-solubilizing cleaners. TSP cleaners have been proven very effective in the removal of lead dust with out stripping lead-based paint.

The time it takes to clean one residence depends primarily on the size of the house. Generally speaking, the PETF estimated that it takes about a day to clean a small home and 3 days to clean a large home.

The main factor determining costs for clearance sampling is the number of samples taken at each residence. The number of samples varies according to each individual house based on the type of sample (single-surface or composite) number of rooms, windows, total square footage of common areas, and whether or not there is containment (plastic sheeting as airlock on doors between treated and untreated areas) within the home. The PETF bases their clearance sampling on a written protocol. The following example incorporates the PETF protocol (found in the Attachment) for determining the number of samples necessary for clearance sampling.

Example: For a home with no containment requiring single-surface interior treatments, a minimum of 11 dust samples would be required:

- Two dust samples form at least four rooms
- One interior window sill, alternating between rooms
- One floor
- One for every 2000 sq. ft. of a common area room floor.

This number may vary according to square footage and number of rooms in a home.

able 15.1 Recommended Minimum Number and Location of [illegible]gle-Surface Dust Samples

Clearance Category	Category Description	Number and Location of Single-Surface Wipe Samples In Each Area[1]	Number and Location of Composite Wipe Samples
1	Interior treatments No containment within dwelling	Two dust samples from at least four rooms in dwelling (whether treated or untreated): ♦ One interior window sill or window trough, alternating between rooms. ♦ One floor. AND ♦ For common areas, one for every 2,000 ft^2 of a common area room floor (if present).	Three composite samples for every batch of *four* rooms (whether treated or untreated): ♦ One floor composite. ♦ One interior window sill composite. ♦ One window trough composite. AND ♦ For common areas, one floor subsample for every 2,000 ft^2 (if present); up to 8,000 ft^2 can be sampled for each composite.
2	Interior treatments With containment (plastic sheeting as airlock on doors between treated and untreated areas)	Same as Category 1 but only in every *treated* room (up to four rooms) AND One floor sample outside the containment area but within 10 feet of the airlock to determine the effectiveness of the containment system. This extra *single-surface sample is recommended in 20 percent* of the treated dwellings in multifamily housing and *all* single-family homes. ♦ For common areas, one floor sample for every 2,000 ft^2 and one floor sample outside containment.	Same as Category 1 but only in every *treated* room AND One floor sample outside the containment area but within 10 feet of the airlock to determine the effectiveness of the containment system. This *extra single-surface sample is recommended in* 20 percent of the treated dwellings in multifamily housing and *all* single-family homes. ♦ For common areas, one floor subsample for every 2,000 ft^2 (up to 8,000 ft^2 for each composite) and one floor sample outside containment.
3	Exterior treatments	Two dust samples as follows: ♦ At least one dust sample on a horizontal surface in part of the outdoor living area (e.g., a porch floor or entryway). ♦ One window trough sample on each floor where exterior work was performed. An additional trough sample should be collected from a few lower floors to determine if troughs below the area were contaminated by the work above.	Two dust samples as follows: ♦ One composite on a horizontal surface in part of the outdoor living area (e.g., a porch floor or entryway). ♦ One window trough composite for every four floors where exterior work was performed, including lower floors where exterior work was not done, if present.
4	Routine maintenance work	At least 1 floor dust sample for every 20 high-hazard jobs near the work area (see Chapter 17 for definition of "high hazard").	Same as single-surface sampling.
5	Soil treatment	One dust sample from the entryway.	One dust sample from the entryway.

[1] A room includes a hallway or a stairway. If no window is present, collect just one floor sample. When a closet is treated, the room to which it is attached should be tested. A closet is not considered to be a separate room. If all rooms received similar treatments and cleaning, only four rooms need to be sampled for clearance purposes. More rooms may need to be sampled in larger dwellings. The room to be sampled should be selected based on where most of the dust-generating work was done or in the judgment of the clearance examiner.

Appendix C

APPENDIX C

Predesign Sampling Cost Estimate and Sampling Protocols

BLACK & VEATCH
Philadelphia Office

MEMORANDUM

Palmerton Zinc Site OU3
Summary of Costs for Laboratory Analysis-Metals

B&V Project 47102.111
November 18, 1998

To: File

From: Jody L. Shade

Metals Analysis Costs- Soil- lead, zinc, cadmium, and arsenic

On September 24, 1998, I called four EPA Contract Laboratory Program (CLP) laboratories and requested cost information for metals analysis (lead, zinc, cadmium, and arsenic) on residential soil samples. I asked for turnover periods of 2 weeks, 3-5 days, 48 hours, and 24 hours. The following shows the ranges of costs that were quoted for lead, zinc, cadmium, and arsenic analysis on soil samples.

Turnover	Cost/sample	Average Cost
2 weeks	$43 - $60	$45
3-5 days	$65 - $85	$69
48 hours	$75 - $96	$83
24 hours	$86 - $144	$114

These costs include analysis, sampling jars, preservatives, shipping containers, and shipping charges. These costs are for analysis of the four mentioned metals only. If analysis for additional metals is desired, the costs would increase.

The actual quotes from the CLP laboratories are found in the Attachment.

Metals Analysis Costs - household dust- lead, zinc, cadmium, and arsenic

On November 17, 1998, I called Triangle Labs and asked them for cost information for analyses on household dust for lead, zinc, cadmium, and arsenic using University of Cincinnati Surface Dust Analysis Protocol.

Turnover	Cost/sample
21 days	$160
14 days	$200
7 days	$240

These quotes are for dust samples collected on cassettes or as wipe samples. A copy of this price quote is found in the Attachment.

RECRA
LabNet
a division of Recra Environmental, Inc.
Virtual Laboratories Everywhere

September 24, 1998 Quote PA98-152

Ms. Jody Shade
Black & Veatch
601 Walnut St., Suite 850W
Philadelphia, PA 19104

Dear Ms. Shade:

In response to your request, RECRA LabNet is pleased to provide this proposal for analytical services. The analyses and the charges per sample are listed in the following table.

Parameter	Method	$/Sample(soil)
Arsenic, T	6010	12
Lead, T	6010	12
Cadmium, T	6010	12
Zinc, T	6010	12

The charges reflect our normal 14 day turnaround time and a level 2 data package with supporting standard QC data. The prices also include the necessary bottles, preservatives and shipping containers. The analyses will be performed in accordance with the specified EPA test methods.

Accelerated TAT is availble for a premium. Premiums are: 3-5 days at 50%, 48 hrs at 100% and 24 hrs at 200%. Accelerated TAT requires advance notice and scheduling with the laboratory.

Field, trip and site specific MS/MSD samples are charged as regular samples.

This quote is valid for 90 days. The information in this proposal shall not be disclosed to a third party without the written consent of RECRA Labnet. RECRA terms and conditions apply.

Thank you for considering RECRA LabNet. If you have any questions or if we can be of further assistance, please feel free to call me at 412-825-9614.

Very truly yours,

David L. Bernard
Regional Sales Manager

110 Route 4 • Englewood, New Jersey 07631 Phone: (201) 567-6868 Fax: (201) 567-1333

Friday, September 25, 1998

Jodi Shade
Black & Veatch
601 Walnut Street
Suite 850
Philadelphia, PA 19106

Re. Metals
Quotation #: 9/24/981585

Dear Ms. Shade:

Chemtech is pleased to provide you with this quotation for analytical services. All analyses will be performed in accordance with the requirements of the proposal and approved methodologies. This quotation shall remain in effect for 30 days.

1. Qualifications:

Chemtech has been an EPA Superfund CLP laboratory for over ten years, and is certified by the New York State Department of Health as a CLP laboratory. Chemtech is also certified by the NYSDOH (Certification Number 10624), and New Jersey Department of Environmental Protection (Certification Number 02548), as well as other states for potable and non-potable water, wastewater, solid and hazardous waste.

2. Services and Unit Prices:

ANALYSIS	QUANT.	MATRIX	TURNAROUND	$ UNIT PRICE
Lead, Cadmium, Zinc, and Arsenic	500 10/Round	Soil	21Days	60.00

- Prices include the delivery of bottles, preservatives and COC's by UPS second day. The same day or overnight delivery charges will be assessed to the client (minimum charge is $25.00).

CHEMTECH

3. Data Deliverables:

Data deliverables shall be according to the CLP Format. There will be additional charges for the applicable QC's. Duplicates, Spikes, Method Spikes, Method Spike Duplicates, Field Blanks and Trip Blanks are considered as additional samples and billed at unit cost.

4. Turnaround Time:

The normal turnaround time is three weeks from the time of sample arrival at the laboratory. Faster turnaround time (EXPRESS...) is available at additional cost.

EXPRESS...	COST ($)
21 Days	0. 0
5 Days	75.00
48 Hours	96.00
24 Hours	120.00

Samples will be properly stored at our facility, for a period of 30 days after the completion of the required analyses unless there are further instructions.

We are looking forward to providing you with quality analytical services and on time delivery. Should you have any questions or need additional information, please do not hesitate to call me.

Sincerely,

Chemtech

FP

Franco Pugliese
Director of Sales

Committed To *Your* Success

Severn Trent Laboratories
200 Monroe Turnpike
Monroe CT 06468

Tel: (203) 261-4458
Fax: (203) 268-5346

September 24, 1998

Ms. Jodi Shade
Black & Vetch
Philadelphia, Pa

tel: (215) 928-2211
fax: (215) 928-1780

RE: EPA-SUPERFUND FEASIBILITY STUDY

Dear Ms. Shade:

In response to your request, attached please find the unit price quotation for this EPA Feasibility Project. The prices reflect a (2) week verbal turnaround time, followed by the final report in our standard Level 2 type data package format. If requested, an electronic deliverable would be available in your desired format within a few days.

We are pleased that you have considered using Severn Trent Laboratories for this upcoming work, and I am hopeful that this quotation will meet with your approval. As we discussed, please bear in mind that our ability to accomodate rush turnaround times will vary from time to time, so please be sure to schedule this type of work as much in advance as possible.

If you have any questions or comments, please do not hesitate to call me, or in my absence, our Client Service Manager, Stephanie Plunkett, at (203) 452-3268 and (203) 452-3250 respectively. We look forward to working with you and AMC Technologies.

Sincerely,

Eric N. Johnson

Eric N. Johnson
Account Executive/ Severn Trent Laboratories

STL

Committed To *Your* Success

Severn Trent Laboratories
200 Monroe Turnpike
Monroe CT 06468

Tel: (203) 261-4458
Fax: (203) 268-5346

STL Quotation/September 24, 1998
for
Black & Vetch/EPA Superfund Feasibility Study
TABLE I

Analytical/Method	Unit Price	24-hr TAT	48-hr TAT	5-day TAT/50%
ICP Prep/3010	$15	$30	$26.25	$22.50
Total lead analysis/6010	$ 7	$14	$12.25	$10.50
Total arsenic analysis/6010	$ 7	$14	$12.25	$10.50
Total cadmium analysis/6010	$ 7	$14	$12.25	$10.50
Total zinc analysis/6010	$ 7	$14	$12.25	$10.50
UNIT SAMPLE PRICES	$43	$86	$75.25	$64.50

Extended Prices:

Typically, STL-CT can accommodate up to (1) SDG per day. This quote is based on not exceeding that volume; however, the Severn Trent network of laboratories has additional capacity to perform CLP metals analysis should the need arise.

Rocky Mountain Laboratories, Inc.
The Microanalysis Experts

602 Park Point Drive, Suite 101
Golden, CO 80401

Phone (303) 526-9449 (800) PRO-LABS
Fax (303) 526-0877
e-mail rmlab@prolabs.com

Fee Schedule

Effective March 1 1996

Rocky Mountain Laboratories is an independent, analytical chemistry laboratory. We specialize in ***materials analysis*** and have complete, state-of-the-art equipped facilities. Our staff provides personalized service for production, quality assurance, failure analysis, and research and development efforts. Our services are described in our General Services Brochure.

PRICING

BEAM TIME™ SERVICE (XPS/ESCA, Auger, SEM, EDS/EDX, SIMS, SPM, FTIR)	$330 per BTU

Each BEAM TIME™ Unit (BTU) includes:

- Sample mounting
- One hour staffed instrument
- Data reduction, quantification
- Verbal report by telephone
- Complete written report
- Overnight delivery of report if requested
- Archiving of samples, data, and report

OTHER SERVICES (stylus profilometry, optical microscopy, gravimetric analysis, sample preparation)	$125 per hour
STAFF CHARGES	$100 per hour

TERMS AND CONDITIONS

Firm, fixed-price quotations are provided on request.
Delivery time is one to two weeks after receipt of samples.
Scheduling interrupt fees apply to priority requests.
Payment terms are NET 30.

PLEASE CALL FOR SAMPLE HANDLING AND SHIPPING INFORMATION

Quotation
Triangle Laboratories, Inc.

To: Jody Shade

Re: Quotation: 9800002350

This quotation is provided to acknowledge receipt of your request for bid and provide you with information about your requested sample analysis. Please review this information. If you have any questions, please phone your Triangle Laboratories Customer Services Representative and refer to the TLI Quotation number above. Unless instructed otherwise, we will use these addresses and phone numbers.

Billing Address: (BLV01)
Black & Veatch
601 Walnut Street
Suite 850 W
Philadelphia, PA 19106

Shipping Address:
601 Walnut Street
Suite 850 W
Philadelphia, PA 19106

Telephone Numbers:
Phone: 215-928-2211
Fax: 215-928-1780

What are SDG?
Cassettes
Wipe sample

Please send this form with your samples.

Ship Samples to:
Triangle Laboratories, Inc.
Attn: Sample Custodian
801 Capitola Drive
Durham, NC 27713
USA

Standard Delivery group
300 samples sent in group of 10

Our quotation is based on your sample(s) as follows:

Quote Made On: 11/17/98 **Valid Through:** 07/17/99
Purchase Order #:
Your Project ID: Household Dust

Analysis Description and Sample Size	Quantity	Matrix	Unit Price	Expanded Price
7000 SERIES (SW846) (1) SDGs expected 1 week apart starting during the week of: 02/15/99 Turn Around Time: 21 days Lead, Cadmium, Zinc, Arsenic Report Level II: Summary & Sample Raw Data	30 SDGs of 10	Dust	160.00	48,000.00
7000 SERIES (SW846) (1) SDGs expected 1 week apart starting during the week of: 02/15/99 Turn Around Time: 14 days Lead, Cadmium, Zinc, Arsenic Report Level II: Summary & Sample Raw Data	30 SDGs of 10	Dust	200.00	60,000.00
7000 SERIES (SW846) (1) SDGs expected 1 week apart starting during the week of: 02/15/99 Turn Around Time: 7 days Lead, Cadmium, Zinc, Arsenic Report Level II: Summary & Sample Raw Data	30 SDGs of 10	Dust	240.00	72,000.00

Quotation
Triangle Laboratories, Inc.
TLI Quotation 9800002350

~~Recommended Sampling Amounts:~~
(1) ~~200 grams in 16 oz wide mouth amber jar~~

All prices are in U. S. dollars. Should the scope of project change, Triangle Labs reserves the right to modify pricing accordingly.

* Re-extractions or dilutions due to high analyte levels or sample matrix problems may increase the total amount of the final bill. All additional charges must be authorized by you before the re-work is initiated.

Special Requirements / Comments:

Using the TLI Chain of Custody or including the TLI Quote number on your Chain of Custody and providing a Purchase Order at time of sample submission will enable the laboratory to start work on samples more quickly.

Please notify TLI of sample shipment 2-3 days prior to receipt at the laboratory to confirm scheduling.

For additional information please contact:
Customer Services Representative: Tanya Edmonds : 919-544-5729x257

Thank you for your Interest!

For TRIANGLE LABORATORIES, INC.

Signature: [signature] Date: 11/17/98
Tanya Edmonds : 919-544-5729x257

United States
Environmental Protection
Agency

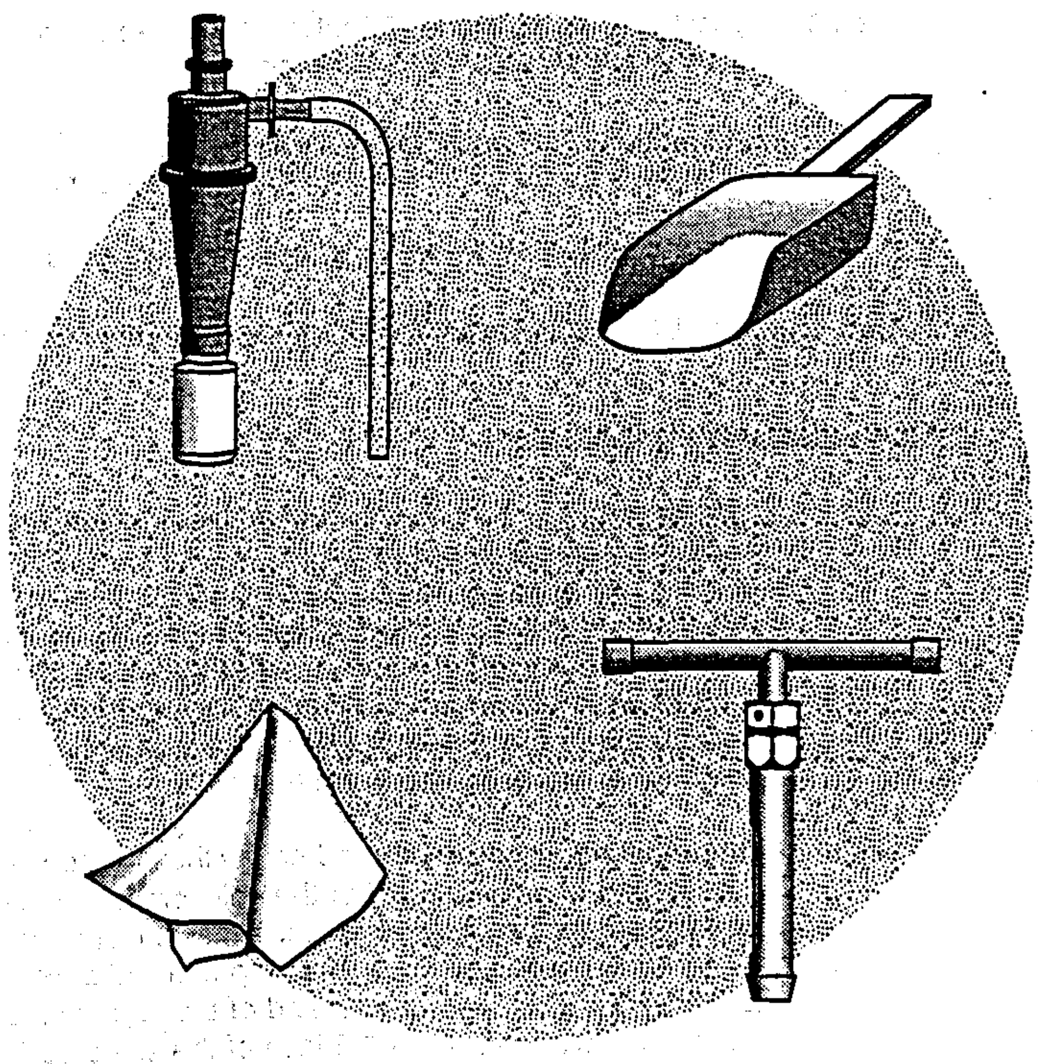
Pollution Prevention
and Toxics
(7404)

EPA 747-R-95-001
March 1995

EPA

Residential Sampling for Lead: Protocols for Dust and Soil Sampling

Final Report



B. Protocol for Collection of Soil Samples for Lead Determination

1.0 Introduction

This protocol provides for the collection of soil samples using either scooping or coring methods. The protocol is applicable for collection of soil samples for lead determination.

2.0 Equipment and Supplies

2.1 Scoop Sampling Equipment

2.1.1 Plastic centrifuge tube, 50-mL with screw-on cap. Used for scoop sampling or soil collection containers.

2.1.2 Sample collection container, resealable plastic bags (1 quart or 1 gallon) or sealable rigid-walled container with 50-mL minimum volume.

2.1.3 Spoon, plastic or stainless steel. Used for scoop sampling.

2.1.4 Steel or plastic measuring tape or ruler, divisions to at least 1/8 inch.

2.2 Core Sampling Equipment

2.2.1 Coring probe, 0.5 inch minimum diameter, lead-free. The probe must be capable of being forced into hard ground to a depth of at least 2 inches without being damaged and have a mechanism to remove the core from the probe to permit discarding all but the top 0.5 inch of the soil core (see subsection 2.2.2). A number of devices can be utilized as a coring probe. Examples include: plastic or steel pipe, small tree sapling planters, and a professional stainless steel coring probe equipped with plastic liners, cross T-bar, and hammer.

2.2.2 Coring plungers, one with and one without a stop, sized to fit coring probe, lead-free. Removal of the soil core is generally performed using a pair of plungers machined to fit the inside diameter of the coring device. One plunger is equipped with a stop that limits extension of the plunger to within 0.5 inch from the far end of the coring probe. It is used to remove all except the top 0.5 inch of the soil core from the coring probe. The other plunger (without a stop) is used to remove the remaining 0.5 inch of the soil core from the coring probe.

2.2.3 Sample collection container, resealable plastic bags (1 quart or 1 gallon) or sealable rigid walled container with 50-mL minimum volume. If plastic bags are used, samples should be double bagged to protect against breakage and potential sample loss.

2.2.4 Spoon, plastic or stainless steel. Used for scoop sampling.

2.2.5 Steel or plastic measuring tape or ruler, divisions to at least ⅛ inch.

2.3 General Supplies

2.3.1 Field notebooks, bound with individually numbered pages, see subsection 4.1.

2.3.2 Indelible ink marker, black or blue.

2.3.3 Ink pens, black or blue.

2.3.4 Packaging tape, used for sealing shipping containers.

2.3.5 Plastic bags, trash bags with ties.

2.3.6 Plastic gloves, powderless. Gloves with powder should not be used to avoid potential contamination of samples from powder material.

2.3.7 Preprinted field forms, preprinted with sufficient entry lines to address documentation needs presented in subsection 4.1

2.3.8 Shipping containers, cardboard or plastic for interim storage and shipment of sample collection containers.

2.4. Cleaning Supplies

2.4.1 Water, drinking water. Drinking water is used to assist in cleaning sampling equipment for soil sample collection. High purity water is not required for cleaning of sampling equipment because action levels for lead in soils are relatively high with respect to lead levels in drinking water.

2.4.2 Wipe, Disposable towelette moistened with a wetting agent. Used for cleaning sampling equipment. Wipe brands or sources should contain insignificant background lead levels. Laboratory analysis of replicate blank wipes should be used to determine background lead levels prior to use in the field. It is recommended to avoid brands of wipes that contain aloe because wipes containing aloe have been found to contain higher background lead levels. Background lead levels less than 10 µg per wipe are considered insignificant for most soil sampling activities.

3.0 Sampling Procedure

Two types of collection procedures are described in this section: scoop sampling and core sampling. Either procedure can be used for the collection of soil samples for lead determinations. Advantages and disadvantages of each are presented at the beginning of each procedure.

3.1 Scoop Sampling Procedures

Two procedures are provided for collection of soils at a given sampling location using a scooping methods. Scooping procedures are effective for collection from semisoft, sticky, and loose, sandy soils. Scooping procedures are not recommended for hard or frozen soils. Scooping procedures are less effective than coring methods for collection of multiple samples having uniform surface area sampled and consistent sampling depths. The scooping methods described here may result in collection bias toward increased amounts of surface soil as opposed to subsurface soil caused by the curvature of the scooping tools. Coring methods are generally free from this collection bias.

3.1.1 Scoop Sampling Using a Plastic Centrifuge Tube

3.1.1.1 Label a new plastic 50-mL centrifuge tube for use as a sample collection container (See subsections 2.1.2 and 5.5).

3.1.1.2 Pull on a pair of clean, powderless, plastic gloves. Gloves are used to protect the workers' hands and the integrity of the samples (to aid in avoiding cross-contamination between samples).

3.1.1.3 Using a measuring tape and a spare plastic 50-mL centrifuge tube, determine the proper scooping depth of the tube needed to collect approximately the top 0.5 inch soil. For example, if the plastic centrifuge tube is about 1 inch in diameter, then the proper scooping depth is to insert the tube into the soil until the soil surface is about even with the center of the tube.

3.1.1.4 Remove the cap of the plastic centrifuge tube and insert the open end of the tube into the soil to the desired depth as determined in step 3.1.1.3. Collect the soil into the tube by pushing or pulling the tube through the soil surface while maintaining the scooping depth of the tube (0.5 inch) in the soil. Move the tube a distance of 6-12 inches across the soil surface to complete collection of the soil into the tube. The movement of the tube across the sample location will result in a composite type soil sample.

3.1.1.5 Remove the tube from the ground, and wipe off any excess soil clinging to the outside of the tube and cap threads with a gloved finger. Replace the cap. Label the plastic centrifuge tube with sufficient information to uniquely identify the sample. Discard any gloves used during sample collection in a trash bag.

3.1.2 Scoop Sampling Using a Spoon

3.1.2.1 Label a new resealable plastic bag for use as a sample collection container (See subsection 5.5).

3.1.2.2 Pull on a pair of clean, powderless, plastic gloves. Gloves are used to protect the workers' hands and the integrity of the samples (to aid in avoiding cross-contamination between samples).

3.1.2.3 Using a measuring tape and a clean spoon, dig a small test hole adjacent to the sampling location to the depth of 0.5 inch. Use this hole as a visual aid during soil collection to help limit collection to a depth of 0.5 inch. Clean the spoon using a wipe until soil is no longer visible on the spoon.

3.1.2.4 Scoop the soil with the spoon down to the depth indicated by the test hole and place the sample in a sample collection container. Continue to collect soil until a circular hole of approximately 2 inch (0.5 inch deep) has been created.

3.1.2.4 Collect soil from two more locations within a 1 foot diameter circle around the first sample location, using the same procedure described above (subsections 3.1.2.2 through 3.1.2.4). Composite these scoop samples into the same sample collection container and seal the container in a manner that will minimize the air contained in the container. Discard any gloves used during collection in a trash bag after all three scoop samples have been collected and composited.

3.1.2.5 Pull on a pair of clean, powderless, plastic gloves. Clean the spoon using wipes and water until soil is no longer visible on the spoon. Discard any wipes and gloves used during cleaning in a trash bag. An alternative approach to cleaning is to use disposable spoons.

3.2 Core Sampling Procedures

The collection of soils using a coring method at a given sample location is provided in this subsection. Coring methods are effective for collection of soils from dense, hard, or sticky soils. Coring methods are not recommended for loose, sandy soils. Coring methods generally produce samples with more uniform surface areas and consistent sampling depths than scooping methods.

3.2.1 Label a new resealable plastic bag for use as a sample collection container (See section 5.5).

3.2.2 Pull on a pair of clean, powderless, plastic gloves. Gloves are used to protect the workers' hands and the integrity of the samples (to aid in avoiding cross-contamination between samples).

3.2.3 If needed, clean the coring probe and coring plungers using wipes or water. The sampling equipment is considered clean if no soil or other debris is visible on any of the surfaces. Check the stop on the coring plunger, equipped with a stop, to ensure that the plunger tip stops at a distance of 0.5 inch from the end of the coring probe. Adjust the stop if needed.

3.2.4 Place a directional arrow on the outside of the coring probe with the arrow head pointed toward the ground. This arrow identifies the orientation of the soil core with respect to the surface of the ground. The arrow is used to avoid inadvertent loss of the top of the soil core when the plunger is used to remove and collect the soil sample. If the coring probe is a professional stainless steel coring tool equipped with plastic liners, place the arrow on the outside of the plastic liner and orient the liner in the probe so that the arrow head is pointed toward the ground.

3.2.5 Grip the coring tool firmly between two hands and, using a slight twisting motion, drive the tool into the soil surface at the designated sampling location to a depth of at least 2 inches. The directional arrow (from section 3.2.4) must be pointing down. For extremely hard soils (i.e., hard packed or frozen), a hammer or other similar device may be needed to drive the tool into the ground. If conditions do not allow for full penetration to a minimum of 2 inches, make every effort to penetrate to a depth of at least 0.5 inches. If penetration is less than 0.5 inches, the documentation generated for the sample should indicate the approximate depth achieved.

3.2.6 Twist and snap the coring tool to one side and carefully remove the tool from the ground while retaining the soil core in the tool.

3.2.7 Insert a clean plunger, equipped with stop, into the top end of the coring probe or liner. (The bottom end is indicated by the arrow head drawn on the tool.

The top end is the opposite opening.) Push out all but 0.5 inch of the soil from the probe with the plunger. Using a gloved finger, wipe off the excess soil protruding from the probe. Allow the soil pushed out of the probe to fall on the ground near but not on the sampling location.

3.2.8 Using a clean plunger (without stop), push the remaining 0.5 inch section of the sample core into a sample collection container.

3.2.9 Collect two more soil cores within a 1 ft diameter circle around the first sampling location, using the same procedure described above (subsections 3.2.2 through 3.2.8). Composite these cores into the same sample collection container and seal the container in a manner that minimizes the air contained in the container. Discard any gloves used during collection in a trash bag after all three core samples have been collected and composited.

3.2.10 Pull on a pair of clean, powderless, plastic gloves. Clean the coring probe, coring plungers, and plastic inserts (if used) using wipes and water until soil is no longer visible on the equipment. Discard any wipes and gloves used during cleaning in a trash bag.

4.0 Quality Control

Adherence to quality control (QC) procedures is an important part of field sample collection. QC procedures, including documentation requirements, field QC samples, reference material check samples, and contamination avoidance are presented in this section.

4.1 Documentation

All field data related to sample collection must be documented. A field notebook or sample log form can be used to record field collection data. It is recommended that both types of documentation records (field notebooks and preprinted sample log forms) be utilized to assure collection of all relevant field data. Field data entries on documentation records must adhere to the following requirements:

4.1.1 General Documentation Requirements:

- All entries must be made using ink.
- Each page (notebook or form) must include the name of the person making the entries and the date of entries found on the page.
- Any entry errors must be corrected by using only a single line through the incorrect entry (no scratch outs) accompanied by the initials of the person making the correction and the date of correction.

- An initial page that correlates initials to a specific name must be generated and maintained with field data records to trace any initials used in notebooks and on data forms.

4.1.2 Specific Sampling Site Documentation Requirements:

- General sampling site description.
- Project or client name, address, and city/state location.
- Information as to what specific collection protocol was used.
- Information as to the use of interim storage and sample shipment mechanisms.

4.1.3 Documentation Required for Each Sample Collected:

- An individual and unique sample identifier and date of collection. This must be recorded on the sample container in addition to the field data records (notebook or form).
- Name of person collecting the sample and specific sampling location data from which the sample was removed.

4.2 QC Samples

4.2.1 Blank Samples. Normally, blank samples should be periodically collected (designated) throughout the sampling day at each sampling site. Field blank samples are used to identify any potential systematic lead contamination present in the sampling media and handling of samples during field collection and laboratory analysis activities. However, because soil samples are not collected on a sampling media such as a wipe of filter, there is no practical method for collection of a blank sample.

Although sampling equipment rinses can be used to collect potential field contamination related information, difficulties exist in laboratory processing of these "field blanks" with soil samples. Sampling equipment rinse-type field blanks cannot be carried through the homogenization/ drying steps that are commonly applied to soil samples. In addition, lead results from equipment rinses are reporting in weight-volume units (i.e., µg/mL) and cannot be directly compared or related to the reported soil lead weight-weight results (i.e., µg/g). Therefore, no field blanks are recommended for soil sampling. Contamination effects should be minimized through adherence to the procedures specified in this protocol.

4.2.2 Blind Reference Material Samples. Reference materials should be periodically submitted to the laboratory for analysis as a check on adherence to proper laboratory sample preparation and instrumental analysis methods. Prepare a blind reference material by placing a portion (1-2 grams) of a reference material into a labeled sample collection container. It is recommended that the frequency of these QC samples be at least 1 per 20 field samples. Reference materials from NIST[6], such as SRMs 2709, 2711, and 2704, are readily available and can be used for preparing blind reference materials. Other sources of materials with known lead levels, such as soil materials from the ELPAT[7] program, may also be used as blind reference materials.

4.3 Contamination Avoidance

The following work practices should be followed to prevent cross-contamination of samples:

- Avoid tracking soil from one location to another by:
  - identifying and clearly marking all sampling locations upon arrival at the sampling site, and
  - instructing field team members to avoid walking through or over any of the marked sampling location areas.
- Use a new pair of powderless gloves at each sampling location.
- Inspect all sampling equipment for cleanliness prior to collection of each sample. Always clean suspect equipment if in doubt.
- Do not open sample containers until needed to collect each sample.
- When using bulk packed wipes, at each sampling location, discard the first two wipes pulled from the wipe container.

5.0 Glossary

5.1 Digestion, Sample preparation process that solubilizes lead present in the sample. The digestion process produces an acidified, aqueous solution called the digestate. A lead determination is made on the digestate during an instrumental measurement process.

5.2 Field Data, Any information collected at the sampling site.

5.3 Field Sample, Physical material taken from the sampling site that is targeted for lead determination.

5.4 Reference Material, Material of known composition containing a known amount of lead. These materials have typically been subjected to a large number of lead determinations to develop a lead result known to a high degree of confidence.

5.5 <u>Sample Collection Container</u>, Container for holding and transporting the samples from the field to the laboratory. The internal volume of the container must be sufficient to hold the entire collected sample.

5.6 <u>Sampling Location</u>, Specified area within a sampling site that is subjected to sample collection. Multiple sampling locations are commonly designated for a single sampling site. An example would be at the bottom of a specific slide in a specific playground area.

5.7 <u>Sampling Site</u>, Local geographical area that contains the sampling locations. A sampling site is generally limited to an area that can be easily covered on foot. An example would be John Smith's house at 3102 Nowhere Avenue, Detroit, MI.

5.8 <u>Sample Preparation</u>, Process used to ready a sample received from the field for lead determination using instrumental measurement methods. The process is dependent on the sample type and can include a large number of steps such as homogenization, drying, splitting, weighing, digestion, dilution to a final known volume, and filtering.

C. Protocol for Collection of Dust Samples for Lead Determination Using Wipe Sampling

1.0 Introduction

This protocol provides for the collection of settled dust samples from hard, relatively smooth, nonporous surfaces using wipe methods. The protocol is not applicable for the collection of settled dust samples from highly textured surfaces, such as brickwork and rough concrete, and soft fibrous surfaces, such as upholstery and carpeting. The protocol is capable of producing samples for lead determination results in loading terms ($\mu g/ft^2$).

2.0 Equipment and Supplies

2.1 Sampling Equipment

2.1.1 Disposable shoe covers (optional), see subsection 4.3.

2.1.2 Masking tape, used for holding down sampling templates and marking sampling locations.

2.1.3 Sample collection container, sealable rigid-walled container with 50-mL minimum volume. Use of a resealable plastic bags for holding and transporting the settled dust wipe sample is not recommended due to the potential losses of settled dust within the plastic bag during laboratory handling. Quantitative removal and processing of the settled dust wipe sample by the laboratory is significantly improved through the use of sealable rigid walled containers.

2.1.4 Sampling template, 1 ft^2 inside area reusable aluminum or plastic, or disposable cardboard or plastic template. A variety of shapes are recommended for use in variable field situations such as square, rectangular, square "U" shaped, rectangular "U" shaped, and "L." All templates must have accurately known inside dimensions. Templates should be thin (less than $^1/_8$ inch) and capable of lying flat on a flat surface.

2.1.5 Steel or plastic measuring tape or ruler, divisions to $^1/_{16}$ inch.

2.1.6 Wipe, disposable towelette moistened with a wetting agent. Wipe brands or sources should contain insignificant background lead levels. Laboratory analysis on replicate blank wipes should be used to determine background lead levels prior to use in the field. Background lead levels less than 10 µg per wipe are considered insignificant for most dust sampling activities. It is recommended to avoid brands of wipes that contain aloe because wipes containing aloe have been found to contain higher background lead levels. Increased laboratory sample preparation difficulties have also been noted for wipes containing lanolin. Wipe brands or sources selected for use should be of adequate width and thickness to perform the collection procedure. A thin wipe which is approximately 6 inches by 6 inches is recommended. Use of large, multiply or extra thick wipes can cause problems with laboratory analysis. Use of wipes with smaller dimensions may not be capable of holding settled dust contained within the sampling area.

2.2 General Supplies

2.2.1 Field notebooks, bound with individually numbered pages, see subsection 4.1.

2.2.2 Indelible ink marker, black or blue.

2.2.3 Ink pens, black or blue.

2.2.4 Packaging tape, used for sealing shipping containers.

2.2.5 Plastic bags, trash bags with ties.

2.2.6 Plastic gloves, powderless. Gloves with powder should not be used to avoid potential contamination of samples from powder material.

2.2.7 Preprinted field forms, preprinted with sufficient entry lines to address documentation needs presented in subsection 4.1

2.2.8 Shipping containers, cardboard or plastic for interim storage and shipment of sample collection containers.

3.0 Sampling Procedure

Two sampling procedures are presented. One is to accommodate collection of a settled dust sample in an unrestricted area such as a floor (Template Assisted Sampling Procedure). The other is to accommodate collection of a settled dust sample in a restricted area such as a window channel (Confined Area Sampling Procedure). The Confined Area Sampling Procedure should only be used when the Template Assisted Sampling Procedure can not be used due to sampling location constraints. The Confined Area Sampling Procedure assumes the operator can be orientated to a collection position where the sampling location's width is greater than its depth. It also assumes that the depth is no larger than the dimensions of a wipe. If this is not true, then the Template Assisted Sampling Procedure should be used.

3.1 Template Assisted Sampling Procedure

Following is a summary of this procedure:

1. Select a sampling location.
2. Mark the sampling location using a template.
3. Perform first wiping: Side-to-side, fold the wipe.
4. Perform second wiping: Top-to-bottom, fold the wipe.
5. Perform third wiping: Clean-up the corners, fold the wipe, and store the sample.

The detailed procedure is as follows:

3.1.1 Pull on a pair of clean, powderless, plastic gloves.

3.1.2 Carefully place a clean template on the surface in manner that minimizes disruption of settled dust at the sampling location. Either tape or place a heavy object on the outside edge of the template to prevent it from moving during sample collection. An alternative to using a template is to mark an outline of the sampling location using masking tape as described in subsection 3.2.2.

3.1.3 Discard any gloves used to mark the area in a trash bag and pull on a new pair of clean, powderless, plastic gloves.

3.1.4 At the beginning of a sampling period (or if a new bulk-packed container of wipes is opened), remove a minimum of the top 2 wipes from the container and wipe off gloved fingers with each wipe as they are removed. Use the next wipe from the container to collect the sample.

3.1.5 <u>First Wiping, Side-to-Side</u>: Hold one edge of the wipe between the thumb and forefinger, draping the wipe over the fingers of a gloved hand. Hold fingers together, hand flat, and wipe the selected surface area, starting at either corner furthest away from the operator (referred to as a far corner), using a slow side to side (left-to-right or right-to-left) sweeping motion. During wiping, apply pressure to the finger tips.

At the end of the first pass from one side to the other, turn the leading edge of the wipe (the portion of the wipe touching the surface) 180 degrees, pulling the wipe path slightly closer to the operator and make a second side-to-side pass in the reverse direction, slightly overlapping the first pass. (The 180 degree turn is used to assure that the wiping motion is always performed in the same direction on the wipe to maximize dust pickup.) Continue to cover the sampling area within the template, using the slightly overlapping side-to-side passes with the 180 degree turns at each edge until the close corner of the template is reached. Carefully lift the leading dust line into the wipe using a slight rolling motion of the hand to capture the dust inside the wipe. Fold the wipe in half with the sample side folded inside the fold.

3.1.6 Second Wiping, Top-to-Bottom: Using a clean side of the wipe, perform a second wiping over the sampling area within the template starting from a far corner in the same manner used for the first wiping, except use a top-to-bottom sweeping of the surface. When the close corner of the template is reached, carefully lift the leading dust line into the wipe using a slight rolling motion of the hand to capture the dust inside the wipe. Fold the wipe in half (again) with the sample from this second wiping folded inside the fold.

3.1.7 Third Wiping, Clean Corners: Using a clean side of the wipe, perform a third wiping around the perimeter of the sampling area within the template to pick up any dust remaining in the corners. Start from one edge of the template and use the same wiping technique as described above. When the perimeter has been wiped and the starting location reached, carefully lift the leading dust line into the wipe using a slight rolling motion of the hand to capture the dust inside the wipe. Fold the wipe in half one more time with the sample from this third wiping folded inside the fold.

3.1.8 Insert the folded wipe into a sample collection container. Using a tape measure, verify the internal dimensions of the sampling template used to collect the sample and label the sample collection container with sufficient information to uniquely identify the sample and the dimensions of the selected dust sampling area (with units such as inches). Discard any gloves in the trash bag. If the template is a reusable type, clean the template with several clean wipes.

3.2 Confined Area Sampling Procedure

Following is a summary of this procedure:

1. Select a sampling location.
2. Mark the sampling location using masking tape.
3. Perform first wiping: One direction, Side-to-side, fold the wipe.

4. Perform second wiping: One direction (reverse), Side-to-side, fold the wipe.
5. Perform third wiping: Clean-up the corners, fold the wipe, and store the sample.

The detailed procedure is as follows:

3.2.1 Pull on a pair of clean, powderless, plastic gloves.

3.2.2 Mark an outline of the sampling location using masking tape. Care should be taken to minimize any disruption of dust at the sampling location. For areas that are dirty or contain high dust levels, new tape may have to be applied more than once to get adhesion to the surface. Discard any soiled tape in a trash bag.

3.2.3 Discard any gloves used to mark the area in a trash bag and pull on a new pair of clean, powderless, plastic gloves.

3.2.4 At the beginning of a sampling period (or if a new bulk-packed container of wipes is opened), remove a minimum of the top 2 wipes from the container and wipe off gloved fingers with each wipe as they are removed. Use the next wipe from the container to collect the sample.

3.2.5 First Wiping, One Direction, Side-to-Side: Hold one edge of the wipe between the thumb and forefinger, draping the wipe over the fingers of a gloved hand. Hold fingers together, hand flat, and wipe the selected surface area, starting at either corner furthest away from the operator (referred to as a far corner), using a slow side to side (left-to-right or right-to-left) sweeping motion. During wiping, apply pressure to the finger tips. At the end of the first pass from one side to the other, carefully lift the leading dust line into the wipe using a slight rolling motion of the hand to capture the dust inside the wipe. Fold the wipe in half with the sample side folded inside the fold.

3.2.6 Second Wiping, One Direction, Side-to-Side: Using a clean side of the wipe, repeat step 3.2.5 using a wiping motion in the reverse direction.

3.2.7 Third Wiping, Clean Corners: Using a clean side of the wipe, perform a third wiping around the perimeter of the sampling area to collect any dust remaining in the corners. Start from the middle of one edge of the area and use the same wiping technique as described above. When the perimeter has been wiped and the starting location reached, carefully lift the leading dust line into the wipe using a slight rolling motion of the hand to capture the dust inside the wipe. Fold the wipe in half one more time with the sample from this third wiping folded inside the fold.

3.1.8 Insert the folded wipe into a sample collection container. Using a tape measure, measure the dimensions of the sampled area and label the sample collection container with sufficient information to uniquely identify the sample and the dimensions of the selected sampling area (with units such as inches). Discard any gloves in the trash bag.

4.0 Quality Control

Adherence to quality control (QC) procedures is an important part of field sample collection. QC procedures, including documentation requirements, field QC samples, reference material check samples, and contamination avoidance are presented in this section.

4.1 Documentation

All field data related to sample collection must be documented. A field notebook or sample log form can be used to record field collection data. It is recommended to utilize both types of documentation records (field notebooks and preprinted sample log forms) for assuring collection of all relevant field data. Field data entries on documentation records must adhere to the following requirements:

4.1.1 General Documentation Requirements:

- All entries must be made using ink.
- Each page (notebook or form) must include the name of the person making the entries and the date of entries found on the page.
- Any entry errors must be corrected by using only a single line through the incorrect entry (no scratch outs), and marked with the initials of the person making the correction and the date of correction.
- An initial page that correlates initials to a specific name must be generated and maintained with field data records to trace any initials used in notebooks and on data forms.

4.1.2 Specific Sampling Site Documentation Requirements:

- General sampling site description.
- Project or client name, address, and city/state location.
- Information as to what specific collection protocol was used.
- Information as to the use of interim storage and sample shipment mechanisms.

4.1.3 Documentation Required for Each Sample Collected:

- An individual and unique sample identifier and date of collection. This must be recorded on the sample container in addition to the field data records (notebook or form).
- Name of person collecting the sample and specific sampling location data from which the sample was removed.

4.2 QC Samples

4.2.1 Blank Samples. Blank samples should be periodically collected at random throughout the sampling day at each sampling site. Two types of blank samples should be collected: field blanks and QC blanks. Both these blanks are collected in the same manner; however, they are used for different purposes.

4.2.1.1 Field blanks. Field blank samples are used to identify any potential systematic lead contamination present in the wipe and during the handling of samples during field collection and laboratory analysis activities. Field blanks should be collected in the same manner as used to collect field samples with the exception that no surface is wiped. Each wipe designated as a field blank should be removed from the bulk pack, folded to match the field samples, and placed into a labeled sample collection container.

Each field blank must be labeled with its own unique identifier. The identifier for all blanks should be similar to other field samples to mask the identify of the blank from the laboratory (i.e., blanks can then be submitted in a blind manner to the laboratory). It is recommended that field blanks be collected at a frequency of 1 per 20 field samples. At a minimum, three should be collected at each sampling site for each new pack of bulk wipes used for sample collection (i.e., one near the beginning of the sampling period at the site, one in the middle, and one near the end). Field blank lead results should not exceed 20 µg/sample. Lead results above this value should trigger an investigation into the potential cause and resampling of samples associated with the field blank may have to be undertaken. Large blank lead values can often be sporadic and not systematic; therefore, blank correction of field sample results using field blank data is not recommended.

4.2.1.2 QC blanks. QC blank samples are used for preparation of blind reference material samples described in subsection 4.2.2. QC blanks should be collected in exactly the same manner as described for field blanks. Each QC blank must be labeled with its own unique identifier. The identifier for all blanks should be similar to other field samples to mask the identify of the blank from the laboratory (i.e., reference materials prepared from the blanks can then be submitted in a blind manner to the laboratory). It is recommended that QC blanks be collected at a frequency of 1 per 20 field samples. At a minimum, two should be collected at each sampling site (an extra should be collected to assure sufficient QC blanks are available in case problems are experienced during preparation of blind reference material samples).

4.2.2 Blind Reference Material Samples. Reference materials should be periodically submitted to the laboratory for analysis as a check on adherence to proper laboratory sample preparation and instrumental analysis methods. Prepare a blind reference material by placing an accurately weighed portion (0.3000-1.0000 gram) of a reference material into a wipe (QC blank). The wipe should be folded to the same degree as the field samples. Place the reference material containing wipe inside a labeled sample collection container. Include a dummy sampling area on the label to disguise the identity of the blind reference material. The weight of reference material should be chosen to produce a blind reference material sample that will produce a lead level between 200 and 1000 µg/sample. It is recommended that the frequency of these QC samples, submitted to the laboratory for lead determinations, be at least 1 per 20 field samples. Reference materials from NIST[6], such as SRMs 2709, 2711, and 2704, are readily available and can be used for preparing blind reference materials. Other sources of materials with known lead levels, such as performance samples from the ELPAT[7] program, also may be used to prepare blind reference materials.

4.3 Contamination Avoidance

The following work practices should be followed to prevent cross-contamination of samples:

- Avoid disturbing and tracking dust from one location to another by:
  - identifying and clearly marking all sampling locations upon arrival at the sampling site,
  - avoiding walking through or over any of the marked sampling location areas, and
  - instructing field team members to pull on new disposable shoe covers upon each entry into the building.
- Change gloves frequently. Collection of each new sample must be conducted with a new pair of gloves.

- Clean sampling equipment and measuring tapes frequently with wipes.
- Inspect all sampling equipment for cleanliness prior to collection of each sample. Always clean suspect equipment if in doubt.
- Do not open sample collection containers until needed to collect each sample.
- When using bulk packed wipes, at each sampling location, discard the first two wipes pulled from wipe container.

5.0 Glossary

5.1 Digestion, Sample preparation process that solubilizes lead present in the sample. The digestion process produces an acidified, aqueous solution called the digestate. A lead determination is made on the digestate during an instrumental measurement process.

5.2 Field Blank, See subsection 4.2.1.

5.3 Field Data, Any information collected at the sampling site.

5.4 Field Sample, Physical material taken from the sampling site that are targeted for lead determination.

5.5 Reference Material, Material of known composition containing a known amount of lead. These materials have typically been subjected to a large amount of lead determinations to develop a lead result known to a high degree of confidence.

5.6 Sample Collection Container, Container for holding and transporting the samples from the field to the laboratory. The internal volume of the container must be sufficient to hold the entire collected sample.

5.7 Sampling Location, Specified area within a sampling site that is subjected to sample collection. Multiple sampling locations are commonly designated for a single sampling site. An example would be at the bottom of a specific slide in a specific playground area.

5.8 Sampling Site, Local geographical area that contains the sampling locations. A sampling site is generally limited to an area that can be easily covered on foot. An example would be John Smith's house at 3102 Nowhere Avenue, Detroit, MI.

5.9 Sample Preparation, Process used to ready a sample received from the field for lead determination using instrumental measurement methods. The process is dependent on the sample type and can include a large number of steps such as homogenization, drying, splitting, weighing, digestion, dilution to a final known volume, and filtering.

5.10 QC Blank, See subsection 4.2.2.

D. Protocol for Collection of Dust Samples for Lead Determination Using Vacuum Sampling

1.0 Introduction

This protocol provides for the collection of settled dust samples from surfaces using vacuum methods. The protocol is suitable for the collection of settled dust samples from both hard or smooth and highly textured surfaces, such as brickwork and rough concrete, and soft, fibrous surfaces, such as upholstery and carpeting.

Procedures presented in this protocol are intended to provide a method for collection of dust from surfaces that can not be sampled using wipe collection methods. In addition, these procedures are written to utilize equipment that is readily available and in common use for other environmental sampling applications (i.e., air particulate sample collection).

Due to the flow dynamics inherent in the vacuum method, results for vacuum dust samples are not likely to reflect the total dust contained within the sampling area. This protocol generally will have a collection bias toward smaller, less dense, dust particles. However, the protocol, if performed as written, will generate dust lead data that will be consistent and comparable between operators performing the method. This protocol can be used to produce samples for lead determination results in both loading ($\mu g/ft^2$) and concentration ($\mu g/g$). It is recommended, however, that it not be used for the generation of concentration results due to particle size collection bias and potential errors intrinsic to processing and handling preweighed filters (or entire filter cassettes), which are required to determine total collected sample weight. Even though it is not normally recommended, this protocol includes procedures for generation of total collected sample weight.

Other vacuum sampling methods that utilize less common equipment, such as cyclone sample collectors, may be useful for collection of settled dust, particularly with respect to generation of more quantitative dust lead concentration results.

2.0 Equipment and Supplies

2.1 Sampling Equipment

2.1.1 <u>Air-sampling pump</u>. A portable, battery-powered air pump that is capable of a flow rate of 2.5 L/min through a filter cassette equipped with the nozzle specified in subsection 2.1.2. Inlet of the pump must be fitted with a nipple to accept the tubing sized to fit tightly on the outlet side of a filter cassette.

2.1.2 Collection nozzle, A piece of stainless steel or carbon-impregnated plastic machined or molded on each end as follows: one machined or molded end to accept the tubing sized to fit tightly on the inlet side of a filter cassette; the other machined or molded to form a thin rectangular opening of $^{1}/_{2}$ inch by $^{3}/_{64}$ inch.

2.1.3 Disposable shoe covers (optional), See subsection 4.3.

2.1.4 Filter cassette, 37-mm filter cassette, preloaded with 0.8-µm, pore-size Mixed-Cellulose Ester Filters (MCEF) and backup support pad. If lead concentration results are to be determined and reported, then a special handling of these cassettes is required, as described in subsections 3.3.1 and 3.3.2.

2.1.5 Masking tape, used for holding down sampling templates and marking sampling locations.

2.1.6 Soap bubble air flow meter or calibrated rotameter, equipped with inlet and outlet fittings sized to fit tubing used to connect the filter cassette to the air-sampling pump.

2.1.7 Sampling templates, one ft^2 inside area reusable aluminum or plastic, or disposable cardboard or plastic template. A variety of shapes are recommended for use in variable field situations such as: square, rectangular, square "U" shaped, rectangular "U" shaped, and "L." All templates must have accurately known inside dimensions. Templates should be thin (less than $^{1}/_{8}$ inch), and be capable of lying flat on a flat surface.

2.1.8 Secondary sample collection container, resealable plastic bags for holding and transporting the filter cassettes.

2.1.9 Steel or plastic measuring tape or ruler, divisions to at least $^{1}/_{16}$ inch.

2.1.10 Tubing, plastic, flexible tubing sized to fit tightly on both the inlet and outlet of a filter cassette and the inlet of the air-sampling pump.

2.1.11 Wipe, disposable towelette moistened with a wetting agent. Wipe brands or sources should contain insignificant background lead levels. Laboratory analysis on replicate blank wipes should be used to determine background lead levels prior to use in the field. Background lead levels less than 10 µg per wipe are considered insignificant for most dust-sampling activities. It is recommended to avoid brands of wipes that contain aloe because wipes containing aloe have been found to contain higher background lead levels.

2.2 General Supplies

2.2.1 Field notebooks, bound with individually numbered pages, see subsection 4.1.

2.2.2 Indelible ink marker, black or blue.

2.2.3 Ink pens, black or blue.

2.2.4 Packaging tape, used for sealing shipping containers.

2.2.5 Plastic bags, trash bags with ties.

2.2.6 Plastic gloves, powderless. Gloves with powder should not be used to avoid potential contamination of samples from powder material.

2.2.7 Preprinted field forms, preprinted with sufficient entry lines to address documentation needs presented in subsection 4.1

2.2.8 Shipping containers, cardboard or plastic for interim storage and shipment of sample collection containers.

3.0 Sampling Procedure

Two types of sampling procedures are presented. The first, Loading Only Vacuum Collection, is intended for collection of dust for lead loading determinations ($\mu g/ft^2$) only. The second, Collection on Preweighed Media, is intended for collection of dust for both lead loading ($\mu g/ft^2$) and lead concentration ($\mu g/g$) determinations. The later type has two options that differ in the methods used for determining the total collected sample weight.

3.1 Calibration of Air-Sampling Pump

Regardless of the type of the sampling procedure used (see subsection 3.2 or 3.3), the air-sampling pump used for sample collection must be calibrated prior to sample collection for any given day. The procedure for air pump calibration is as follows:

3.1.1 Label a filter cassette with an ink marker to distinguish it as one used for pump calibration (and not to be confused with or used for collection of a field sample). Remove the inlet and outlet plugs and place them in a labeled, resealable plastic bag.

3.1.2 Attach the filter cassette to the air-sampling pump with a piece of flexible tubing. Attach a collection nozzle to the inlet side of the filter cassette using a short section of tubing (less than ½ inch).

3.1.3 Insert a soap bubble meter, calibrated rotameter, or other equivalent calibrated flow rate measuring device in-line between the air pump and the filter cassette equipped with a nozzle.

3.1.4 Turn on the air pump and adjust the flow rate of the air-sampling pump (if possible) to achieve an air flow between 2.5-2.8 L/min. Replace the air-sampling pump if this flow rate cannot be reached. Document the calibration in field data records (notebook or forms).

At the end of the sample collection day, the calibration must be verified. Perform the verification in the same manner as indicated in steps 3.1.1, 3.1.2, 3.1.3, and 3.1.4 above. Document the calibration verification in a field data records (notebook or forms). If the calibration verification fails to reproduce the minimum flow rate of 2.5 L/min, then all samples collected during the day are questionable and should be discarded.

3.2 Loading Only Vacuum Collection Procedure

The following procedure assumes that concentration results will not to be determined. In addition, it assumes that the air-sampling pump has been warmed up, and the calibration has been performed as described in subsection 3.1.

Following is a summary of this procedure:

1. Select a sampling location.
2. Mark the sampling location.
3. Perform first vacuuming: One direction, side-to-side.
4. Perform second vacuuming: One direction, top-to-bottom.
5. Perform third vacuuming: One direction, side-to-side, store the sample..

The detailed procedure is as follows:

3.2.1 Pull on a pair of clean, powderless, plastic gloves.

3.2.2 Mark the area to be sampled using one of the following two procedures:

3.2.2.1 <u>Template Assisted Marking</u>. Carefully place a clean template on the surface in manner that minimizes disturbance of settled dust at the location. Either tape or place a heavy object on the outside edge of the template to prevent it from moving during sample collection.

3.2.2.2 Manual Marking of Sampling Area, Mark an outline of the sampling location using masking tape. Care should be taken to minimize any disruption of dust within the sampling location. For areas that are dirty or contain high dust levels, new tape may have to be applied more than once to get adhesion to the surface. Discard any soiled tape in a trash bag.

3.2.3 Discard any gloves used to mark the area in a trash bag and pull on a new pair of clean, powderless, plastic gloves.

3.2.4 If not prelabeled from prefield processing, label a filter cassette with an ink marker. Remove the inlet and outlet plugs and place them into a labeled resealable plastic bag. Attach the outlet to the air-sampling pump with a piece of flexible tubing. Attach collection nozzle to the inlet side of the filter cassette using a short section of new tubing (less than ½ inch). Always use a new section of tubing for the inlet side of the filter cassette.

3.2.5 First Vacuuming: One Direction, Side-to-Side: With the air-sampling pump on, vacuum the selected sampling surface area, starting at either of the corners furthest from the operator (referred to as a far corner), using a slow side to side (left-to-right or right-to-left) sweeping motion while holding the collection nozzle at an angle of approximately 45° to the sampling surface. Avoid pressing down hard on the sampling surface during sample collection. Move the nozzle at a rate of approximately 2-4 inches per second. At the end of the first pass from one side to the other, carefully lift the collection nozzle and repeat the vacuuming sweep in the same direction as the first, using a slightly closer overlapping pass. Care must be taken to avoid overloading of the filter cassette. Repeat the procedure until the entire sampling area has been covered using the one-direction, side-to-side sweeping motions.

Overloading will result in decreased air flow and a reduction in sampling efficiency and increased sampling bias toward smaller, less dense particles. A drop of air flow of more than 10% is an indicator of overloading. If overloading of samples becomes evident, reduce the sampling area to prevent filter overloading or use multiple cassettes for collection within the same sampling area.

3.2.6 Second Vacuuming: One Direction, Top-to-Bottom: With the air-sampling pump on, vacuum the selected sampling surface area, starting at a far corner, using a slow top-to-bottom sweeping motion in the same manner as described in subsection 3.2.5. Repeat the procedure until the entire sampling area has been covered using the one-direction, top-to-bottom sweeping motions.

3.2.7 Third Vacuuming: One Direction, Side-to-Side: With the air-sampling pump on, vacuum the selected sampling surface area, starting at a far corner, using the slow, one-direction, side-to-side sweeping motion described in subsection 3.2.5. Repeat the procedure until the entire sampling area has been covered using the one-direction, side-to-side sweeping motions.

3.2.8 Remove the filter cassette from the inlet and outlet tubing sections, replace the cassette plugs, and place the sample into a labeled resealable plastic bag. Using a tape measure, measure the dimensions of the sampled area to within $^1/_{16}$ inch (or verify the dimensions of the template) and label the plastic bag containing the sample with sufficient information to uniquely identify the sample and the dimensions of the selected sampling area (with units such as inches). Also record this information on a preprinted data form or in a field notebook. Discard the used gloves in the trash bag.

3.3 Loading and Concentration Vacuum Collection Procedure

The collection procedure used for reporting both loading and concentration results is the same collection procedure as described in subsection 3.2 with two exceptions. First, a prefield and postfield, stabilization-weighing procedure is required to determine the total sample weigh collected. These procedures are described below. Second, if the Option 2 procedures listed below are used for weight determinations, care must be exerted during all handling of the sample cassettes to avoid inadvertent additions of weight to the filter cassettes. Option 2 always requires that the sample cassettes be handled with gloves and never with bare hands.

The overall collection procedure assumes that the air-sampling pump has been warmed up and the calibration has been performed as described in subsection 3.1. Following is a summary of the overall collection procedure:

1. Perform prefield stabilization and gravimetric procedures.
2. Select a sampling location.
3. Mark the sampling location.
4. Perform first vacuuming: One direction, side-to-side.
5. Perform second vacuuming: One direction, top-to-bottom.
6. Perform third vacuuming: One direction, side-to-side, store the sample.
7. Perform postfield stabilization and gravimetric procedures.

The two options available for determining a prefield and postfield sample media weight, preweighed filter and preweighed filter cassette, are presented below:

3.3.1 Prefield Stabilization and Gravimetric Procedure, Option 1—Preweighed Filter

This procedure suffers from the lack of quantitative transfer of all dust clinging to the cassette during postfield processing. Therefore, this option is considered somewhat more qualitative than Option 2. However, unlike Option 2, it is not susceptible to weight errors resulting from inadvertent touching or improper handling of the filter cassettes between pre- and postfield processing.

3.3.1.1 <u>Prefield Procedure</u>. The filter inside the cassette (not the backup support pad) must be weighed to constant weight prior to sample collection (prefield) at known temperature and humidity conditions (i.e., desiccated at room temperature). This can be performed for preloaded filter cassettes as follows:

a. Pull on a new pair of clean, powderless, plastic gloves.
b. Place a unique sample identifier on the outside of each cassette targeted for preweight generation using indelible ink and allow to dry.
c. Using a clean screwdriver, separate the cassette rings that hold the filter in place. Place the rings on a clean, dry area, such as a plastic bag or equivalent surface.
d. Using clean plastic tongs, lift the filter from the cassette and place it in a clean, dry, labeled beaker, watch glass, or other equivalent labeled container.
e. Place the container with filter into a desiccator and allow the filter to stabilize to a constant weight. Periodically weigh and record the filter on a clean balance to determine weight stability. (Record all weights to ±0.0001 g.) A constant weight for this protocol is one that does not change more than ±0.002 gram for repeated measurements (minimum of 2) taken over a minimum of a 24-hour period. Using clean plastic tongs, replace the filter back into the cassette, reassemble the cassette, reweigh the container, and record the empty container weight. The prefield filter weight is the difference between the container plus filter weight and the container-only filter weight.
f. Place the preweighed filter inside the sample cassette into a resealable plastic bag container for transport to the field.

3.3.1.2 <u>Postfield Procedure</u>. The filter and dust inside the cassette (not the backup support pad) must be weighed to constant weight prior to laboratory sample preparation (postfield) at the same known temperature and humidity conditions used for prefield processing. This can be performed as follows:

a. Pull on a new pair of clean, powderless, plastic gloves <u>for each sample handled</u>.

b. Place a unique sample identifier on the outside of a clean digestion vessel (usually a borosilicate glass beaker) using indelible ink and allow to dry. Tare the beaker (determine and record the weight) to ±0.0001 g.
c. Using a clean screwdriver, carefully separate the cassette rings that hold the filter in place while holding the cassette over the labeled beaker. Allow any dust contained inside the cassette to fall into the beaker. Using clean plastic tongs, carefully lift the filter from the cassette and drop it into the beaker. Carefully tap any visible dust clinging to the inside of the cassette into the beaker.
d. Place the beaker with filter into a desiccator and allow the filter to stabilize to a constant weight. Periodically weigh and record the weight of the container plus filter. (Record all weights to ±0.0001 g.) A constant weight for this protocol is one that does not change more than ±0.002 gram for repeated measurements (minimum of 2) taken over a minimum of a 24-hour period. The postfield filter weight is the difference between the container plus filter and dust weight and the container-only weight. Due to the potential of the dust to have significant water absorption, stabilization times for postfield weighing is expected to be considerably longer than for prefield gravimetric. It is recommended (not required) that no initial weight data be attempted until the sample has remained in the desiccator for at least 72 hours.
e. The entire sample plus filter in the beaker must be prepared for lead analysis. The total sample weight for use in determining lead concentration is the difference between the postfield filter weight and the prefield filter weight.

3.3.2 Prefield Stabilization and Gravimetric Procedure, Option 2—Preweighed Filter Cassette

This procedure results in a better quantitative transfer of all dust clinging to the cassette during postfield processing. Therefore, this option is considered somewhat more quantitative than Option 1. However, it is susceptible to weight errors resulting from inadvertent touching or improper handling of the filter cassettes between pre- and postfield processing.

3.3.2.1 <u>Prefield Procedure</u>. The entire filter cassette must be weighed to constant weight prior to sample collection (prefield) at known temperature and humidity conditions (i.e., desiccated at room temperature). All handling of the cassettes must be done with gloves. This can be performed for preloaded filter cassettes as follows:

a. Pull on a new pair of clean, powderless, plastic gloves.
b. Place a unique sample identifier on the outside of each cassette targeted for preweight generation using indelible ink and allow to dry.

c. Remove the inlet and outlet plugs and place them into a labeled, resealable plastic bag.
d. Place the filter cassette into a desiccator in a manner that allows air to flow freely through the inlet and outlet holes. Allow the filter cassette to stabilize to a constant weight. Record the weight of the entire filter cassette without plugs. (Record all weights to ±0.0001 g.) A constant weight for this protocol is one that does not change more than ±0.002 grams for repeated measurements (a minimum of 2) taken over a minimum of a 24-hour period.
e. Replace the inlet and outlet plugs and place the entire filter cassette with plugs into a labeled resealable plastic bag for transport to the field.

3.3.2.2 Postfield Procedure. The filter cassette with dust (without plugs) must be weighed to constant weight prior to laboratory sample preparation (postfield) at the same known temperature and humidity conditions used for prefield processing. This can be performed as follows:

a. Pull on a new pair of clean, powderless, plastic gloves.
b. Remove the inlet and outlet plugs and place them back into the original labeled, resealable plastic bag.
c. Place the filter cassette into a desiccator in a manner that allows air to flow freely through the inlet and outlet holes and that does not allow any spillage of dust out the holes. Allow the filter cassette to stabilize to a constant weight. Record the weight of the entire filter cassette plus dust without plugs. (Record all weights to ±0.0001 g.) A constant weight for this protocol is one that does not change more than ±0.002 grams for repeated measurements (minimum of 2) taken over a minimum of a 24-hour period. It is recommended (not required) that no initial weight data be attempted until the sample has remained in the desiccator for at least 72 hours.
d. The contents of the filter cassette should be prepared for lead analysis. A quantitative transfer procedure that utilizes the backup support pad for wiping dust out of the inside of the cassette combined with rinsing out the cassette with dilute acid can be used to transfer the entire sample to the digestion vessel. The total sample weight for use in determining lead concentration is the difference between the postfield filter cassette weight and the prefield filter cassette weight.

4.0 Quality Control

Adherence to quality control (QC) procedures is an important part of field sample collection. QC procedures, including documentation requirements, field QC samples, reference material check samples, and contamination avoidance are presented in this section.

4.1 Documentation

All field data related to sample collection must be documented. A field notebook or sample log form can be used to record field collection data. It is recommended to utilize both types of documentation records (field notebooks and preprinted sample log forms) for assuring collection of all relevant field data. Field data entries on documentation records must adhere to the following requirements:

4.1.1 General Documentation Requirements:

- All entries must be made using ink.
- Each page (notebook or form) must include the name of the person making the entries and the date of entries found on the page.
- Any entry errors must be corrected by using only a single line through the incorrect entry (no scratch outs) and marked with the initials of the person making the correction and the date of correction.
- An initial page that correlates initials to a specific name must be generated and maintained with field data records to trace any initials used in notebooks and on data forms.

4.1.2 Specific Sampling Site Documentation Requirements:

- General sampling site description.
- Project or client name, address, and city/state location.
- Information as to what specific collection protocol was used.
- Information as to the use of interim storage and sample shipment mechanisms.
- Prefield weight data including stabilization conditions for filter cassette.
- Postfield weight data including stabilization conditions for filter cassette.

4.1.3 Documentation Required for Each Sample Collected:

- An individual and unique sample identifier and date of collection. This must be recorded on the sample container in addition to the field data records (notebook or form).
- Name of person collecting the sample and specific sampling location data from which the sample was removed.

4.2 QC Samples

4.2.1 Blank Samples. Blank samples should be periodically collected (designated) throughout the sampling day at each sampling site. Two types of blank samples should be collected; field blanks and QC blanks.

Both these blanks are collected in the same manner; however, they a[illegible] used for different purposes.

4.2.1.1 Field blanks. Field blank samples are used to identify any potential systematic lead contamination present in the filter cassette and handling of samples during field collection and laboratory analysis activities. Field blanks should be collected in the same manner used to collect field samples with the exception that no air is drawn through the filter cassette. Each cassette designated as a field blank should be removed from the plastic bag, inlet and outlet caps pulled off, the tubing and sampling nozzle attached, and then this procedure is reversed. The vacuum pump is not turned on.

Each field blank must be labeled with its own unique identifier. The identifier for all blanks should be similar to other field samples to mask the identify of the blank from the laboratory (i.e., blanks can then be submitted in a blind manner to the laboratory). It is recommended that field blanks be collected (or designated) at a frequency of 1 per 20 field samples. At a minimum, one field blank should be collected at each sampling site. Field blank lead results should not exceed 20 µg/sample. Lead results above this value should trigger an investigation into the potential cause of the problem and resampling of samples associated with the field blank may have to be undertaken. Large blank lead values can often be a sporadic and not systematic; therefore, blank correction of field sample results using field blank data is not recommended.

4.2.1.2 QC blanks. QC blank samples are used for preparation of blind reference material samples described in subsection 4.2.2. QC blanks should be collected in exactly the same manner as described for field blanks. Each QC blank must be labeled with its own unique identifier. The identifier for all blanks should be similar to other field samples to mask the identify of the blank from the laboratory (i.e., blind reference materials prepared from the blanks can then be submitted in a blind manner to the laboratory). It is recommended that QC blanks be collected (or designated) at a frequency of 1 per 20 field samples. At a minimum, two should be collected at each sampling site (an extra should be collected to assure sufficient QC blanks are available in case problems are experienced during preparation of blind reference material samples).

4.2.2 Blind Reference Material Samples. Reference materials should be periodically submitted to the laboratory for analysis as a check on adherence to proper laboratory sample preparation and instrumental analysis methods. Prepare a blind reference material by placing an accurately weighed portion (0.3000-1.0000 gram) of a reference material into a blank filter cassette (a collected QC blank). Place the cassette with weighed reference material inside a labeled, sample collection container. Include a dummy sampling area on the label to help disguise the blind reference material sample. The weight of reference material should be chosen to produce a blind reference material sample that will produce a lead level between 200 and 1000 µg/sample. It is recommended that the frequency of these QC samples submitted to the laboratory for lead determinations be at least 1 per 20 field samples. Reference materials from NIST[6], such as SRMs 2709, 2711, and 2704, are readily available and can be used for preparing blind reference materials. Other sources of materials with known lead levels, such as performance evaluation materials from the ELPAT[7] program, also may be used to prepare blind reference materials.

4.3 Contamination Avoidance

The following work practices should be followed to prevent cross-contamination of samples:

- Avoid disturbing and tracking dust from one location to another by:
  - identifying and clearly marking all sampling locations upon arrival at the sampling site,
  - avoiding walking through or over any of the marked sampling location areas, and
  - instructing field team members to pull on new disposable shoe covers upon each entry into the building.
- Use a new pair of powderless gloves at each sampling location.
- Inspect all sampling equipment for cleanliness prior to collection of each sample. Always clean suspect equipment if in doubt.
- Do not open sample collection containers until needed to collect each sample.
- When using bulk packed wipes, at each sampling location, discard the first two wipes pulled from the wipe container.

5.0 Glossary

5.1 Digestion, Sample preparation process that solubilizes lead present in the sample. The digestion process produces an acidified, aqueous solution called the digestate. A lead determination is made on the digestate during an instrumental measurement process.

5.2 Field Blank, See subsection 4.2.1.

5.3 Field Data, Any information collected at the sampling site.

5.4 Field Sample, Physical material taken from the sampling site that is targeted for lead determination.

5.5 Reference Material, Material of known composition containing a known amount of lead. These materials have typically been subjected to a large number of lead determinations to develop a lead result known to a high degree of confidence.

5.6 Sample Collection Container, Container for holding and transporting the samples from the field to the laboratory. The internal volume of the container must be sufficient to hold the entire collected sample.

5.7 Sampling Location, Specified area within a sampling site that is subjected to sample collection. Multiple sampling locations are commonly designated for a single sampling site. An example would be at the bottom of a specific slide in a specific playground area.

5.8 Sampling Site, Local geographical area that contains the sampling locations. A sampling site is generally limited to an area that can be easily covered on foot. An example would be John Smith's house at 3102 Nowhere Avenue, Detroit, MI.

5.9 Sample Preparation, Process used to ready a sample received from the field for lead determination using instrumental measurement methods. The process is dependent on the sample type and can include a large number of steps such as homogenization, drying, splitting, weighing, digestion, dilution to a final known volume, and filtering.

5.10 QC Blank, See subsection 4.2.2.

Borough of Palmerton
"Lead-Safe" Home Grant Program
443 Delaware Avenue
PO Box 198
Palmerton, Pa 18071
(610) 826-4804 Fax (610) 826-4827

Fax Cover Sheet

Date: March 3, 1999

To: Jody Shade - Black & Veatch

Fax Number: (215) 928-1780

From: Dolores Ziegenfus

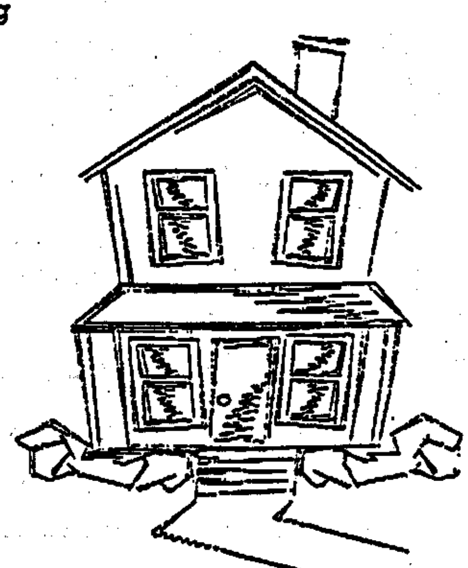
Pages (including cover sheet):

For information call: (610) 826-4804
Fax Number: (610) 826-4827

MESSAGE:

Information reference clearance testing

FIRST FAX 10 PAGES
SECOND FAX 10 PAGES
Third FAX 3 PAGES



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Chapter 15: Clearance

Clearance: How To Do It

1. Decide who will conduct clearance. Clearance on all abatement projects and federally funded interim control work must be done by a certified risk assessor or inspector technician. The U.S. Department of Housing and Urban Development (HUD) strongly recommends the use of a certified risk assessor or inspector technician who is completely independent of the lead hazard control contractor to eliminate conflicts of interest. Some local jurisdictions may require a license to conduct clearance.
2. Finish the lead hazard control and cleanup effort. Seal floors before clearance testing (if necessary).
3. Wait 1 hour to allow any airborne dust to settle. Do not enter the work area during that hour.
4. Conduct visual examination.
   a. Determine if *all* required work has been completed and *all* lead-based paint hazards have been controlled.
   b. Determine if there is visible settled dust, paint chips, or debris in the interior or around the exterior.
5. Complete the Visual Clearance Form contained in this chapter; if all specified work was not completed, inform the owner and order completion of work and repeated cleanup, if necessary.
6. Conduct clearance dust sampling of floors, interior window sills, and window troughs using the protocol in this chapter.
7. Conduct clearance soil sampling if bare soil is present that was not sampled previously, or if exterior paint work was completed as part of the lead hazard control effort. Whenever exterior work has been done, it may be necessary to take samples from soil that is not bare to determine if contamination has occurred. If results are above 2,000 µg/g (or 400 µg/g in high contact play areas), compare the results to baseline soil sampling results to determine what additional measures are needed.
8. Complete the Dust and Soil Sampling Clearance Form contained in this chapter.
9. Submit samples to a U.S. Environmental Protection Agency (EPA) recognized laboratory participating in the National Lead Laboratory Accreditation Program (NLLAP) for analysis.
10. Interpret results by comparing them to the HUD Interim Clearance Standards contained in this chapter (until EPA issues its health-based leaded dust standards).
11. If clearance is achieved, go to step 15.
12. Order repeated cleaning or soil treatments if results are above applicable standards. Clean all surfaces the sample represents.
13. Continue sampling and repeated cleaning until the dwelling achieves compliance with all clearance standards.

Step-by-Step Summary (continued)

14. Complete any related construction work that does not disturb a surface with lead-based paint (all work that does disturb painted surfaces or that could generate leaded dust should be completed as part of the lead hazard control effort).

15. Issue any necessary statements of lead-based paint compliance or releases and maintain appropriate records.

16. Permit residents into the cleared work area.

Chapter 15: Clearance

I. Introduction

A. Purpose of Clearance

Clearance refers to the various environmental evaluation procedures used to determine if:

- The lead hazard control work was actually completed as specified.
- The area is safe for unprotected workers to enter.
- The area is a safe place for residents and young children to live.

Since most lead hazard control work generates a considerable amount of leaded dust, and since previous studies have indicated that cleaning can be accomplished only with great care and skill (HUD, 1991), it is necessary to determine if the cleaning was successful. Some type of clearance is required for all forms of lead hazard control. Certified risk assessors or certified inspector technicians (clearance examiners) can best recommend the exact type of clearance testing to be employed on a specific project. The process outlined in this chapter provides a means of determining if lead hazards have been controlled.

B. Clearance as the Endpoint

If clearance criteria are met, the contractor who performed the work can conclude that the job is complete. However, if the clearance criteria are not met, the contractor must complete the work and/or repeat the cleaning process until the area is clean enough to meet clearance criteria. For example, if the job included the removal and replacement of all windows, but the clearance examiner determines that one window has been overlooked, the contractor must remove and replace it as originally specified (in addition to carrying out any necessary additional cleaning in that area). Similarly, if excessive leaded dust levels remain, the contractor's job cannot be considered complete until leaded dust levels are below clearance standards. Normally, the final payment to the contractor is withheld until compliance with clearance standards is achieved.

The clearance examination described in this chapter is similar to the punchlist that follows a typical construction or repair job. The major difference is that the normal visual check is almost always augmented with environmental testing since leaded dust and soil hazards are not visible to the naked eye.

The clearance examination protects *all* parties involved—the job contractor, the owner, and the resident. The process provides the contractor with an objective determination that the job was completed safely. The owner will have assurance that the abatement job was successful in correcting hazards and that the amount of leaded dust left after the work was completed is at a safe level. The resident can be certain that dangerous shortcuts were not taken during the work process and that resident children will be safe.

C. Conflicts of Interest

The owner should retain the services of a certified risk assessor or a certified inspector technician to determine compliance with clearance criteria. The clearance examiner must not be paid or employed, or otherwise compensated by the lead hazard control contractor and should have no vested interest in seeing that the job is completed on schedule. The clearance examiner's *only* concern should be that compliance with clearance standards has been achieved.

This does not mean that job supervisors should not perform their own visual assessments of the quality of the cleanup job performed by their workers. Such assessments will help ensure that clearance criteria are met the first time around.

Some owners of multiple dwelling units may wish to have lead hazard control work performed by their own trained crews, rather than contract for such services. In this case it is essential that clearance testing be performed by an independent third party whose payment is not dependent on completion of the job within any particular time period.

The clearance procedures contained in this chapter should always be included in the job specifications so that performance responsibilities are clear.

II. Time Between Completion of Cleanup and Clearance

Clearance dust sampling should be performed no sooner than 1 hour after completion of the final cleanup to permit airborne leaded dust to settle. Clearance dust sampling is for *settled* leaded dust, not airborne leaded dust, since the main source of lead exposure for children is through contact with contaminated surfaces followed by ingestion. Most children in the United States, are *not* lead poisoned by inhalation (ATSDR, 1988). Airborne leaded dust sampling is not recommended for clearance purposes in lead hazard control work.

While often performed for asbestos abatement projects, air sampling does not appear to be a useful tool for determining if clearance has been achieved in lead hazard control work. Because asbestos fibers are known to have low settling velocities (that is, they take a long time to settle out of the air), air sampling can be used to determine the effectiveness of the cleanup effort in asbestos abatement jobs. But because dust particles typically generated during lead abatement jobs are larger, denser, more spherical, and heavier, settling time is much faster.

The U.S. Department of Housing and Urban Development's (HUD's) *Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing* recommended 24 hours as the minimum waiting period to allow airborne lead-contaminated particles to settle, although no justification for the 24-hour waiting period was provided (HUD, 1990a). The reduction in the waiting period before sampling from 24 hours to 1 hour marks an important change in the new recommendations. The current *Guidelines* recommend 1 hour because the additional amount of leaded dust that would settle onto floors after 1 hour is negligible. The analysis supporting this finding is summarized below. (A full description of the analysis can be found in Appendix 11.)

Analysis of the settling velocity of airborne leaded particulate has demonstrated that nearly all particulate greater than 5 µm in diameter will have settled out of the air within an hour. It is estimated that any remaining airborne particulate less than 5 µm would contribute no more than an additional 5 µg/ft² of lead to surface dust, even if all of it were to settle out of the air. This is well below the HUD Interim Clearance Standard for floors (100 µg/ft²) and also well below the routine limit of quantitation for wipe sampling (25 µg/ft²). Therefore, a reduction in the waiting period to 1 hour is justified. This change will contribute to significant cost savings by cutting 1 day off the length of the abatement job (reducing relocation costs and job delays). Entry into the area should be prohibited during the 1-hour waiting period to keep turbulence and re-entrainment of particulate matter to a minimum.

III. Visual Examination Procedures

Clearance occurs in two main phases: visual examination and environmental sampling (dust and, if exterior work was conducted, soil sampling). A standard Visual Clearance Form can be found at the end of this chapter (see Form 15.1).

A. Determination of Completed Work

A visual examination determines whether the work on all interior and exterior surfaces to be treated was in fact completed and to ensure that no visible settled leaded dust or debris are present. Visual clearance is a relatively straightforward process requiring an understanding of the scope of the job and a keen eye for detail. It is

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essential that clearance examiners have full knowledge of the extent of the work and specifically which surfaces did not require treatment. The clearance examiner should have access to any risk assessment or paint inspection report as well as the job scope of work or specifications and a report from the owner or contractor that the work has been completed.

The visual examination of completed work should be done on a room-by-room basis to ensure that all areas are examined (this includes the exterior and common areas). In most cases the visual examination will be conducted by a clearance examiner when the environmental samples are collected.

When paint removal and repainting or soil removal and covering is planned, verification of the removal of the lead hazards will be necessary prior to the completion of work. In these instances the owner or a representative of the owner (which may be the hazard control contractor) may take responsibility for confirming that the hazard is removed prior to repainting or covering. This allows the owner to avoid the expense of having the clearance examiner travel to the job site twice—once to verify the hazard removal and again to collect environmental samples. On the other hand, owners may choose to have the clearance examiner confirm that the work was actually completed. Regardless of who verifies the hazard removal, verification should be documented on Form 15.1.

In multifamily housing of similar construction, it is not necessary to perform a visual examination of every single unit. Instead, a random sample of abated units can be visually examined before the paint is applied. The abatement contractor should not know ahead of time which units will be visually inspected prior to repainting. The random sample size can be determined by using the table for lead-based paint inspections (Table 7.3). Random sampling of single-family dwellings is not possible due to the large variability in construction and work. Therefore, each single-family dwelling should be cleared individually.

In the case of a child with an elevated blood lead level, local authorities may require that the treatment of all indicated surfaces be verified by a government employee or certified third party, especially in cases where the abatement has been ordered by local authorities. Clearance examiners should determine if the property they are investigating has been abated as a result of a legal or regulatory proceeding. If so, the enforcement agency should be contacted to coordinate clearance procedures, prevent duplication of effort and, most importantly, ensure that the private clearance process is not inadvertently overstepping the bounds of the normal practices of the local health department or childhood lead-poisoning prevention program.

1. Paint Removal and Repainting

All surfaces where paint has been removed should be visually examined *prior to repainting*. If clearance is conducted after new paint is applied, it is often impossible to determine if the old paint was actually removed. Areas commonly overlooked during paint removal projects include the underside of interior window sills and handrails, backside of radiator ribs, bottom edge of doors, top of doorframes, and the back edge of shelving.

For both onsite and offsite removal, the clearance examiner or the owner should examine the bare surfaces to ensure that there is no visible residue. If residue remains, the component should be cleaned prior to repainting or refinishing.

Wipe sampling and x-ray fluorescence (XRF) testing are not appropriate tools for determining the effectiveness of paint removal from a particular surface. Wipe sampling cannot dislodge any leaded dust that may have been absorbed into the substrate during the removal process, nor can it remove paint that is still bonded to the substrate. Wipe sampling is appropriate for measurement of settled leaded dust on floors, interior window sills, and window troughs. It is not appropriate to apply the settled leaded dust clearance standard to these components since the bare surface will be sealed with new paint.

thus rendering the dust inaccessible. Appendix 1 describes how much lead-contaminated dust can remain on a surface (at least 35,000 µg/ft²) before it would cause the newly applied paint to become lead-based paint (at 0.5 percent).

2. Building Component Removal and Replacement

If building components coated with lead-based paint were removed as a lead hazard control measure, the clearance examiner should have detailed knowledge of the scope of the replacement activities so that actual removal can be verified. Each building component specified for replacement should also be examined to determine if it was overlooked during the lead hazard control work.

3. Enclosures

Complete installation of enclosure systems, such as new drywall, paneling, or siding, can be best evaluated by direct visual observation. The clearance examiner should determine that the mechanical fastening system used to hold the enclosure to the substrate is adequate. This is especially important for ceilings. All seams and edges in the enclosure should be sealed to provide a "dust-tight," but not necessarily airtight, system.

4. Soil Treatments

Soil treatments, which typically consist of some form of covering or removal and/or replacement, can be assessed by direct visual observation to determine if the covering is present. For example, if sod or asphalt has been used as a soil covering, the clearance examiner should determine if all bare areas have been covered by the sod or asphalt, as specified.

No visible lead-based paint chips should be observed in soil following lead hazard control work. It is not necessary to turn over or rake soil to look for paint chips. A visual examination of the surface is adequate.

If exterior work on lead-based paint has been performed, baseline soil samples should have been collected but not necessarily analyzed until clearance soil samples have been collected, analyzed, and compared to clearance standards. It may be necessary to collect samples from soil that is not bare to determine if contamination has occurred. If post-hazard control soil levels are below applicable limits, the preabatement samples need not be analyzed. The clearance level for most soil is 2,000 µg/g (400 µg/g for small, high-contact play areas). If post-hazard control soil levels are greater than or equal to the applicable limits, the baseline samples should be analyzed to determine where additional work is needed. If paint chips originating from the work are identified in the soil, they should be picked up with a high-efficiency particulate air (HEPA) vacuum.

5. Encapsulants

Another category of lead hazard control that can best be assessed visually is the application of encapsulants. Assuming that the encapsulant was properly selected for the surface undergoing treatment and that patch tests were conducted as recommended in Chapter 13, the clearance examiner can determine if the encapsulant is in fact present.

6. Interim Controls

Visual examination of the wide variety of interim control measures consists of a confirmation that all lead-based paint (either suspected or identified through testing) is stabilized and that any friction, impact, and other surfaces marked for treatment in the risk assessment report or project specifications have all been properly treated. No known or suspected lead-based paint should be in a deteriorated condition in a cleared dwelling.

B. Visual Examination for Settled Dust and Debris

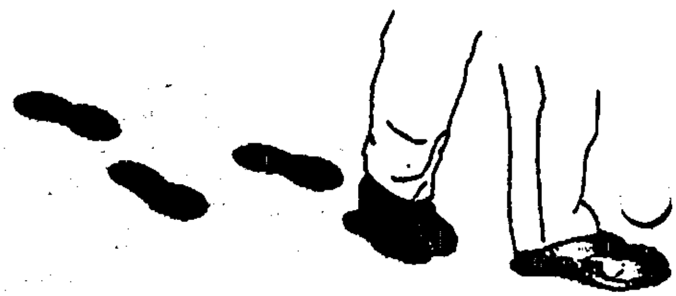
There should be no evidence of settled dust following a cleanup effort. If dust is observed, the contractor must be required to repeat the cleaning effort *before* clearance dust samples are collected to avoid conducting dust sampling twice. Any settled dust present following abatement or interim control work provides sufficient evidence that cleanup was not adequate (see Figure 15.1).

Figure 15.1 Visible Dust Indicates Cleaning Should Be Repeated.

Lead Tracking

Lead dust can be transported from one area to another on shoes.

Tracking lead dust from one area to another is a big problem on lead hazard control jobs. Lead dust can be tracked on shoes from the work area to the outside. Sometimes lead dust from the outside soil is tracked into the work area. Lead dust from a porch or nonwork area can get tracked into a cleaned area. When this happens, the whole area must be cleaned.



There are conflicting reports regarding the use of the so-called "white glove test" as part of the visual examination. Some housing agencies have indicated that they find this to be a useful preliminary examination tool, while others indicate that this test almost always shows some discoloration, even if surfaces have been cleaned well. Until it has been demonstrated to effectively predict leaded dust levels, use of the "white glove test" is left to the discretion of the examiner and is not recommended by HUD. The "white glove test" is not a substitute for laboratory analysis of dust samples.

Finally, the grounds around the dwelling should also be examined visually to make certain that all waste and debris have been removed and that leaded dust or paint chips were not transferred outside the dwelling. For example, waste should not be left at the curbside for trash pickup; all waste should be removed from the site. The examiner should be particularly conscientious about looking for paint chips when exterior components have been disturbed.

IV. Clearance Dust Sampling

A visual examination alone is not adequate for determining if a residence is safe for occupancy, since small dust particles are not visible to the naked eye. A person with normal eyesight cannot detect individual dust particles smaller than 50 µm in diameter (Olishifski, 1983). Data indicate that a significant percentage of the dust generated during abatement is smaller than 50 µm (Mamane, 1994; NIOSH,

Table 15.1 Recommended Minimum Number and Location of Single-Surface Dust Samples

Clearance Category	Category Description	Number and Location of Single-Surface Wipe Samples in Each Area[1]	Number and Location of Composite Wipe Samples
1	Interior treatments No containment within dwelling	Two dust samples from at least four rooms in dwelling (whether treated or untreated): ✦ One interior window sill or window trough, alternating between rooms. ✦ One floor. AND ✦ For common areas, one for every 2,000 ft² of a common area room floor (if present).	Three composite samples for every batch of four rooms (whether treated or untreated): ✦ One floor composite. ✦ One interior window sill composite. ✦ One window trough composite. AND ✦ For common areas, one floor subsample for every 2,000 ft² (if present); up to 8,000 ft² can be sampled for each composite.
2	Interior treatments With containment (plastic sheeting as airlock on doors between treated and untreated areas)	Same as Category 1 but only in every *treated* room (up to four rooms) AND One floor sample outside the containment area but within 10 feet of the airlock to determine the effectiveness of the containment system. This extra single-surface sample is recommended in 20 percent of the treated dwellings in multifamily housing and *all* single-family homes. ✦ For common areas, one floor sample for every 2,000 ft² and one floor sample outside containment.	Same as Category 1 but only in every *treated* room AND One floor sample outside the containment area but within 10 feet of the airlock to determine the effectiveness of the containment system. This extra single-surface sample is recommended in 20 percent of the treated dwellings in multifamily housing and *all* single-family homes. ✦ For common areas, one floor subsample for every 2,000 ft² (up to 8,000 ft² for each composite) and one floor sample outside containment.
3	Exterior treatments	Two dust samples as follows: ✦ At least one dust sample on a horizontal surface in part of the outdoor living area (e.g., a porch floor or entryway). ✦ One window trough sample on each floor where exterior work was performed. An additional trough sample should be collected from a few lower floors to determine if troughs below the area were contaminated by the work above.	Two dust samples as follows: ✦ One composite on a horizontal surface in part of the outdoor living area (e.g., a porch floor or entryway). ✦ One window trough composite for every four floors where exterior work was performed, including lower floors where exterior work was not done, if present.
4	Routine maintenance work	At least 1 floor dust sample for every 20 high-hazard jobs near the work area (see Chapter 17 for definition of "high hazard").	Same as single-surface sampling.
5	Soil treatment	One dust sample from the entryway.	One dust sample from the entryway.

[1] A room includes a hallway or a stairway. If no window is present, collect just one floor sample. When a closet is treated, the room to which it is attached should be tested. A closet is not considered to be a separate room. If all rooms received similar treatments and cleaning, only four rooms need to be sampled for clearance purposes. More rooms may need to be sampled in larger dwellings. The room to be sampled should be selected based on where most of the dust-generating work was done or in the judgment of the clearance examiner.

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1993b). Since these smaller dust particles are associated with an increased risk of lead poisoning, clearance dust testing is required to determine if a leaded dust hazard remains following lead hazard control work.

Unless U.S. Environmental Protection Agency (EPA) regulations establish different clearance levels, the following HUD clearance standards should be used, based on wipe sampling:

- 100 µg/ft² for floors.
- 500 µg/ft² for interior window sills.
- 800 µg/ft² for window troughs and exterior concrete or other rough surfaces.

There is no standard for vacuum sampling at this time.

Portable XRF analyzers have not yet demonstrated a capacity to detect dust lead levels in the range of interest. Wet chemical field test kits are also not sufficiently reliable for routine analysis of leaded dust at this time and do not yield quantitative data that can be compared to clearance standards.

Dust samples must be analyzed by laboratory methods such as atomic absorption spectroscopy, inductively coupled plasma-emission spectroscopy, laboratory XRF using standard methods, or other equivalent analytical methods (see Appendix 14). Only laboratories that participate in a national proficiency testing program and are recognized by EPA should be used.

If the dust sample from any surface indicates a leaded dust level above the clearance standard, all similar surfaces in the dwelling that sample represents (e.g., all interior window sills or floors) should be recleaned and retested. Only the similar components need to be recleaned, not necessarily the entire dwelling. If any such surface fails twice, the property owner should consider additional hazard control measures and/or further sealing of the surface. See sections D and VII for further disussion interpreting dust sampling results.

A. Multifamily Housing (20 or More Units)

It is possible to conduct clearance dust sampling in a number of randomly selected dwelling units in multifamily housing where similar dwelling units have undergone comparable types of lead hazard control activity. The random sampling can be performed for a portion of the housing development or for all of it. In either case the randomly selected units represent a specified group of housing units. The contractor must not know in advance which units will be sampled since this would bias the results. In addition, it is necessary to choose an adequate number of randomly selected units (Table 7.3). Significant cost savings could be realized with such a sampling plan.

However, the implications of random clearance sampling should be understood fully before it is used. First, if the random sampling shows that levels of leaded dust are too high, it will be necessary to reclean not only the affected component in the selected dwelling unit, but also the affected component in *all* the other units that the randomly selected unit was meant to represent. Alternatively, all the units represented by the randomly selected unit could be sampled individually to determine which ones need recleaning. The costs of repeated sampling should be compared with the costs of repeated cleaning. Regardless of whether all the represented units are sampled or recleaned, a further delay in permitting residents back into the area is possible when using random clearance sampling.

Second, insurance carriers covering lead hazard control work may demand a high degree of assurance that the work was performed properly in each and every dwelling. The extra cost of dust sampling in all units is likely to be minor compared to the liability of a child with an elevated blood lead level in an abated unit that was not sampled but was later found to contain high leaded dust levels.

Third, there has been a significant failure rate in attaining compliance with clearance dust standards in both the ongoing public housing program and the HUD Demonstration Project

(HUD, 1991). In the latter study, failure rates on the initial wipe tests were 19 percent for floors at 200 µg/ft², 14 percent for window sills, and 33 percent for window troughs. In one large abatement job for a public housing authority, 15 percent of the housing units failed the clearance tests and required recleaning (Jacobs, 1993a). While this failure rate can be partially attributed to abatement strategy, variable contractor performance, and perhaps the inexperience of the abatement industry, the high rate of failure argues for more extensive unit-by-unit testing.

In spite of all these caveats, there is one special situation that may lend itself well to random clearance sampling. A large *vacant* apartment building or housing development that will not be immediately reoccupied following abatement could conceivably be randomly sampled at the end of the project and, if necessary, completely recleaned. Alternatively, all units could be sampled to determine which ones require recleaning.

Whether random clearance sampling or unit-by-unit clearance sampling is performed, repeated sampling should *always* be performed in all units that required recleaning. In short, most cases of lead hazard control will require that clearance dust sampling be conducted in every unit treated. With additional research and innovative abatement and cleaning techniques that improve compliance rates with clearance dust standards, it may be possible to sample only a fraction of the units treated.

B. Single-Family Housing and Multifamily Housing (Fewer Than 20 Units)

Clearance dust sampling should be conducted in every single-family dwelling unit and in all multifamily housing with fewer than 20 units. Because treatment and housing conditions vary so greatly in these housing units, random sampling is inappropriate.

C. Clearance Dust Sampling and Floor Sealant Application

Wipe samples should be collected after application of a floor sealant, not before. In lead hazard control programs, coating floors with a sealant is often one of the final measures completed. The purpose of sealing floors is not to trap leaded dust underneath the sealant, but to provide a surface that can be cleaned effectively by the resident. The type of flooring determines the type of sealant. Wooden floors should either be painted with a deck enamel or coated with polyurethane, concrete floors should be sealed with a concrete sealant, and tile floors should be sealed with appropriate wax.

The maintenance and monitoring system should check the integrity of the floor sealant at least yearly.

D. Location and Number of Clearance Dust Samples

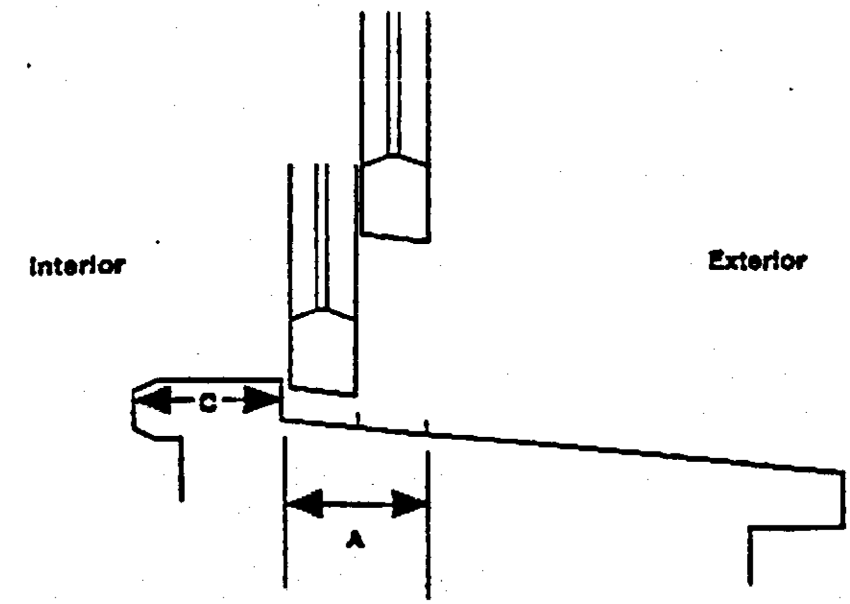
Clearance dust samples should be taken either from specific locations near the area where the lead hazard control treatment was done, from nearby high-traffic areas (around doorways, for example), or from other areas. The clearance examiner may determine which specific site is best based on the type of treatment, visual observation, and professional judgment. The abatement contractor must not know exactly where the clearance samples will be collected.

The number of clearance samples depends on whether composite or single-surface samples are collected.

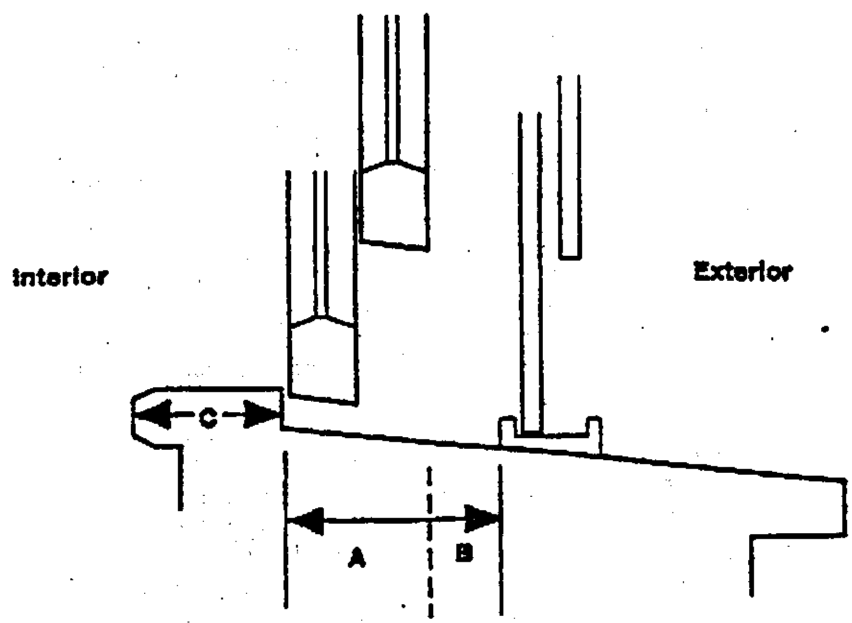
1. Single-Surface Sampling

Single-surface sampling can be conducted using essentially the same methodology as that described in Chapter 5 and Appendix 13. However, the number and location of clearance samples is based on the type of containment used and the number of rooms treated, not on the use pattern of the room (as is the case for risk assessment purposes). The three building components that should be tested are floors, interior window sills, and window troughs. A window trough is the part of the window in which both sashes sit when lowered. An interior window sill (sometimes called the stool) is the part of the window ledge facing the interior of the room (see Figure 15.2 for an illustration of areas to be sampled).

Figure 15.2 Window Locations for Dust Sampling.



1. Sectional view of window (with no storm window) showing window trough area, A, to be tested. Trough is the surface where both window sashes can touch the sill when lowered. The interior window sill (stool) is shown as area C. Interior window sills and window troughs should be sampled separately.



2. Sectional view of window (including storm window) showing window trough area, A and B, to be tested. Trough extends out to storm window frame. The interior window sill (stool) is shown as area C. Interior window sills and window troughs should be sampled separately.

Courtesy: Warren Friedman

The field sampling and analytical methods for collecting and analyzing wipe dust samples are in Appendixes 13 and 14, respectively. Until the EPA standards and protocols are established, wipe sampling should be performed on all surfaces. While vacuum samples can be collected, neither HUD nor EPA can provide standards to interpret vacuum sampling results at this time. Until vacuum sampling standards have been established, wipe sampling is the preferred method.

Readers should note that these *Guidelines* recommend the following precautions when conducting dust sampling (see Appendix 13.1):

- A standard sampling motion should be used.
- Only certain brands of wipes can be used (unless equivalence is demonstrated through side-by-side field sampling).
- Whatman™ filters and thick diaper wipes should not be used (Whatman™ filters are not sufficiently durable and some thick diaper wipes are too difficult for the laboratory to digest).
- Field-spiked wipe samples will need to be included in the sample stream in a blind fashion (i.e., the lab should not know the amount of lead spiked onto the wipe) to ascertain the efficiency of the laboratory digestion procedure.
- Hard-shelled containers (not plastic bags) must be used to contain wipe samples, since the container must be rinsed thoroughly and quantitatively. A nonsterilized 50-ml polypropylene centrifuge tube works well.

The minimum number of clearance samples recommended in each room is shown in Table 15.1. Field sampling data can be recorded on Form 15.2.

Further information on wipe sampling technique can be obtained from ASTM Standard ES-30-94.

2. Composite Clearance Dust Sampling

When lead hazard control treatments are similar in multiple rooms of the same dwelling, composite samples may be collected. For composite sampling each room treated must be included. The total number of required samples will depend on the number of rooms treated and whether those treatments are similar (see Table 15.1). Wipe samples are composited in the field, not in the laboratory, by inserting up to four wipes from four surfaces into the same tube. The laboratory analyzes all four wipes as one sample using a modified analytical procedure (see Appendix 13).

An example of a composite sampling scheme can be found in the example below. Field sampling data can be recorded on Form 15.2a.

The rules for combining subsamples into a sin-gle composite sample described in Chapter 5 for risk assessment also apply to clearance sampling. Those rules are as follows:

- Separate composite samples are required from carpeted and hard surfaces (e.g., a single composite sample should not be collected from both carpeted and bare floors).
- Separate composite samples are required from each different component sampled (e.g., a composite sample should not be collected from both floors and interior window sills).
- Separate composite samples are required for each dwelling.
- Floor surface areas sampled in each room should be approximately the same size (approximately 1 ft^2). Interior window sill and window trough sampling sizes are dependent on window characteristics, but should also be similar from room to room, if possible (e.g., the surface sampling area should not be skewed so that one room is oversampled).
- For composite wipe samples, a separate wipe must be used for each spot sampled (each subsample).

- The same wipe should not be used to sample two different spots. All subsamples should be inserted into the same tube. No more than four different wipes should be inserted into a single container for a composite sample. Acceptable recovery rates have been found when no more than four wipes are analyzed as a single sample (Jacobs, 1993b).

Because composite sampling requires fewer samples than single-surface sampling, sampling costs may be reduced. Also, more surfaces are often sampled than would be possible for single-surface sampling. The drawback to composite sampling, however, is that if only one of the composite samples fails, all similar components in each room will have to be recleaned or each room will need to be sampled individually. In contrast, if one of the single-surface samples fails, only one room will have to be recleaned.

Composite samples should not be taken from rooms that have dramatically different conditions. For example, if the clearance examiner has some reason to believe that cleanup was not performed adequately in a room, a single-surface sample should be collected there. In some cases both single-surface samples and composite samples may be needed.

V. Clearance Soil Sampling

If no exterior lead hazard control work was performed, it is not necessary to conduct any soil sampling. Clearance soil sampling should be conducted following any abatement or interim control treatment on the exterior of a house or soil treatment. The purpose of such testing is to ensure that the treatment did not contaminate soil surrounding the dwelling.

Clearance soil sampling is typically conducted around the foundation of the house, although it is also important to collect samples in play areas that could have been contaminated as a result of the work. All soil samples should be composite samples. If the exterior work involved covering bare soil areas only, clearance soil samples are not needed; a visual examination is adequate. A detailed protocol for soil sampling is provided in Appendix 13 and ASTM ES-29-94. Sampling data can be recorded on Form 15.3.

There is evidence that soil lead levels can increase following abatement if proper precautions are not taken. For example, in one study, 6 percent of the dwellings had statistically significant increases in soil lead levels when compared to pre-abatement soil lead levels (NIOSH, 1990).

There should be no visible paint chips on the surface of the soil near the foundation. However, soil sampling near the foundations of dwellings is often complicated by the presence of paint chips embedded in or under the soil surface from previous repainting efforts. The hazard associated with these paint chips in the soil is difficult to assess since it is often not practical to sample all the different paint chips that may be present. Therefore, these paint chips should be considered a part of the soil. They should not be sampled preferentially or excluded when collecting or analyzing the soil. Laboratories should be instructed to disaggregate (force) paint chips through the soil sieve as part of the analytical process.

If the paint chips were generated by hazard control work, they should be picked up with a HEPA vacuum. A visual examination is usually adequate. If the clearance soil samples are above 2,000 µg/g in the yard (or 400 µg/g in bare, high-contact play areas), the baseline soil samples should be analyzed to determine if soil lead levels were already high before the work began. Soil samples collected during risk assessments (if one was performed) can be used for this purpose.

A. Multifamily Housing (20 or More Units)

If a large complex of multifamily housing has undergone similar lead hazard control work, random sampling of the soil around the buildings can be conducted using the sampling scheme for lead-based paint inspection. The drawbacks of conducting random clearance sampling are the same for soil as for dust (see the section on clearance dust sampling earlier in this chapter).

Example of Clearance Composite Sampling Scheme

A house has undergone an abatement job involving extensive interior paint removal (clearance category 1) and has passed a visual examination. The owner and the clearance examiner have agreed to use composite clearance dust sampling to minimize expenses. The house has eight rooms that were treated, four of which are carpeted, and all of which have windows.

At a minimum, the clearance examiner should collect the following samples:

No.	Description
1	Composite carpeted floor sample (one subsample from each of the four carpeted rooms).
1	Composite hard floor sample (one subsample from each of the four uncarpeted rooms).
1	Composite interior window sill sample, with a subsample collected from a location in four selected rooms.
1	Composite window trough sample, using the same procedure as for interior window sills.

This results in a total of four composite samples for analysis. If single-surface sampling had been completed under the recommendations in Table 15.1, it would have been necessary to collect eight samples (four rooms x two samples/room = eight samples/dwelling).

B. Single-Family Housing

If exterior lead hazard control work was done, composite soil samples should be collected near the building foundation close to the work area and in nearby play areas that could have been contaminated by the work. All single-family housing units should be cleared.

C. Number and Location of Clearance Soil Samples at Each Building

One composite soil sample should be collected around the perimeter of the building. If only selected faces of the building were treated, the samples should come from those faces.

A second composite soil sample should be collected from any nearby play areas.

In both cases bare soil should be sampled preferentially. If there is no bare soil, the soil covering should be sampled to determine if it has been contaminated by the lead hazard control work.

VI. Clearance Paint Testing

XRF testing of surfaces that have been stripped and repainted is not recommended. If the paint has been removed, removal should be assessed visually prior to repainting. If for some reason it is not possible to visually determine that the paint has been removed, then XRF readings can be taken. The protocols described in Chapter 7 apply.

Some forms of interim control involve paint film stabilization (repainting). In this case the clearance examiner must visually inspect all painted surfaces to determine if they are all sealed, intact, smooth, and cleanable.

VII. Interpretation of Clearance Testing Results

A. Visual Examination Results

Interpreting the results of the visual examination is a straightforward process. If there is visual evidence that work on building components or soil is incomplete, the clearance examiner should inform the owner and contractor and ensure that the work is completed *before collecting any dust or soil samples*. In situations where job specifications are used, they should clearly state that failure to pass the clearance visual examination means failure to comply with clearance standards.

Table 15.2 Interim HUD Clearance Dust Standards (Wipe Sampling Only)[1]

Surface	Leaded Dust Loading (µg/ft²)	Leaded Dust Loading (mg/m²)[2]
Bare and carpeted floors	100	1.08
Interior window sills	500	5.38
Window troughs	800	8.61
Exterior concrete or other rough surfaces	800	8.61

[1] No clearance standards are currently available for vacuum sampling.

[2] To convert from µg/ft² to mg/m², multiply by 0.01076.

B. Dust Results

Interim HUD clearance dust standards are shown in Table 15.2. These may be revised subject to EPA's issuance of regulations.

No standard method has been developed to correlate the wide variety of vacuum methods available with the wipe sampling standards. Until and unless EPA regulations state otherwise, all hard surfaces should be tested with wet wipe samples. While vacuum sampling is acceptable, there is no HUD Interim Clearance Standard for vacuum sampling at this time, making interpretation of vacuum sampling results against recognized standards impossible.

The results of dust samples collected using a vacuum method may be reported in lead concentration (µg/g) and loading (µg/ft²); wipe sampling results are reported in loading only. For clearance purposes, however, the lead concentration cannot be used to determine the effectiveness of the cleanup. It is possible to remove nearly all leaded dust from a surface, but not change its concentration significantly, since most cleaning methods do not preferentially remove lead from the dust. However, adding lead-free soil or dust to the area *will* reduce the concentration, even in the absence of cleaning. In short, leaded dust loading (not leaded dust concentration) should be used to determine if an adequate cleanup job has been completed. If leaded dust levels exceed those given in Table 15.2, the contractor must repeat the cleaning until compliance is achieved.

The recleaning should be focused on those surfaces where the sampling results indicate that the first round of cleaning was inadequate. For example, if floor leaded dust levels are above the standard, but interior window sills and window troughs are below the standard, only the floors need to be recleaned. Similarly, if single-surface samples fail in one room, then only that room and any rooms not sampled need to be recleaned. If composite samples fail, then *all* the surfaces the composite represents need to be recleaned (or resampled individually to determine which ones require recleaning). For example, consider the two examples shown in Tables 15.3 and 15.4.

In Table 15.3, only the floors in Rooms 1 and 2 require recleaning (assuming a four-room unit). In Table 15.4 the window troughs should be recleaned in all four rooms and any rooms not sampled. While the window troughs could conceivably be sampled individually to determine which ones require recleaning, it is likely to be far more cost-effective to simply reclean all of them. When cleaning troughs, the sills should also be cleared, even if they were not originally contaminated. In both examples, repeated sampling of the recleaned surfaces should be completed to ensure that the recleaning was sufficiently effective.

For composite sampling the HUD Interim Clearance Standard should *not* be reduced by dividing the standard by the number of subsamples in the composite. The purpose of the

Table 15.3 Hypothetical Example of Single-Surface Clearance Dust Sampling Data

Room	Floors (µg/ft²)	Interior Sills (µg/ft²)	Window Troughs (µg/ft²)
1	475	40	60
2	878	65	90
3	30	70	75
4	50	40	80

Table 15.4 Hypothetical Example of Composite Clearance Dust Sampling Data

Surface	Rooms Included in Composite	Leaded Dust (µg/ft²)
Floors	1, 2, 3, 4	30
Interior window sills	1, 2, 3, 4	129
Window troughs	1, 2, 3, 4	3,695

composite sample is to average the lead loading in all rooms sampled to determine if *all* the rooms require additional cleaning. Composite sampling is used to determine the average lead loading in a group of rooms, not individual rooms. Since composite sampling is done in units with the same hazard control technique and since the method of correction is always the same (i.e., recleaning), it is not necessary to determine the leaded dust level in each room. Even a single-surface sample only represents a small area on a larger surface, in much the same way as a composite represents many surfaces over a larger area, e.g., all floors within a unit. For paint chip sampling, however, it is necessary to know the concentration on each surface sampled, making it necessary to divide the paint standard by the number of subsamples contained in a composite sample (see Chapter 5).

C. Soil Results

If clearance sampling shows that post-abatement soil samples are more than 2,000 µg/g, additional soil treatment should be required. If the area sampled is a high-contact play area, the soil should be no more than 400 µg/g.

VIII. Recordkeeping and Issuance of Statement of Lead-Based Paint Compliance

A. Recordkeeping Responsibilities

Three parties should maintain records of all abatement, interim control, risk assessment, inspection, and clearance results:

- Property owner.
- Contractor.
- Clearance examiner.

Some jurisdictions will also require submission of such records to an enforcement agency or a lead-safe housing registry.

B. Record Content

The records should include all laboratory results, quality control/quality assurance procedures, dates of both visual examination and environmental sampling, completed forms,

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and appropriate identifiers for the property—the owner, inspector, job contractor, and resident(s).

Depending on the jurisdiction and the type of abatement or interim control work undertaken, the owner may be awarded a Statement of Lead-Based Paint Compliance. One State now issues a statement indicating that the property is "Lead-Free" when all lead-based paint is removed and all other lead hazards are corrected. The property is "Lead-Safe" when all lead-based paint *hazards* have been rectified (Rhode Island, 1993).

C. Length of Time

Statements of lead-based paint compliance and records of all clearance testing should be kept for the duration of the life of the building, since it is to the benefit of the owners to retain this information.

IX. Clearance and Reevaluation Procedures

The clearance process evaluates the effectiveness of the lead hazard control efforts immediately following cleanup. Reevaluation determines the continued effectiveness of all lead hazard control treatments (except complete removal of all lead-based paint). Reevaluation also determines whether any new lead-based paint hazards have appeared. Because most forms of lead hazard control have limited lifespans, they will require ongoing monitoring by the owner and a reevaluation by a certified risk assessor based on the reevaluation schedule for the specific property. The method and frequency of reevaluation is detailed in Chapter 6.

In those cases where the owner did not have a risk assessment or inspection before hazard control, the clearance examiner should conduct a risk assessment at the time of clearance to ensure that all lead-based paint hazards were, in fact, addressed.

Form 15.1
Lead Hazard Control Visual Clearance Form

Date ____________________

Name of clearance examiner ____________________

License no. (if applicable) ____________________

Name of property owner ____________________

Property address ____________________ Apt. no.______

Date cleanup completed ____________________

Time cleanup completed ____________________

Abatement/Interim control contractor name ____________________

Address ____________________

Telephone no. ____________________

Check if repeat clearance examination ________

Room identifier	List all building components required to be treated in each room	Work on each component completed? (yes or no)	Visible paint chips seen? (yes or no)	Visible settled dust seen? (yes or no)	Additional work required?

Exterior soil ______Treated ______Not treated

If treated, is bare soil present? ______Yes ______No

Was contaminated soil removed? ______Yes ______No

Is additional soil treatment required? ______Yes ______No

NOTES:

Signature ____________________

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Form 15.2

Lead Hazard Control Clearance Dust Sampling Form (Single-Surface Sampling)

Date ______________________________

Name of clearance examiner ______________________________

License no. (If applicable) ______________________________

Name of property owner ______________________________

Property address ______________________ Apt. no. ________

Clearance categories:

1. Interior treatments without containment.
2. Interior teatments with containment.
3. Exterior work on painted surfaces.
4. Routine maintenance.
5. Soil work.

Sample number	Room number or identifier	Surface type (floor, interior window sill, window trough)	Clearance category number	Dimensions of sample area (inches)	Area (ft^2) (can be completed by lab)	Result of lab analysis ($\mu g/ft^2$) (can be completed by lab)	Pass or Fail

Total number of samples on this page________

Page ________ of ________

Date of sample collection ____/____/____ Date shipped to lab ____/____/____

Shipped by ______________________________ (Signature) Received by ______________________________ (Signature)

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Form 15.2a
Lead Hazard Control Clearance Dust Sampling Form (Composite Sampling)

Date ____________________

Name of clearance examiner ____________________

License no. (If applicable) ____________________

Name of property owner ____________________

Property address ____________________ Apt. no.________

Clearance categories:

1. Interior treatments without containment.
2. Interior treatments with containment.
3. Exterior work on painted surfaces.
4. Routine maintenance.
5. Soil work.

Sample number	Name of room or identifiers included in sample	Dimensions of surface sampled in each room (inches x inches)	Total surface area sampled (ft^2)	Type of surface sampled (smooth floors, carpeted floors, interior window sills, window troughs)	Clearance category number	Lab result ($\mu g/ft^2$)	Pass or fail
	____ ____ ____ ____	____ X ____ ____ X ____ ____ X ____ ____ X ____					
	____ ____ ____ ____	____ X ____ ____ X ____ ____ X ____ ____ X ____					
	____ ____ ____ ____	____ X ____ ____ X ____ ____ X ____ ____ X ____					
	____ ____ ____ ____	____ X ____ ____ X ____ ____ X ____ ____ X ____					

Total number of samples on this page ________

Page ________ of ________

Date of sample collection ____/____/____ Date shipped to lab ____/____/____

Shipped by ____________________ (Signature) Received by ____________________ (Signature)

Form 15.3

Lead Hazard Control Clearance Soil Sampling Form (Composite Sampling Only)

Date ______________________

Name of clearance examiner ______________________

License no. (if applicable) ______________________

Name of property owner ______________________

Property address ______________________ Apt. no. ________

Sample number	Location	Bare or covered	Lab result (µg/g)
	building perimeter		
	building perimeter		

Sketch soil sampling plot plan. Collect only the top 1/2" of soil.

Total number of samples on this page ________

Page ________ of ________

Date of sample collection ____/____/____ Date shipped to lab ____/____/____

Shipped by ______________________ (Signature) Received by ______________________ (Signature)

Appendix D

APPENDIX D
Waste Management Determination

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

January 21, 1999

SUBJECT: Determination If Soil Is Contaminated by RCRA Listed Waste K061, for the Palmerton Zinc Site Draft Feasibility Study Report, OU 3, December 1998

FROM: Douglas A. Donor, Sr. RCRA Tech. Advisor
Technical Support Branch (3HW11)

TO: Charlie Root, RPM
Eastern Pennsylvania Remedial Section (3HS21)

I reviewed the Draft Feasibility Study (DFS) Report for Operable Unit 3 (OU 3), the Residential Soil and Household Dust Unit, at the Palmerton Zinc Site, dated December 1998. It was requested that the evaluation determine whether such soil and dust was contaminated by the RCRA listed waste K061.

There are several references in this DFS, primarily in the description of remedial alternatives, that if contaminated soil is designated as K061 waste by EPA, excavation and disposal may require treatment and disposal in a hazardous waste landfill.

I do not believe it would be appropriate to consider soil and dust removed from residential properties as containing RCRA listed waste. This is based on the multiple historic sources of contaminates at this site and within the context of current EPA guidance.

Attached to these comments is the entire October 14, 1998 EPA Policy Memorandum on "Management of Remediation Waste Under RCRA" (this is also an EPA OSWER document "EPA530-F-98-026"). Of importance to this evaluation are the statements on page 5 of this Policy Memorandum, under the heading "Determination of When Contamination is Caused by Listed Hazardous Waste". There are two sentences from this section of the policy memorandum that are appropriate to this DFS. The sentences read as.

> "Where a facility owner/operator makes a good faith effort to determine if a material is a listed hazardous waste but cannot make such a determination because documentation regarding a source of contamination, contaminant, or waste is unavailable or inconclusive, EPA has stated that one may assume the source, contaminant or waste is not listed hazardous waste and, therefore, provided the material in question does not exhibit a characteristic of hazardous waste, RCRA requirements do not apply."

and,

" i.e., if, after a good faith effort to determine dates of disposal a facility owner/operator is unable to make such a determination because documentation of dates of disposal is unavailable or inconclusive, one may assume disposal occurred prior to the effective date of applicable land disposal restrictions. This is important because, if hazardous waste was originally disposed of before the effective dates of applicable land disposal restrictions and media contaminated by the waste are determined not to contain hazardous waste when first generated (i.e., removed from the land, or area of contamination), the media are not subject to RCRA requirements, including LDRs."

Also attached to this DFS evaluation is a January 22, 1996 Memorandum on a flood issue and hazardous waste determination at the Palmerton Zinc Site. In that memorandum the following opinion was expressed,

"It is my opinion that the RCRA listing would not attach to such material.
The soils and even perhaps some existing waste material on-site and off-site may have been contaminated by zinc ore processing which does not have the RCRA listing attached. In addition, at least for lead, there is always the claim of many sources, such as prior industrial smokestack emissions, lead gasoline deposition, and even lead paint deterioration as contaminant sources. Therefore in the absence of resource intensive metal speciation studies it would be extremely difficult to clearly attach the RCRA listing to the hazardous metal constituents when there are many other historical sources."

In addition, it is well known that there were past applications of a derived-from material from K061 processing that was used for anti-skid purposes on Palmerton City roads, although that practice has ceased for many years. That anti-skid material contains similar constituents to those found in K061. Anti-skid use was actually allowed by EPA until 1995. The Federal law would still allow use of such material in road be construction and fill today, although it is believe that Pennsylvania State law limits such use. In any event this was also an additional potential source of contaminants that would appear similar to those constituents found in K061, however such constituents found in soil would not be considered K061.

It would appear that although management of K061 could have been a potential source of the constituents that contaminated the soil, all the available information would appear to support the "inconclusive" criteria of the October 14, 1998 EPA policy memorandum. Additionally due to the historic nature of most of the sources, even if K061, those sources would predate the effective dates of RCRA Land Disposal Restrictions as referenced in the policy memorandum's sentence above. Only if there was definitive information that the listed K061 was disposed on these residential properties, for example a known spill from a vehicle carrying manifested K061, than would such soil be subject to the hazardous waste listing. In the absence of such information it is appropriate to not apply the listing.

Therefore as I stated in the flood issue memorandum, the appropriate evaluation to the soils and dust at the site should not be the application of the RCRA listed waste, however regardless of historical sources, any of the soil/dust that fails the RCRA characteristic should be treated to remove the characteristic prior to disposal, For example any soils found to fail the TCLP level for lead should have further treatment prior to disposal. Such treatment likely would allow disposal of the soil as non-hazardous.

If you have any question on these comments or the attachments please contact me at 4-3394, or by LAN.

Attachments (2)
cc: W. Naylor (3WC11)

United States Environmental Protection Agency | Solid Waste and Emergency Response (5305W) | EPA530-F-98-026 October 1998 www.epa.gov/osw

EPA

Management of Remediation Waste Under RCRA

October 14, 1998

MEMORANDUM

SUBJECT: Management of Remediation Waste Under RCRA

TO: RCRA/CERCLA Senior Policy Managers
Regional Counsels

FROM: Timothy Fields, Jr., Acting Assistant Administrator for
Solid Waste and Emergency Response */signed/*

Steven A. Herman, Assistant Administrator for
Enforcement and Compliance Assurance */signed/*

Rapid clean up of RCRA corrective action facilities and Superfund sites is one of the Agency's highest priorities. In this context, we often receive questions about management of remediation waste under the Resource Conservation and Recovery Act (RCRA). To assist you in successfully implementing RCRA requirements for remediation waste, this memorandum consolidates existing guidance on the RCRA regulations and policies that most often affect remediation waste management. We encourage you to work with the regulations, policies and approaches outlined in this memorandum to achieve our cleanup goals as quickly and efficiently as possible.

Note that not all remediation wastes are subject to RCRA Subtitle C hazardous waste requirements. As with any other solid waste, remediation wastes are subject to RCRA Subtitle C only if they are listed or identified hazardous waste. Environmental media are subject to RCRA Subtitle C only if they contain listed hazardous waste, or exhibit a characteristic of hazardous waste. These distinctions are discussed more completely below.

The information in this memo is divided into three categories: information on regulations and policies that apply to all remediation waste; information on regulations and policies that apply only to contaminated media; and, information on regulations and policies that apply only to contaminated debris. Most of the references cited in this memo are available over the Internet. The Federal Register notices published after 1994 are available at www.access.gpo.gov/nara; the guidance memos and other EPA documents are available at www.epa.gov/correctiveaction. Federal Register notices and other documents are also available through the RCRA/CERCLA hotline: in Washington D.C., call (703) 412-9810; outside Washington D.C., call (800) 424-9346; and hearing impaired call (800) 553-7672. The hotline's hours are Monday - Friday, excluding

Federal holidays, 8:00 - 5:00, eastern standard time. Many EPA guidance memos and other documents may also be obtained through the RCRA/CERCLA hotline fax-back system. To obtain a list of documents available over the fax-back system, and fax-back system code numbers, call the RCRA/CERCLA hotline at the numbers listed above.

I hope this information will assist you as you continue to make protective, inclusive, and efficient cleanup decisions. If you have additional questions or require more information, please contact Robert Hall or Greg Madden, of our staffs, on (703) 308-8484 or (202) 564-4229 respectively.

Regulations and Policies that Apply to All Remediation Wastes

Area of Contamination Policy. In what is typically referred to as the area of contamination (AOC) policy, EPA interprets RCRA to allow certain discrete areas of generally dispersed contamination to be considered RCRA units (usually landfills). Because an AOC is equated to a RCRA land-based unit, consolidation and *in situ* treatment of hazardous waste within the AOC do not create a new point of hazardous waste generation for purposes of RCRA. This interpretation allows wastes to be consolidated or treated *in situ* within an AOC without triggering land disposal restrictions or minimum technology requirements. The AOC interpretation may be applied to any hazardous remediation waste (including non-media wastes) that is in or on the land. Note that the AOC policy only covers consolidation and other in situ waste management techniques carried out within an AOC. For *ex situ* waste management or transfer of wastes from one area of contamination to another, see discussion of corrective action management units, below.

The AOC policy was first articulated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). See 53 FR 51444 for detailed discussion in proposed NCP preamble; 55 FR 8758-8760, March 8, 1990 for final NCP preamble discussion. See also, most recent EPA guidance, March 13, 1996 EPA memo, "Use of the Area of Contamination Concept During RCRA Cleanups."

Corrective Action Management Units (CAMUs). The corrective action management unit rule created a new type of RCRA unit – a Corrective Action Management Unit or CAMU -- specifically intended for treatment, storage and disposal of hazardous remediation waste. Under the CAMU rule, EPA and authorized states may develop and impose site-specific design, operating, closure and post-closure requirements for CAMUs in lieu of MTRs for land-based units. Although there is a strong preference for use of CAMUs to facilitate treatment, remediation waste placed in approved CAMUs does not have to meet LDR treatment standards.

The main differences between CAMUs and the AOC policy (discussed above) are that, when a CAMU is used, waste may be treated *ex situ* and then placed in a CAMU, CAMUs may be located in uncontaminated areas at a facility, and wastes may be consolidated into CAMUs from areas that are not contiguously contaminated. None of these activities are allowed under the AOC policy, which, as discussed above, covers only consolidation and *in situ* management techniques carried out within an AOC.

CAMUs must be approved by EPA or an authorized state and designated in a permit or corrective action order. In certain circumstances, EPA and states (including states that are not authorized for the CAMU regulations) may use other mechanisms to approve CAMUs. See, 58 FR 8677, February 16, 1993; appropriate use of RCRA Section 7003 orders and comparable state orders is discussed below and in an EPA guidance memo from J. Winston Porter to EPA Regional Administrators, "RCRA Permit Requirements for State Superfund Actions," November 16, 1987, OSWER Directive 9522.00-2. In addition, as appropriate, CAMUs may be approved by EPA as an applicable or relevant and appropriate requirement during a CERCLA cleanup using a record of decision or by an authorized state during a state cleanup using a CERCLA-like authority and a similar state document. See, e.g., 58 FR 8679, February 16, 1993. An opportunity for the public to review and comment on tentative CAMU approvals is required by the regulations when CAMUs are approved using permitting procedures and as a matter of EPA policy when CAMUs are approved using orders. EPA recommends that, whenever possible, remediation project managers combine this public participation with other public involvement activities that are typically part of remediation. For example, public notice of tentative approval of a CAMU could be combined with public notice of a proposed plan under CERCLA.

The CAMU rule is currently subject to litigation; however, the suit has been stayed pending promulgation of the final HWIR-Media regulations. Although EPA proposed to withdraw CAMUs as part of the HWIR-Media proposal, the Agency now intends to retain the CAMU rule. The Agency encourages approval of CAMUs when they are appropriate given the site-specific conditions.

The CAMU regulations are at 40 CFR 264.552, promulgated February 16, 1993 (58 FR 8658). The differences between CAMUs and AOCs are discussed in more detail in the March 13, 1996 EPA guidance memo, "Use of the Area of Contamination Concept During RCRA Cleanups."

Corrective Action Temporary Units (TUs). Temporary units, like corrective action management units, are RCRA units established specifically for management of hazardous remediation waste. The regulations for temporary units (TUs) were promulgated at the same time as the regulations for corrective action management units. The CAMU regulations established land-based units for treatment, storage and disposal of remediation waste; the TU regulations established non-land based units for treatment and storage of hazardous remediation waste. Under the TU regulations, EPA and authorized states may modify existing MTR design, operating and closure standards for temporary tank and container units used to treat and store hazardous remediation waste. Temporary units may operate for one year, with an opportunity for a one year extension.

Like CAMUs, temporary units must be approved by EPA or an authorized state and designated in a permit or corrective action order. In certain circumstances, EPA and states (including states that are not authorized for the TU regulations) may use other mechanisms to approve TUs. See, 58 FR 8677, February 16, 1993; appropriate use of RCRA Section 7003 orders and comparable state orders is discussed below and in an EPA guidance memo from J. Winston Porter to EPA Regional Administrators, "RCRA Permit Requirements for State Superfund Actions," November 16, 1987, OSWER Directive 9522.00-2. In addition, as appropriate, TUs may be approved by EPA as an applicable or relevant and appropriate requirement during a CERCLA cleanup using a record of decision or by an authorized state during a state cleanup using a CERCLA-like authority and a similar state document. Placement of waste in tanks or containers, including temporary units, is not considered land disposal. Therefore, waste does not have to be treated to meet LDR treatment standards prior to being placed in a TU. Of course, LDRs must be met if hazardous remediation wastes are eventually land disposed, for example, after they are removed from the TU; however, if treatment in a TU results in constituent concentrations that comply with applicable land disposal restriction treatment standards, no further treatment prior to land disposal is required as a condition of the LDRs.

An opportunity for the public to review and comment on tentative TU approvals is required by the regulations when TUs are approved using permitting procedures and as a matter of EPA policy when TUs are approved using orders. As with CAMUs, EPA recommends that whenever possible, remediation project managers combine this public participation with other public involvement activities that are typically part of remediation. For example, public notice of tentative approval of a temporary unit could be combined with public notice of a proposed plan under CERCLA.

The TU regulations are at 40 CFR 264.553, promulgated February 16, 1993 (58 FR 8658).

Determination Of When Contamination is Caused by Listed Hazardous Waste. Where a facility owner/operator makes a good faith effort to determine if a material is a listed hazardous waste but cannot make such a determination because documentation regarding a source of contamination, contaminant, or waste is unavailable or inconclusive, EPA has stated that one may assume the source, contaminant or waste is not listed hazardous waste and, therefore, provided the material in question does not exhibit a characteristic of hazardous waste, RCRA requirements do not apply. This approach was first articulated in the Proposed NCP preamble which notes that it is often necessary to know the source of a waste (or contaminant) to determine whether a waste is a listed hazardous waste under RCRA[1] and also notes that, "at many CERCLA sites no information exists on the source of the wastes." The proposed NCP preamble goes on to recommend that the lead agency use available site information such as manifests, storage records and vouchers in an effort to ascertain the sources of wastes or contaminants, but that when this documentation is not available or inconclusive the lead agency may assume that the wastes (or contaminants) are not listed RCRA hazardous wastes. This approach was confirmed in the final NCP preamble. See, 53 FR 51444, December 21, 1988 for proposed NCP preamble discussion; 55 FR 8758, March 13, 1990 for final NCP preamble discussion.

This approach was also discussed in the HWIR-Media proposal preamble, 61 FR 18805, April 29, 1996, where it was expanded to also cover dates of waste disposal – i.e., if, after a good faith effort to determine dates of disposal a facility owner/operator is unable to make such a determination because documentation of dates of disposal is unavailable or inconclusive, one may

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1. Listing determinations are often particularly difficult in the remedial context because the listings are generally identified by the sources of the hazardous wastes rather than the concentrations of various hazardous constituents; therefore, analytical testing alone, without information on a waste's source, will not generally produce information that will conclusively indicate whether a given waste is a listed hazardous waste.

assume disposal occurred prior to the effective date of applicable land disposal restrictions. This is important because, if hazardous waste was originally disposed of before the effective dates of applicable land disposal restrictions and media contaminated by the waste are determined not to contain hazardous waste when first generated (i.e., removed from the land, or area of contamination), the media are not subject to RCRA requirements, including LDRs. See the discussion of the contained-in policy, below.

Site Specific LDR Treatment Variances. The regulations for site-specific LDR treatment variances allow EPA and authorized states to establish a site-specific LDR treatment standard on a case-by-case basis when a nationally applicable treatment standard is unachieveable or inappropriate. Public notice and a reasonable opportunity for public comment must be provided before granting or denying a site-specific LDR treatment variance. EPA recommends that remediation project managers combine this public involvement with other public involvement activities that are typically part of remediation. Regulations governing site-specific LDR treatment variances are at 40 CFR 268.44(h), promulgated August 17, 1988 (53 FR 31199) and clarified December 5, 1997 (62 FR 64504). The most recent EPA guidance on site-specific LDR treatment variances, which includes information on establishing alternative LDR treatment standards, is in the January 8, 1997 guidance memo, "Use of Site-Specific Land Disposal Restriction Treatability Variances Under 40 CFR 268.44(h) During Cleanups."

In 1996, EPA revised its policy on state authorization for site-specific LDR treatment variances and began encouraging states to become authorized to approve variances. See, HWIR-Media proposal, 61 FR 18828 (April 29, 1996).

On May 26, 1998, EPA promulgated additional site-specific land disposal restriction treatment variance opportunities specific to hazardous contaminated soil. These opportunities are discussed below.

Treatability Studies Exemption. The term "treatability study"as defined at 40 CFR 260.10 refers to a study in which a hazardous waste is subjected to a treatment process to determine: (1) whether the waste is amenable to the treatment process; (2) what pretreatment (if any) is required; (3) the optimal process conditions needed to achieve the desired treatment; (4) the efficiency of a treatment process for a specific waste or wastes; or, (5) the characteristics and volumes of residuals from a particular treatment process. Under regulations at 40 CFR 261.4(e) and (f), hazardous wastes managed during a treatability study are exempt from many RCRA Subtitle C requirements. The regulations limit the amount of waste that may be managed under an exempt treatability study to, generally, 1000 kg of hazardous waste or 1 kg of acutely hazardous waste per study. For contaminated environmental media, the volume limit is, generally, 10,000 kilograms of media that contain non-acutely hazardous waste and 2,500 kilograms of media that contain acutely hazardous waste per study. There are also limits on the types and lengths of studies that may be conducted under the exemption and record keeping and reporting requirements. Regulations governing treatability studies are at 40 CFR 261.4(e) and (f), associated preamble discussions at 52 FR 27290 (July 19, 1988) and 59 FR 8362 (February 18, 1994).

Exemption for Ninety Day Accumulation. Management of hazardous waste in tanks, containers, drip pads and containment buildings does not constitute land disposal. In addition, EPA has provided an exemption for generators of hazardous waste which allows them to accumulate (i.e., treat or store) hazardous waste at the site of generation in tanks, containers, drip pads or containment buildings for up to ninety days without RCRA interim status or a RCRA permit. Accumulation units must meet applicable design, operating, closure and post-closure standards. Because putting hazardous waste in a tank, container, drip pad or containment building is not considered land disposal, LDR treatment standards do not have to be met before putting waste in such units. LDRs must be met if hazardous wastes are eventually land disposed, for example, after they are removed from the accumulation unit; however, if treatment in an accumulation unit results in constituent concentrations that comply with applicable land disposal restriction treatment standards, no further treatment prior to land disposal is required as a condition of the LDRs. The exemption for ninety-day accumulation is found in regulations at 40 CFR 262.34; associated preamble discussion is at 51 FR at 10168 (March 24, 1986).

Permit Waivers. Under CERCLA Section 121(e), no Federal, state or local permit is required for on-site CERCLA response actions. EPA has interpreted CERCLA Section 121(e) to waive the requirement to obtain a permit and associated administrative and procedural requirements of permits, but not the substantive requirements that would be applied through permits.[2]

In addition, on a case-by-case basis, where there may be an imminent and substantial endangerment to human health or the environment, EPA has broad authority to require corrective action and other appropriate activities under RCRA Section 7003. Under RCRA Section 7003, EPA has the ability to waive both the requirement to obtain a permit and the substantive requirements that would be imposed through permits. When EPA uses RCRA Section 7003, however, the Agency seldom uses RCRA Section 7003 to waive substantive requirements. In rare situations where substantive requirements are waived, the Agency would impose alternative requirements (e.g, waste treatment or storage requirements) as necessary to ensure protection of human health and the environment. EPA may issue RCRA Section 7003 orders at, among other sites, facilities that have been issued RCRA permits and facilities that are authorized to operate under RCRA interim status. In discussing the use of 7003 orders, where other permit authorities are available to abate potential endangerments, EPA generally encourages use of those other permit authorities (e.g., 3005(c)(3) omnibus permitting authority) rather than RCRA Section 7003. Similarly, if RCRA Section 3008(h) or RCRA Section 3013 authority is available, EPA generally encourages use of these authorities rather than RCRA Section 7003. If permit authorities or non-RCRA Section 7003 enforcement authorities are inadequate, cannot be used to address the potential endangerment in a timely manner, or are otherwise inappropriate for the potential endangerment at issue, use of RCRA Section 7003 should be considered. See, "Guidance on the Use of Section 7003 of RCRA," U.S. EPA, Office of Enforcement and Compliance Assurance, October 1997.

In 1987, EPA issued guidance indicating that RCRA-authorized states with state waiver authorities comparable to CERCLA 121(e) or RCRA Section 7003 could use those state waiver authorities to waive RCRA requirements as long as the state did so in a manner no less stringent than that allowed under the corresponding Federal authorities. These waivers are most often

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[2] Note that, under certain circumstances, substantive requirements may be waived using CERCLA. See the ARAR waiver provisions at 40 CFR 300.430(f)(1)(ii)(C).

used, as are the Federal waivers, to obviate the need to obtain a RCRA permit, rather than to eliminate substantive requirements. See, EPA guidance memo from J. Winston Porter to EPA Regional Administrators, "RCRA Permit Requirements for State Superfund Actions," November 16, 1987, OSWER Directive 9522.00-2.

Exemption from 40 CFR Part 264 Requirements for People Engaged in the Immediate Phase of a Spill Response. Regulations at 40 CFR 264.1(g)(8) provide that people engaged in treatment or containment activities are not subject to the requirements of 40 CFR part 264 if the activities are carried out during immediate response to: (1) a discharge of hazardous waste; (2) an imminent and substantial threat of a discharge of hazardous waste; (3) a discharge of a materials which, when discharged, becomes a hazardous waste; or, (4) an immediate threat to human health, public safety, property or the environment from the known or suspected presence of military munitions, other explosive material, or an explosive device. This means that, during the immediate phase of a spill response, hazardous waste management activities do not require hazardous waste permits (or interim status) and hazardous waste management units used during immediate response actions are not subject to RCRA design, operating, closure or post-closure requirements.

Of course, if hazardous waste treatment activities or other hazardous waste management activities continue after the immediate phase of a spill response is over, all applicable hazardous waste management and permitting requirements would apply. In addition, if spills occur at a facility that is already regulated under 40 CFR part 264, the facility owner/operator must continue to comply with all applicable requirements of 40 CFR Part 264 Subparts C (preparedness and prevention) and D (contingency plan and emergency procedures). See regulations at 40 CFR 260.1(g) and associated preamble discussion at 45 FR 76626 (November 19, 1980). See also, Sept. 29, 1986 memo from J. Winston Porter (EPA Assistant Administrator) to Fred Hansen interpreting the 40 CFR 264.1(g) regulations.

Changes During Interim Status to Comply with Corrective Action Requirements. Under regulations at 40 CFR 270.72(a)(5), an owner or operator of an interim status facility may make changes to provide for treatment, storage and disposal of remediation wastes in accordance with an interim status corrective action order issued by EPA under RCRA Section 3008(h) or other Federal authority, by an authorized state under comparable state authority, or by a court in a judicial action brought by EPA or an authorized state. These changes are limited to treatment, storage and disposal of remediation waste managed as a result of corrective action for releases at the facility in question; however, they are exempt from the reconstruction ban under 40 CFR 270.72(b). Under this provision, for example, EPA could approve a corrective action management unit for treatment of remediation waste using a 3008(h) order (or an authorized state could approve a CAMU using a similar state authority), even if that unit would otherwise amount to "reconstruction." Of course, units added at interim status facilities in accordance with this provision must meet all applicable unit requirements; for example, in the case of a CAMU, the CAMU requirements apply. See, regulations at 40 CFR 270.72(a)(5) promulgated March 7, 1989 and associated preamble discussion at 54 FR 9599.

Emergency Permits. In the event of an imminent and substantial endangerment to human health or the environment, EPA, or an authorized state, may issue a temporary emergency permit for treatment, storage or disposal of hazardous waste. Emergency permits may allow treatment, storage or disposal of hazardous waste at a non-permitted facility or at a permitted facility for waste not covered by the permit. Emergency permits may be oral or written. (If oral, they must be followed within five days by a written emergency permit.) Emergency permits must specify the hazardous wastes to be received and managed and the manner and location of their treatment, storage and disposal. Emergency permits may apply for up to ninety days, but may be terminated at any point if EPA, or an authorized state, determines that termination is appropriate to protect human health or the environment. Emergency permits must be accompanied by a public notice that meets the requirements of 40 CFR 124.10(b), including the name and address of the office approving the emergency permit, the name and location of the hazardous waste treatment, storage or disposal facility, a brief description of the wastes involved, the actions authorized and the reason for the authorization, and the duration of the emergency permit.

Emergency permits are exempt from all other requirements of 40 CFR part 270 and part 124; however, to the extent possible and not inconsistent with the emergency situation, they must incorporate all otherwise applicable requirements of 40 CFR part 270 and parts 264 and 266.

See, regulations at 40 CFR 270.61, originally promulgated as 40 CFR 122.27 on May 19, 1987 (45 FR 33326). EPA has also written a number of letters interpreting the emergency permit regulations, see, for example, November 3, 1992 letter to Mark Hansen, Environmental Products and Services Inc., from Sylvia Lowrance, Director Office of Solid Waste (available in the RCRA Permit Policy Compendium).

Temporary Authorizations at Permitted Facilities. Under regulations at 40 CFR 270.42(e), EPA, or an authorized state, may temporarily authorize a permittee for an activity that would be the subject of a class two or three permit modification in order to, among other things, facilitate timely implementation of closure or corrective action activities. Activities approved using a temporary authorization must comply with applicable requirements of 40 CFR part 264. Temporary authorizations are limited to 180 days, with an opportunity for an extension of 180 additional days. To obtain an extension of a temporary authorization, a permittee must have requested a class two or three permit modification for the activity covered in the temporary authorization. Public notification of temporary authorizations is accomplished by the permittee sending a notice about the temporary authorization to all persons on the facility mailing list and to appropriate state and local governments. See regulations at 40 CFR 270.42, promulgated on September 28, 1988, and associated preamble at 53 FR 37919.

Regulations and Policies that Apply to Contaminated Environmental Media Only

Contained-in policy. Contaminated environmental media, of itself, is not hazardous waste and, generally, is not subject to regulation under RCRA. Contaminated environmental media can become subject to regulation under RCRA if they "contain" hazardous waste. As discussed more fully below, EPA generally considers contaminated environmental media to contain hazardous waste: (1) when they exhibit a characteristic of hazardous waste; or, (2) when they are contaminated with concentrations of hazardous constituents from listed hazardous waste that are above health-based levels.

If contaminated environmental media contain hazardous waste, they are subject to all applicable RCRA requirements until they no longer contain hazardous waste. EPA considers contaminated environmental media to no longer contain hazardous waste: (1) when they no longer exhibit a characteristic of hazardous waste; and (2) when concentrations of hazardous constituents from listed hazardous wastes are below health-based levels. Generally, contaminated environmental media that do not (or no longer) contain hazardous waste are not subject to any RCRA requirements; however, as discussed below, in some circumstances, contaminated environmental media that contained hazardous waste when first generated (i.e., first removed from the land, or area of contamination) remain subject to LDR treatment requirements even after they "no longer contain" hazardous waste.

The determination that any given volume of contaminated media does not contain hazardous waste is called a "contained-in determination." In the case of media that exhibit a characteristic of hazardous waste, the media are considered to "contain" hazardous waste for as long as they exhibit a characteristic. Once the characteristic is eliminated (e.g., through treatment), the media are no longer considered to "contain" hazardous waste. Since this determination can be made through relatively straightforward analytical testing, no formal "contained-in" determination by EPA or an authorized state is required. Just like determinations about whether waste has been adequately decharacterized, generators of contaminated media may make independent determinations as to whether the media exhibit a characteristic of hazardous waste. In the case of media that are contaminated by listed hazardous waste, current EPA guidance recommends that contained-in determinations be made based on direct exposure using a reasonable maximum exposure scenario and that conservative, health-based, standards be used to develop the site-specific health-based levels of hazardous constituents below which contaminated environmental media would be considered to no longer contain hazardous waste. Since this determination involves development of site-specific health-based levels, the approval of EPA or an authorized state is required.

In certain circumstances the, RCRA land disposal restrictions will continue to apply to contaminated media that has been determined not to contain hazardous waste. This is the case when contaminated media contain hazardous waste when they are first generated (i.e., removed from the land, or area of contamination) and are subsequently determined to no longer contain hazardous waste (e.g., after treatment), but still contain hazardous constituents at concentrations above land disposal restriction treatment standards. It is also the case when media are contaminated as a result of disposal of untreated (or insufficiently treated) listed hazardous waste after the effective date of an applicable LDR treatment requirement. Of course, if no land disposal will occur (e.g., the media will be legitimately recycled) the LDR treatment standards do not apply. In addition, contaminated environmental media determined not to contain any waste (i.e., it is just media, it does not contain solid or hazardous waste) would not be subject to any RCRA Subtitle C requirements, including the LDRs, regardless of the time of the "contained-in" determination.

The contained-in policy was first articulated in a November 13, 1986 EPA memorandum, "RCRA Regulatory Status of Contaminated Groundwater." It has been updated many times in Federal Register preambles, EPA memos and correspondence, see, e.g., 53 FR 31138, 31142, 31148 (Aug. 17, 1988), 57 FR 21450, 21453 (May 20, 1992), and detailed discussion in HWIR-Media proposal preamble, 61 FR 18795 (April 29, 1996). A detailed discussion of the continuing requirement that some soils which have been determined to no longer contain hazardous waste (but still contain solid waste) comply with land disposal treatment standards can be found in the

HWIR-Media proposal preamble, 61 FR 18804; the September 15, 1996 letter from Michael Shapiro (EPA OSW Director) to Peter C. Wright (Monsanto Company); and the preamble to the LDR Phase IV rule, 63 FR 28617 (May 26, 1998).

Note that the contained-in policy applies only to environmental media (soil, ground water, surface water and sediments) and debris. The contained-in policy for environmental media has not been codified. As discussed below, the contained-in policy for hazardous debris was codified in 1992.

RCRA Section 3020(b) Exemption for Reinjection of Contaminated Ground Water. Under RCRA Section 3020(a), disposal of hazardous waste into or above a formation that contains an underground source of drinking water is generally prohibited. RCRA Section 3020(b) provides an exception for underground injection carried out in connection with certain remediation activities. Under RCRA Section 3020(b), injection of contaminated ground water back into the aquifer from which it was withdrawn is allowed if: (1) such injection is conducted as part of a response action under Section 104 or 106 of CERCLA or a RCRA corrective action intended to clean up such contamination; (2) the contaminated ground water is treated to substantially reduce hazardous constituents prior to reinjection; and, (3) the response action or corrective action will, on completion, be sufficient to protect human health and the environment. Approval of reinjection under RCRA Section 3020(b) can be included in approval of other cleanup activities, for example, as part of approval of a RCRA Statement of Basis or CERCLA Record of Decision. See, RCRA Section 3020(b), established as part of the 1984 HSWA amendments. See also, OSWER Directive 9234.1-06, "Applicable of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection Superfund Management Review: Recommendation No. 26," November 27, 1989.

LDR Treatment Standards for Contaminated Soils. On May 26, 1998, EPA promulgated land disposal restriction treatment standards specific to contaminated soils.[3] These treatment standards require that contaminated soils which will be land disposed be treated to reduce concentrations of hazardous constituents by 90 percent or meet hazardous constituent concentrations that are ten times the universal treatment standards (UTS), whichever is greater. (This is typically referred to as 90% capped by 10xUTS.) For contaminated soil that exhibits a characteristic of ignitable, reactive or corrosive hazardous waste, treatment must also eliminate the hazardous characteristic.

The soil treatment standards apply to all underlying hazardous constituents[4] reasonably expected to be present in any given volume of contaminated soil when such constituents are found at initial concentrations greater than ten times the UTS. For soil that exhibits a characteristic of toxic, ignitable, reactive or corrosive hazardous waste, treatment is also required for: (1) in the case of the toxicity characteristic, the characteristic constituent; and, (2) in the case of ignitability,

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[3] This rule, which also addresses a number of non-soil issues, has been challenged by a number of parties. To date, the parties have filed non-binding statements of issues only; however, based on those statements, it appears that, with the exception of the requirement that PCBs be included as an underlying hazardous constituent which has been challenged for both soil and non-soil wastes, the soil treatment standards are not included in the challenges.

[4] Except fluoride, selenium, sulfides, vanadium and zinc.

reactivity or corrosivity, the characteristic property. Although treatment is required for each underlying hazardous constituent, it is not necessary to monitor soil for the entire list of underlying hazardous constituents. Generators of contaminated soil can reasonably apply knowledge of the likely contaminants present and use that knowledge to select appropriate underlying hazardous constituents, or classes of constituents, for monitoring. As with the LDR treatment standards for hazardous debris (discussed below), generators of contaminated soil may use either the applicable universal treatment standards for the contaminating hazardous waste or the soil treatment standards.

See, soil treatment standard regulations at 40 CFR 268.49, promulgated May 26, 1998 and associated preamble discussion at 63 FR 28602-28622.

Note that the soil treatment standards supersede the historic presumption that an LDR treatment variance is appropriate for contaminated soil. LDR treatment variances are still available for contaminated soil, provided the generator can show that an otherwise applicable treatment standard (i.e., the soil treatment standard) is unachieveable or inappropriate, as discussed above, or can show that a site-specific, risk-based treatment variance is proper, as discussed below.

Site-Specific, Risk-Based LDR Treatment Variance for Contaminated Soils. On May 26, 1998, EPA promulgated a new land disposal restriction treatment variance specific to contaminated soil. Under 40 CFR 268.44(h)(3), variances from otherwise applicable LDR treatment standards may be approved if it is determined that compliance with the treatment standards would result in treatment beyond the point at which short- and long-term threats to human health and the environment are minimized. This allows a site-specific, risk-based determination to supersede the technology-based LDR treatment standards under certain circumstances.

Alternative land disposal restriction treatment standards established through site specific, risk-based minimize threat variances should be within the range of values the Agency generally finds acceptable for risk-based cleanup levels. That is, for carcinogens, alternative treatment standards should ensure constituent concentrations that result in the total excess risk to an individual exposed over a lifetime generally falling within a range from 10^{-4} to 10^{-6}, using 10^{-6} as a point of departure and with a preference for achieving the more protective end of the risk range. For non-carcinogenic effects, alternative treatment standards should ensure constituent concentrations that an individual could be exposed to on a daily basis without appreciable risk of deleterious effect during a lifetime; in general, the hazard index should not exceed one (1). Constituent concentrations that achieve these levels should be calculated based on a reasonable maximum exposure scenario -- that is, based on an analysis of both the current and reasonable expected future land uses, with exposure parameters chosen based on a reasonable assessment of the maximum exposure that might occur; however, alternative LDR treatment standards may not be based on consideration of post-land disposal controls such as caps or other barriers.

See, regulations at 40 CFR 268.44(h)(4), promulgated May 26, 1998 and associated preamble discussion at 63 FR 28606-28608.

Regulations and Policies that Apply Only to Debris

LDR Treatment Standards for Contaminated Debris. In 1992, EPA established land disposal restriction treatment standards specific to hazardous contaminated debris. The debris-specific treatment standards established by these regulations are based on application of common extraction, destruction, and containment debris treatment technologies and are expressed as specific technologies rather than numeric criteria. As with the contaminated soil treatment standards discussed earlier, generators of hazardous contaminated debris may choose between meeting either the debris treatment standards or the numerical treatment standard promulgated for the contaminating hazardous waste. See, regulations at 40 CFR 268.45, promulgated August 18, 1992, and associated preamble discussion at 57 FR 37194 and 27221.

Interpretation that Debris Treated to the LDR Debris Treatment Standards Using Extraction or Destruction Technologies no Longer Contain Hazardous Waste. With the land disposal restriction treatment standards for hazardous contaminated debris, in 1992, EPA determined that hazardous debris treated to comply with the debris treatment standards using one of the identified extraction or destruction technologies would be considered no longer to contain hazardous waste and would, therefore, no longer be subject to regulation under RCRA, provided the debris do not exhibit any of the hazardous waste characteristics. This "contained-in determination" is automatic; no agency action is needed. Note that this automatic contained-in determination does not apply to debris treated to the debris treatment standards using one of the identified immobilization technologies. See, regulations at 40 CFR 261.3(f) and treatment standards at Table 1 of 40 CFR 268.45, promulgated August 18, 1992, and associated preamble discussion at 51 FR 37225.

cc: Barbara Simcoe, Association of State and Territorial Solid Waste Management Officials

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

SUBJECT: RCRA Waste and Flood Issues at Superfund Palmerton Zinc Site **DATE:** 1-22-96

FROM: Douglas A. Donor, RCRA Sr. Tech. Advisor
RCRA Technical & Program Support Branch (3HW70)

TO: Peter Schaul, Chief
Remedial Branch (3HW20)

Fred MacMillan, RPM
Eastern PA Remedial Section (3HW21)

Fred MacMillan, the Remedial Project Manager (RPM) for the Palmerton Zinc site requested an opinion on the disposition of materials that may have been carried by flood waters into residences during the recent snow melt and rain events of January 18-21, 1996. On the date of this memorandum I do not have definitive information on the impact of the flood and potential hazardous waste material dispersal at this site.

In the hypothetical event that currently stored or generated RCRA waste was clearly dispersed by the flood waters, for example if the stored unprocessed K061 was washed off the site, then the RCRA listed may be applicable to any further disposition of contaminated materials to be removed from the residences. If this scenario did occur then it is recommended that the RCRA PA Operations and Compliance & Enforcement Branches pursue further investigation, as there would be regulatory problems with flood plain storage of RCRA wastes and other issues.

It appears more likely that flood waters washed over areas of this site that from prior analysis are known to be contaminated with hazardous substances and in certain instances are known to fail the RCRA characteristic criteria for certain metals (information provided by Fred MacMillan). It is my opinion that the RCRA listing would not attach to such material.
The soils and even perhaps some existing waste material on-site and off-site may have been contaminated by zinc ore processing which does not have the RCRA listing attached. In addition, at least for lead, there is always the claim of many sources, such as prior industrial smokestack emissions, lead gasoline deposition, and even lead paint deterioration as contaminant sources. Therefore in the absence of resource intensive metal speciation studies it would be extremely difficult to clearly attach the RCRA listing to the hazardous metal constituents when there are many other historical sources.

It is my recommendation that the RCRA characteristic criteria may be applicable to final disposition of flood carried materials in the residences. If the material fails TCLP, there is not a good environmental reason to dispose of the material untreated. Once treated, such material is allowed to be disposed of as non-hazardous. However, it also probable that various amounts of the flood carried materials will not fail TCLP, and need no further treatment. Health-based criteria, rather than RCRA criteria will likely drive any cleanup determinations.

Additionally much of the material contacted by flood waters in the residences is likely to be "debris" material that may be subject to simple decontamination activities, such as vacuuming, or even shovelling of solidified material into containers, that may facilitate removal. Surfaces such as basement walls may need simple cleaning to remove any potential contaminants. It would appear that much of the material may be amendable to decontamination, that even if contacted by RCRA listed or characteristic contamination could be returned to non-hazardous conditions and if no longer useful (flood damaged) disposed of as non-hazardous.

I suggest that this recommendation for disposition of this flood material be reviewed and accepted by Division Management or Perhaps the Regional Administrator. This memorandum represents my opinion.

I believe this instant flood situation highlights an apparent gap in our RCRA regulatory policy. I conducted a search of the Statute and Regulations and Policy Guidance and other than some "Act of God" language (see below), I could not find any statement on the disposition of RCRA hazardous waste materials when impacted by natural disasters.
I believe that during the great midwest floods of 1993 that both EPA Regions 5 and 7 waived any RCRA attachment to flood carried materials even in instances where active RCRA units were impacted by flood waters. I would recommend that appropriate EPA Region 3 RCRA and CERCLA Management and Staff contact our counterparts in Regions 5 and 7 to determine what mechanisms was used for this waiver. I believe common sense alone is an reasonable approach.

Paul Gotthold informed me, that even prior to these recent flood events in Region 3, there is an Regional initiative, headed by Dave Wright to formulate Regional Response Policies for such events. I would recommend that within this initiative that Region III formulate and state a specific policy on RCRA application, or waiver of application, to such potential natural disaster impacts on RCRA and CERCLA sites. Actually the policy should even apply to non RCRA sites. For example a Chemical Products distributor, if flooded out is not subject to RCRA storage requirements, as RCRA does not apply to products, but in the event of a flood, the issue of waste disposal should be addressed. A policy on anticipated scenarios would be useful. It may also be useful to have a national policy, rather than a declaration of waiver in each instant event.

In this most recent event, I assume far more than just the Palmerton site is impacted, as there are news reports of extensive floods in many areas throughout Region III from the Ohio to the Delaware and Susquehanna to the Potomac Rivers.

I do not believe it should be difficult or a long term project to formulate a hazardous waste and flood/natural disaster policy.

I am not sure it may be applicable, but there is some language on "Act of God" exclusions in the RCRA permit modifications language at RCRA 40 CFR § 270.41(a)(4) and in the sample below from the CERCLA 40 CFR § 304.30(c)(2) (small claims arbitration) and the reference to the CERCLA Statute.

"Any objections to EPA's position on the liability of the answering participating PRP pursuant to section 107(a) of CERCLA, 42 U.S.C. 9607(a), a description of the evidence insupport of the defenses to liability of the answering participating PRP **which are specifically enumerated in section 107(b) of CERCLA, 42 U.S.C. 9607(b) (i.e., that the release or threat of release of a hazardous substance at the facility was caused solely by an act of God**, an act of war, an act or omission of an unrelated third party, or any combination thereof), and any supporting documentation thereof;"

This suggests that perhaps there may even be a Statutory mechanism to support a policy on RCRA waste and/or CERCLA hazardous substances and natural disaster impacts.

I placed a number of persons in the "cc's" for both the site specific information and for potential Regional policy formation. Please forward to any other interested parties. If there are any specific questions on the Palmerton Site Flood/RCRA waste "opinion", please contact me at 7-9884 or by LAN.

cc: Wayne Naylor (3HW70)
Paul Gotthold (3HW80)
Chris Pilla (3HW100)
Dave Wright (3HW33)
Marcos Aquino (3HW80)
Mike Cramer (3HW100)