PERRINE DUPONT SETTLEMENT
SPELTER VOLUNTEER FIRE DEPARTMENT CLAIMS OFFICE
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April 9, 2012

BY HAND DELIVERY

The Honorable Thomas A. Bedell
Circuit Judge of Harrison County
301 West Main Street, Room 321
Clarksburg, West Virginia 26301

Re: ***Perrine et al. v. DuPont et al.*** **(04-C-296-2) - Results of Soil and House Testing Under the Remediation Property Clean-Up Program (the "Program"); Proposed Remediation Working Budget and Request for Related Remediation Instructions; Our File No. 4609-1 {DD-23}**

Dear Judge Bedell,

We hope this letter finds the Court well.

The purpose of this letter is to update the Court with respect to the Property Clean-Up portion of the Settlement, to provide a Property Remediation Program Working Budget for the Court's review in accordance with the June 27, 2012 Final Order establishing Property Remediation (Clean-Up) Program (the "June Order"), and to ask the Court for instructions on related remediation issues, described below.

I.
PROPERTY CLEAN-UP PROGRAM UPDATE

A. CLAIMANT PROPERTY CLEAN-UP REGISTRATION AND PROPERTY TESTING.

As shown in Exhibit A, at April 4, 2012, the owners of 1,146 properties have attempted to register in the Program, with 987 claims having been found valid. The claim form registration deadline of October 10, 2011, under the June Order was extended to December 2, 2012, and there were two claimant mail-outs to encourage Class participation.

At this time, only a handful of additional property claims are being received, and are still being accepted, so that we expect the number of qualifying properties to be approximately 1,000, of which about 200 are in Zone 1A and are eligible for soil remediation in addition to house remediation.

The Zone 1A participation has therefore been robust, with 91% (218) of the approximately 240 Zone 1A eligible properties participating in the Program. Therefore, we suggest that the question posed in the June Order of whether to make soil remediation in Zone 1A voluntary or mandatory is moot.

Program participation outside Zone 1A has been disappointing, however, with approximately half of the estimated 2,000 eligible houses participating.

Of the 20 so called Upper B Street Properties addressed in the Court's August 31, 2011 Final Order Approving Soil Tests (the"August Order"), 16, or 67%, have had their soil tested. Below we compare the Zone 1A soil test results with those for the Upper B Street Properties to help the Court decide how to treat these properties under the Program.

B. TEST RESULTS.

We have engaged an expert, Mr. Richard B. Adams, to recommend the soil and house contamination levels justifying remediation. His report is in Exhibit B, and recommends remediation if one or more heavy metal contamination levels exceed these amounts:

	Soil (Zone 1A only)	House (All Zones in Class Area)
Cd- Cadmium	39 ppm	144.65 ug/ft^2
As- Arsenic	12.5 ppm	35.95 ug/ft^2
Zn- Zinc	23,000 ppm	43,695 ug/ft^2
Pb- Lead	400 ppm	40 ug/ft^2

Of the 197 Zone 1A properties whose soil was tested, we have received verified test results for 177 properties. Of these, 135, or 76%, are contaminated with at least one of the 4 heavy metals at a level justifying remediation according to Mr. Adams.

Of the 890 houses in the Class Area whose interior were tested, we have received verified test results for 779 houses. Of these, 503, or 65 %, are contaminated with at least one of the 4 heavy metals at a level justifying remediation according to Mr. Adams.

In summary, based on the verified test results received so far and the expert report of Mr. Adams, we recommend that approximately 160 soil properties and approximately 600 houses be remediated (collectively referred to as the "Remediation Level Properties").

The proper treatment of the Upper B Street Properties may be resolved below. As indicated in the expert report of the Settlement Remediation Technical Advisor, Mr. Marc Glass, in Exhibit C, under a t-test and MANOVA statistical analysis, the contamination levels of lead and arsenic in Upper B Street are comparable to those in Zone 1A, where soil remediation is allowed, but contamination levels of zinc and cadmium are materially less.

Because contamination with only one of the 4 heavy metals above the thresholds prescribed by Mr. Adams justifies remediation of a soil property in Zone 1A, the results appear to justify inclusion of the Upper B Street Properties in Zone 1A. This may add 15 soil Remediation Level Properties to the Program for soil clean-up, with a projected additional soil remediation and annoyance payment cost of $700,000 (assumes 15 Upper B Street Soil Properties will be cleaned).

II.
SUGGESTED PROPERTY REMEDIATION PROGRAM WORKING BUDGET AND RELATED UNRESOLVED ISSUES

Assuming that 160 soil properties and 600 houses will be remediated under the Program, we have drafted the Property Remediation Program Working Budget in Exhibit D (the "Working Budget").

Preparation of this estimated budget at this time is not meant to contradict the Court-Approved Remediation Fund budget through August 31, 2011, or to deprive the parties of the right to prepare a joint budget for the Remediation Program and the Medical Monitoring Program for the period commencing September 1, 2011, or for future periods.

Instead, this Working Budget was prepared solely to facilitate Court decision-making on the issues described in this report.

The Working Budget assumes that the lowest qualified bidder for the Property Remediation Program and the Settlement will successfully negotiate a mutually agreeable contract and it is approved by the Court. We are drafting the contract with the lowest qualified bidder now, and we anticipate submitting it to the Court for consideration in the near future.

Under the Working Budget, there is a potential Remediation Fund surplus of $6.4M, after completion of the Program. However, it is axiomatic that Mass Tort Projects usually take longer and cost more than expected.

In addition, the Court may consider the following material items, which may exhaust the surplus:

Material Item	Projected Expense
A. Inclusion of Upper B Street in Zone 1A	$700,000 ($100,000 in Annoyance Payments and $600,000 in Soil clean-Up Costs) (Assumes 15 Upper B Street Soil Properties Will be Cleaned)
B. Reserve for Litigation over Road Deterioration (explained below)	$1,000,000
C. Possibly Remediating Soil to a Depth of 12 inches instead of 6 inches recommended by Dr. Kirk Brown (explained below)	$5,846,000
Total:	$7,546,000

Based on experience in other community remediation projects, litigation with local governments over road deterioration arguably resulting from anticipated large truck traffic is reasonably foreseeable. In one project, resulting settlements with local governments ran into the hundreds of thousands of dollars. Therefore, a Million dollar reserve for this item is recommended as reasonable.

Although Dr. Brown recommended soil remediation to a depth of 6 inches, a prevailing scientific and environmental opinion may be that 12 inches is more sound. See, for example, the EPA Superfund Lead-Contaminated Residential Sites Handbook in Exhibit F at §6.1 at page 37. The adverse financial impact to the Program of excavating to 12 inches may be reduced by only remediating the contaminated areas of soil in each Zone 1A yard instead of remediating the entire yard, which is also approved by the EPA Superfund Lead-Contaminated Residential Sites Handbook. See Exhibit F at §6.3 at page 41. At the requested Fairness Hearing, we propose to offer expert testimony on this issue for the Court's consideration.

It is therefore recommended that the Court first address the possible inclusion of the above three material items in the Working Budget, and that the Program then accomplish the Clean-Up of the Remediation Level Properties, with your Claims Administrator then to compute the surplus, if any, and to submit a final report to the Court at that time.

III.
SUGGESTED FAIRNESS HEARING

It is respectfully requested that the Court hold a two-day Property Clean-Up Program Fairness Hearing on May 1 and 2, 2012, during which any potential Property Class Members (the "Class") may offer their opinions on the implementation of the Property Clean-Up Program, in light of this report and based on any other evidence or factors the Court deems to be appropriate.

Your Claims Administrator proposes to invite the Claimants to the Fairness Hearing based on the following schedule:

DATE	LOCATION	TIME	SUGGESTED CLAIMANTS
Tuesday May 1, 2012	**Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor**	**Register to speak from 9:30 to 10:00am. Hearing begins at 10:00am.**	**Last Names beginning with letters A through L.**
Wednesday May 2, 2012	**Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor**	**Register to speak from 8:30 to 9:00am. Hearing begins at 9:00am.**	**Last Names beginning with letters M through Z.**

Your Claims Administrator will invite the Claimants to the Fairness Hearing, and will provide the verified test results that are now available to the Claimants, on a confidential basis, with an explanation of whether the Claimant's property is a Remediation Level Property or not under Mr. Adam's report in Exhibit B.

The suggested invitation letter is in Exhibit E.

IV.
CONCLUSION

Based on the foregoing, your Claims Administrator requests the following relief from the Court:

(i) that this matter be set down for a Fairness Hearing on May 1 and 2, 2012, with your Claims Administrator to invite the Claimants to the Fairness Hearing using the form letter in Exhibit E, while also providing, on a confidential basis, verified test results to Claimants who now have them;

(ii) that the Court review the expert report of Mr. Richard B Adams in Exhibit B respecting remediation contamination levels, and take Mr. Adams testimony, and take other evidence the Court deems to be appropriate, and determine the contamination levels justifying remediation under the Program;

(iii) that the Court review the Upper B Street Property Report of Mr. Marc Glass in Exhibit C, and take other evidence the Court deems to be appropriate and determine whether these properties should or should not be included in Zone 1A and therefore be eligible for soil remediation and soil inconvenience payments;

(iv) that the Court review the Working Budget in Exhibit D, and take such additional testimony as the Court deems to be appropriate, with the Court then being requested to consider (a) determining if all Remediation Level Properties should be cleaned; (b) the disposition of the potential remediation surplus; and

(v) such other relief as the Court deems to be appropriate.

A proposed Order is submitted for the Court's consideration.

Respectfully Submitted,

Ed Gentle
Claims Administrator

Proposed Order
Exhibits:

A. April 4, 2012 Property Clean-Up Claim Registration and Sampling Report
B. Remediation Contamination Level Report of Mr. Richard B. Adams
C. Upper B Street Property Report of Mr. Marc Glass
D. Property Remediation Program Working Budget
E. Claimant Fairness Hearing Invitation Letter Transmitting Confidential Test Results to Claimants Who Have Them
F. EPA Superfund Lead-Contaminated Residential Sites Handbook

cc: (with Proposed Order and Exhibits)
(via e-mail)(confidential)
Terry D. Turner, Jr., Esq.
Diandra S. Debrosse, Esq.
Katherine A. Harbison, Esq.
Paige F. Osborn, Esq.
Michael A. Jacks, Esq.
William S. ("Buddy") Cox, Esq.
J. Keith Givens, Esq.
McDavid Flowers, Esq.
Farrest Taylor, Esq.
Ned McWilliams, Esq.
Perry B. Jones, Esq.
Angela Mason, Esq.
Meredith McCarthy, Esq.
Mr. Marc Glass
Mr. Billy Sublett
Lewis Sutherland, Esq.

IN THE CIRCUIT COURT OF HARRISON COUNTY, WEST VIRGINIA

LENORA PERRINE, et al., individuals
residing in West Virginia, on behalf of
themselves and all others similarly situated,

Plaintiffs,

v.

Case No. 04-C-296-2
Thomas A. Bedell, Circuit Judge

E.I. DU PONT DE NEMOURS AND COMPANY, et al.,

Defendants.

ORDER SETTING FAIRNESS HEARING

Presently pending before the Court is the issue of the implementation of the property remediation portion of the settlement, including the level of soil contamination in Zone 1A and house or commercial structures contamination throughout the Class Area, with cadmium, arsenic, zinc or lead which justifies remediation, and the results of the Claims Administrator house and soil verified testing to date. To allow Class Area property owners and concerned citizens a chance to comment on the implementation of the property remediation portion of the Settlement, the Court hereby **ORDERS** that a Fairness Hearing will be held on Tuesday, May 1, 2012 and Wednesday, May 2, 2012.

The Fairness Hearing will be held in Judge Bedell's Courtroom on the Fourth Floor of the Harrison County Courthouse. The May 1 Session of the Hearing will begin with registration for interested persons to speak from 9:30-10:00 AM, and the Hearing will begin at 10:00 AM. The May 2 Session of the Hearing will begin with registration for interested persons to speak from 9:30-10:00 AM, and the Hearing will begin at 10:00 AM; the Court will attempt to allow all interested persons an opportunity to address the issues related to the property remediation program during the two-day Hearing.

Both Sessions of the Hearing will begin with a presentation of the issues by the Claims Administrator, Edgar C. Gentle, III, and the Court will consider the opinions presented on either day of the Hearing equally.

Anyone can attend and speak at either day of the Fairness Hearing, but the Court suggests that people with a last name beginning with the letters A through L attend the May 1 Session of the Hearing, and that people with a last name beginning with the letters M through Z attend the May 2 Session of the Hearing.

The following chart is a summary of the dates and times of the two Sessions of the Fairness Hearing.

DATE	**LOCATION**	**TIME**	**SUGGESTED CLAIMANTS**
Tuesday, May 1, 2012	Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor	Register to speak from 9:30 to 10:00 a.m. Hearing begins at 10:00 a.m.	Last Names beginning with Letters A through L.
Wednesday, May 2, 2012	Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor	Register to speak from 9:30 to 10:00 a.m. Hearing begins at 10:00 a.m.	Last Names beginning with Letters M through Z.

IT IS SO ORDERED.

The Clerk of this Court shall provide certified copies of this Order to the following:

Stephanie Thacker, Esq.
Guthrie & Thomas, PLLC
500 Lee St., East, Suite 800
P.O. Box 3394
Charleston, WV 25333-3394
DuPont's Finance Committee Representative

Virgnia Buchanan, Esq.
Levin, Papantonio, Thomas, Mitchell,
Rafferty & Proctor, P.A.
P.O. Box 12308
Pensacola, FL 32591
Plaintiffs' Finance Committee Representative

Meredith McCarthy, Esq.
901 W. Main Street
Bridgeport, WV 26330
Guardian Ad Litem

Edgar C. Gentle, III, Esq.
Gentle, Turner, & Sexton
55 B Street
P.O. Box 257
Spelter, WV 26438
Claims Administrator

This Order Prepared By:

Edgar C. Gentle, III, Esq.
Gentle, Turner & Sexton
P.O. Box 257
Spelter, WV 26438
Claims Administrator

Michael A. Jacks, Esq.
W. Va. Bar No. 11044
P.O. Box 257
Spelter, WV 26438

ENTER: _____

_____
Thomas A. Bedell, Circuit Judge

SCHEDULE OF EXHIBITS

A. April 4, 2012 Property Clean-Up Claim Registration and Sampling Report
B. Remediation Contamination Level Report of Mr. Richard B. Adams
C. Upper B Street Property Report of Mr. Marc Glass
D. Property Remediation Program Working Budget
E. Claimant Fairness Hearing Invitation Letter Transmitting Confidential Test Results to Claimants Who Have Them
F. EPA Superfund Lead-Contaminated Residential Sites Handbook

EXHIBIT A

PERRINE DUPONT SETTLEMENT

PERIODIC PROPERTY CLEAN-UP CLAIM REGISTRATION AND SAMPLING REPORT

April 4, 2012

Table 1: Overview of the Total Number of Claims Received and Claim Processing and Approval Progress

Zone	Claims Filed through 4-4-12	Claims Paid Through Week 23 (Week 23 = April 2-6)	Claimants who withdrew their property claims and returned checks (removed from Paid column)	Claims Denied (Opt Out, Grasselli, Other)	Claims Pending – Requiring Claimant Action or Documentation[1]
Zone 1A	215	195	0	13	7
Zone 1A Bubble	21	15(3)	0	1	2
Zone 1B	66	54	3	2	7
Zone 2	321	270	1	18	32
Zone 3	500	453	2	3	42
Out of Area	23	0	0	First deficiency letters mailed, final denials not sent yet (23)	23
Total	1146[2]	987(+3)[3]	6	37	113

Reconciliation = Zero

[1] All Claimants who have not had their Property Claims approved have received written requests via at least one deficiency letter for documentation or information to complete their claims.

[2] This number will fluctuate as claims continue to be submitted and as files are reviewed.

[3] The Settlement has paid 987 claims, but has approved an additional 3 soil test 1A Bubble properties, so the claim has been approved for the soil test, and the property may eventually be part of the Class, but a check has not been issued

Table 2: Soil Sampling Progress

Total 1A Claims Filed	**213**
Total 1A Bubble Claims Filed	**21**
Total Soil Claims	**233 (One 1A claim is for a trailer only, not soil)**
Total Soil Claims (1A+1A Bubble) Approved and Paid by Claims Office through Week 23	**220**
Total Soil Properties Submitted by CORE to the Claims Office as sampled through Week 22	**219**
Total Properties submitted by CORE as having Soil Lab Analysis completed	**219**
Total Soil claims not approved by Claims Office	**14**
Total Soil Properties that remain to be sampled by CORE that have been approved by the Claims office	**1**

Of the Soil claims, 30 of the claims that have been approved and paid are vacant lots (Soil only claims) and do not have habitable homes.

Table 3: House Claim Processing and Approval Progress

Zone	House and Commercial Structure Claims Filed	Total House Claims Paid and Approved by the Claims Office and submitted to CORE for sampling through Week 23	Total House Claims Denied (Including claims voluntarily withdrawn by property owners who returned their checks and have been removed from the Paid list)	Total house Claims yet to be approved and requiring Settlement action (includes some that will be denied eventually)
Zone 1A and 1A Bubble	206 (236 minus 30 soil only claims)	180	17[4]	9
Zone 1B	66	54	5	7
Zone 2	321	270	19	32
Zone 3	500	453	5	42
Out of Area	23	0	(23, deficiency letters mailed – to be denied)	23 (final denial letters not written yet)
TOTAL	1116	957	41	113

Reconciliation = Zero

Table 4: House Sampling Progress Through Week 22 (March 30, 2012)

CORE & JPEC Sampling progress	
Houses submitted to CORE through Week 23 as ready to sample	957
House submitted to Settlement as sampled through Week 20 by CORE via weekly progress lists and invoices 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 & 11	890
Total remaining houses already submitted to CORE that remain to be sampled	67 (36 Houses have refused to schedule sampling appointments, so only 31 remain to be sampled)

[4] See FN 3 for explanation as to 3 "approved" soil only claims in the 1A Bubble area. The soil claim was approved, the house claim was not because the house was uninhabitable.

EXHIBIT B

RB Adams, LLC

5455 Landmark Place, Ste. 610•Greenwood Village, CO 80111
4539 Southwinds Drive•Miramar Beach, FL 32550
970.471.1952 • rich@rbadamsllc.com•www.rbadamsllc.com

March 30, 2012

Trey Hawthorne, Esq.
Gentle Turner & Sexton
501 Riverchase Parkway East, Suite 100
Hoover, AL 35244

Re: Draft Revised Report
Soil Cleanup – Perrine DuPont Settlement
Spelter, West Virginia
Our File: 12-0201

Dear Mr. Hawthorne,

I have been retained by Gentle Turner & Sexton to review criteria for the cleanup of soils/dust impacted by arsenic, cadmium, lead, and zinc at a site in Spelter, West Virginia. This report is a revision of the report I submitted on March 7, 2012, which did not address zinc, and is based on review of a portion of the expert report prepared by Dr. Kirk W. Brown, dated April 2, 2007; a confidential e-mail memorandum from Edgar C. Gentle, III, Esq., dated January 19, 2012, subject Perrine v. DuPont Settlement – Additional Property Testing Results; applicable state and federal cleanup criteria; and research of remediation criteria for arsenic, cadmium, lead, and zinc in residences. My comments and opinions are as follows:

1. Trigger levels for soil remediation tabulated in the January 19, 2012 memorandum and shown below for arsenic, cadmium, lead, and zinc are consistent with the West Virginia Department of Environmental Protection "Voluntary Remediation and Redevelopment Rule," with the exception of arsenic, for which the criterion shown is the risk-based criterion developed by Dr. Brown.

Metal	Memo (Cited Source)
As	12.5 ppm (Dr. Kirk Brown)[1]
Cd	39 ppm (WVA DEP)[2]
Pb	400 ppm (WVA DEP)[2]
Zn	23,000 ppm (WVA DEP)[2]

[1] $1x10^{-5}$ risk level, Dr. Brown's report dated April 2, 2007.

[2] West VA Dept. of Environmental Protection, "Voluntary Remediation and Redevelopment Rule," effective date June 5, 2009, Title 60, Table 60-3B (De Minimis $1x10^{-6}$ risk). Note: ppm=mg/kg.

Dr. Brown's 12.5 mg/kg (ppm) criterion is composed of a 4.3 mg/kg incremental cancer risk factor and a 8.2 mg/kg value for the mean area-specific background arsenic value that he drew from the 2005 report by Dr. George Flowers, which included the results of metals testing on 1068 soil samples. Referring to the West Virginia Department of Environmental Protection (DEP) "Voluntary Remediation and Redevelopment Rule," the De Minimis value for arsenic in soil is 0.39 mg/kg. However, DEP's rule allows for use of a compound-specific background level or a risk-based standard developed using approved analytical methodologies (Sections 9.1, 9.2 and 9.3 of the rule). It should be noted that there are considerable differences in the cleanup and risk levels adopted for arsenic in soil, with many states choosing to simply adopt state-specific background values of arsenic in soil, ranging from 7 to 40 mg/kg.[3] Also, with respect to the Soil Test Results (Attachment A of the aforementioned January 19, 2012 memorandum), none of the soil samples showed zinc levels above the West Virginia action level of 23,000 mg/kg.

[3] "Arsenic Cleanup Criteria for Soil in the US and Abroad: Comparing Guidelines and Understanding Inconsistencies. Teaf, C. M. et al., Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy, Vol 15/Issue 1, Article 10, June 10, 2010."

2. With regard to internal home remediation for dust, the US EPA wipe sampling action level for remediation of lead is 40 $\mu g/ft^2$ on floors and 250 $\mu g/ft^2$ on window sills.[4] While a dust sample tested for lead may not trigger remediation, such testing would not assure that arsenic, cadmium, and zinc levels are not excessive. A review of soil sample test results, which were reported in Attachment A of the January 19, 2012 memorandum, shows no predictable correlation between the four metals. Sites for soil remediation have been identified based on elevated levels of three metals, on two out of three metals, and on just one metal. Since all four metals are potential concerns for internal home remediation based on the report by Dr. Brown, all four metals should be tested. However, there is a paucity of information upon which to base remediation of arsenic, cadmium, and zinc in residential dust. Based upon the World Trade Center indoor environmental assessment, contributors to which included US EPA and other federal and State of New York agencies, Table A-3 of the assessment indicates action screening levels for remediation of dust containing arsenic, cadmium, and zinc of 35.95 $\mu g/ft^2$, 144.65 $\mu g/ft^2$, and 43,695 $\mu g/ft^2$, respectively.[5] While these values are based on a $1x10^{-4}$ risk level, they are criteria applied to remediation of a major, population dense environment.

[4] Federal Register, January 5, 2001, Part III, Environmental Protection Agency, 40 CFR 745, "Lead: Identification of Dangerous Levels of Lead; Final Rule".
[5] World Trade Center Indoor Environmental Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks, May 2003.

I will be happy to answer any questions you may have about my research or opinions.

Sincerely,
RB Adams, LLC

Richard B. Adams, PE, BCEE

WEST VIRGINIA
SECRETARY OF STATE
NATALIE E. TENNANT
ADMINISTRATIVE LAW DIVISION

Do Not Mark In This Box

FILED

2009 JUN -5 PM 1:39

OFFICE OF WEST VIRGINIA
SECRETARY OF STATE

Form #6

NOTICE OF FINAL FILING AND ADOPTION OF A LEGISLATIVE RULE AUTHORIZED BY THE WEST VIRGINIA LEGISLATURE

AGENCY: Department of Environmental Protection TITLE NUMBER: 60

AMENDMENT TO AN EXISTING RULE: YES X NO ____

IF YES, SERIES NUMBER OF RULE BEING AMENDED: 3

TITLE OF RULE BEING AMENDED: Voluntary Remediation and Redevelopment Rule

IF NO, SERIES NUMBER OF RULE BEING PROPOSED: ____

TITLE OF RULE BEING PROPOSED: ____

THE ABOVE RULE HAS BEEN AUTHORIZED BY THE WEST VIRGINIA LEGISLATURE.

AUTHORIZATION IS CITED IN (house or senate bill number) SB 153

SECTION 64-3-1(s), PASSED ON April 8, 2009

THIS RULE IS FILED WITH THE SECRETARY OF STATE. THIS RULE BECOMES EFFECTIVE ON THE FOLLOWING DATE: June 5, 2009

Authorized Signature

TITLE 60
LEGISLATIVE RULE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SECRETARY'S OFFICE

SERIES 3
VOLUNTARY REMEDIATION AND REDEVELOPMENT RULE

§60-3-1. General.

1.1. Scope. -- This legislative rule establishes the eligibility, procedures, standards and legal documents required for voluntary and brownfield cleanups.

1.2. Authority. -- W. Va. Code §22-22-3.

1.3. Filing Date. -- June 5, 2009

1.4. Effective Date. -- June 5, 2009

§60-3-2. Definitions. Terms defined in the Act are accorded the same definition in this rule.

Unless the context in which used clearly requires a different meaning, the definitions contained in W. Va. Code §22-22-2 and § 22-22B-2 shall apply to the terms in this rule in addition to the definitions expressly set forth in this rule. For ease of reference, some of the statutory definitions are repeated in this section.

2.1. Abandoned Property. -- Real property for which the current owner cannot be determined or cannot be located or property which has been forfeited to or acquired by the state for the nonpayment of taxes pursuant to state law.

2.2. Act. -- The Voluntary Remediation and Redevelopment Act, W. Va. Code §22-22-1 et seq.

2.3. Analytical Expenses. -- Those direct costs associated with laboratory analysis of samples associated with a voluntary remediation.

2.4. Anthropogenic Background. -- Concentrations of chemicals that are present in the environment due to human activities unrelated to operation at the site.

2.5. Applicable Standards. -- Standards described in section 9 of this rule. Such standards include any exposure controls used at a site to meet the acceptable risk level for that site, at the time of the remediation or in the future.

2.6. Applicant. -- A person who is applying or has applied to participate in the voluntary remediation program.

2.7. Brownfield. -- Any industrial or commercial property which is abandoned or not being actively used by the owner as of the effective date of this article, but shall not include any site subject to a unilateral enforcement order under §104 through §106 of the Comprehensive Environmental Response, Compensation and Liability Act, 94 Stat. 2779, 42 U.S.C. §9601, as amended, or which has been listed or proposed to be listed by the United States environmental protection agency on the priorities list of

Title I of said act, or subject to a unilateral enforcement order under §3008 or §7003 of the Resource Conservation Recovery Act" or any unilateral enforcement order for corrective action under this chapter.

2.8. Brownfield Applicant. -- A person who is applying or has applied to participate in the voluntary remediation for a Brownfield property and:

2.8.a. Who is seeking or has obtained a site assessment loan from the Brownfields Revolving Fund; or

2.8.b. Who will use funds from the State of West Virginia or any county or municipality thereof, or brownfields grant funds from USEPA in the assessment or remediation of the property.

2.9. Carcinogen. -- Any substance which can cause cancer.

2.10. Cumulative Site Risk. -- The summation of risks to a human receptor or ecological receptor from one or more contaminants released at the site over a period of time.

2.11. Day or Day Calendar. -- The 24-hour period between 12:00 A.M. - 12:00 A.M.

2.12. De Minimis Risks. -- Those risks that are so trivial that they would not require remediation under this rule.

2.13. Ecological Receptors of Concern. -- Specific ecological communities, populations, or individual organisms protected by federal, state or local laws and regulations or those local populations which provide important natural or economic resources, functions and values.

2.14. Ecosystem. -- An integrated, self-functioning system consisting of interactions among both the biotic community and abiotic environment within a specified location in space and time. Sizes of ecosystems may vary considerably.

2.15. Endangered and Threatened Species. -- Any plant or animal species identified as endangered or threatened pursuant to federal, state, or local laws.

2.16. Engineering Controls. -- Remedial actions directed exclusively toward containing or controlling the migration of contaminants through the environment. These include, but are not limited to, slurry walls, liner systems, caps, leachate collection systems, and groundwater recovery trenches.

2.17. Exposure. -- Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut) and available for absorption.

2.18. Exposure Factors. -- Values used to estimate exposure in risk assessment, such as the number of days per week that exposure is expected to occur, or the amount of contaminated media that a person might incidentally ingest per day.

2.19. Exposure Pathway. -- A complete exposure pathway consists of a source or release from a source, a transport/exposure medium (e.g., air) or media (in cases of intermediate transfer), an exposure point, and an exposure route.

2.20. Exposure Route. -- The way a chemical or physical agent comes in contact with a receptor (e.g., by eating [ingestion], breathing [inhalation], or touching [dermal contact]).

2.21. Fate and Transport. -- The behavior and movement of a chemical through an environmental media.

2.22. Free product refers to a regulated substance that is present as a nonaqueous phase liquid (e.g., liquid not dissolved in water). These substances include liquid petroleum products such as gasoline, kerosene, diesel fuel, or oil, and any hazardous substance either listed in Section 101(14) of CERCLA or defined as such under RCRA. For petroleum hydrocarbons, the term nonaqueous phase liquid includes both liquid phase and residual phase hydrocarbons. Liquid phase product is capable of flowing downward and/or laterally into wells or excavations. Typically it exists as a pool or mound floating on the water table or resting on an impermeable soil layer. Residual phase product does not generally flow as a liquid; it occurs as globules within fractures or pores of soil or bedrock.

2.23. Gross Remediation Costs. -- The direct costs associated with remediation of a site and paid by the remediator. Gross remediation costs include the fees paid to the licensed remediation specialist, and contractors, equipment expenses and rental, disposal costs, permit fees, remediation site personnel costs, and all other expenses directly related to achieving applicable standards at the site.

2.24. Habitat. -- The area or type of environment in which an organism or biological population naturally lives or is found.

2.25. Hazard Index. -- The sum of the hazard quotients for multiple substances and/or multiple exposure pathways.

2.26. Hazard Quotient. -- The value which quantifies noncarcinogenic risk for one chemical for one receptor population over a specified exposure period. The hazard quotient is equal to the ratio of a chemical-specific intake to the reference dose.

2.27. Hourly Rate. -- The gross annual salary (excluding benefits paid to an employee) divided by 2080.

2.28. Implementability. -- The technical and administrative feasibility of an action as well as the availability of needed goods and services.

2.29. Inactive property. -- Real property that has previously been used for commercial or industrial purposes but is no longer actively used for such purposes.

2.30. Industrial Land Use. -- Land used for commercial establishments, manufacturing plants, public utilities, mining, distribution of goods or services, administration of business activities, research and development facilities, warehousing, shipping, transport, remanufacturing, stockpiling of raw materials, storage, repair and maintenance of commercial machinery or equipment, and waste management.

2.31. Institutional Controls. -- Legal or contractual restrictions on property use that remain effective after the remedial

action is completed and are used to meet applicable standards. The term may include, but not limited to, deed and water use restrictions.

2.32 Land Use Covenant -Is an environmental covenant within the meaning of W. Va. Code § 22-22B-2(4), and is a servitude which is agreed to by the owner of the property arising out of remediation projects which attain and demonstrate continuing compliance with site-specific standards for any contaminants at the site, and which meets the requirements of Section 13 of this rule.

2.33. Leaching Potential. -- The potential for soluble constituents to be dissolved and filter through the soil by a percolating fluid.

2.34 LOAEL or Lowest Observed Adverse Effect Level. -- The lowest concentration or dose evaluated in a test that causes statistically significant adverse effects in experimental trials.

2.35. LRS or Licensed Remediation Specialist. --An individual certified by the secretary pursuant to rules adopted under Section 3 of Article 22 as qualified to perform professional services and to supervise the remediation of contaminated sites.

2.36 Natural Background. -- Ambient concentrations of chemicals that are present in the environment and have not been influenced by humans (e.g., iron, manganese).

2.37 NOAEL or No Observed Adverse Effect Level. -- The highest concentration or dose evaluated in a test that does not cause statistically significant adverse effects in experimental trials.

2.38 New Information. -- Any information obtained directly or indirectly by the department from any person after issuance of a certificate of completion, but does not include information the department has received in the application for participation in the voluntary remediation program, including any site assessment, during the execution of the voluntary remediation agreement or any work plan developed under such an agreement, or other information available to department under the voluntary remediation program prior to the execution of the certificate of completion. Information that does not qualify as new information may be considered by the secretary along with new information if necessary, to determine whether any of the conditions for reopening set out in section 16 of this rule, have occurred.

2.39 No Further Action. -- A site is eligible to receive a Certificate of Completion on the basis of site assessment sampling or sampling data developed under a Voluntary Remediation Agreement which demonstrates that the site meets all applicable standards.

2.40 Operator. -- The person responsible for the overall operation of a facility site. For purposes of this rule, a person who executes a voluntary remediation agreement with the secretary may be deemed an operator for the purpose of carrying out the activities required by the agreement.

2.41 Potential to Migrate. -- Refers to the ability of contaminants to migrate

from a source or soil to groundwater.

2.42 Primary Employee. -- A voluntary remediation project manager, engineer or scientist employed by the secretary in negotiating, facilitating, overseeing or confirming a voluntary remediation project. The term does not include secretaries, paralegals, clerks, technicians or others who serve to support the activities of the primary employee.

2.43 Prime Rate. -- The base rate on corporate loans posted by at least 75% of the nation's 30 largest banks.

2.44 Probabilistic Risk Assessment. -- A risk assessment performed using a mathematical technique that produces a distribution of values for a calculated term by solving for that term in successive iterations. Each successive iteration requires the selection of a single input value from defined distribution(s) for each of the terms used to derive the calculated term.

2.45 Readily Apparent Harm. -- If any one of the following criteria are observed at the site, then readily apparent harm is found:

2.45a Visual evidence of stressed biota attributable to the release at the site, including, but not limited to, fish kills or abiotic conditions; or

2.45b Visible presence of oil, tar, or other non-aqueous phase contaminant in soil over an area equal to or greater than two acres, or over an area equal to or greater than 1,000 square feet in sediment.

2.46 Reasonably Anticipated Future Use. -- Potential future land and water uses which have a credible chance of occurrence.

2.47 Reasonably Potential. --A scenario with a credible chance of occurrence without considering extreme or essentially highly unlikely circumstances.

2.48 Receptors (Human). -- Humans potentially exposed to contaminants released from the Site.

2.49 Remedial Action. -- To cleanup, mitigate, correct, abate, minimize, eliminate, control and contain or prevent a release of a contaminant into the environment in order to protect the present or future public health, safety, welfare, or the environment, including preliminary actions to study or assess the release.

2.50 Reopener. -- One or more of the grounds for setting aside some or all of a certificate of completion and reopening a voluntary agreement that is specified in section 16 of this rule.

2.51 Residential Land Use. -- Any real property or portion thereof which is used for housing of human beings. This term includes property used for schools, day care centers, nursing homes, or other residential-style facilities or recreational areas.

2.52 Revolving Fund. -- The Brownfields Revolving Fund established in W.Va. Code §22-22-6(b).

2.53 Risk-based Concentrations. -- Concentration levels developed by the secretary for individual chemicals that correspond to a specific incremental cancer risk level of $1x10^{-6}$ for residential land use

and 1×10^{-5} for industrial land use or a hazard quotient of 1. These concentrations are to be used with the De Minimis Standard.

2.54 Saturation Concentration. -- The maximum possible quantity of a substance which can go into solution of a given liquid (e.g., water) at a given temperature and pressure.

2.55 Secretary. -- The secretary of the Department of Environmental Protection or such other person to whom the secretary has delegated authority or duties pursuant to this rule.

2.56 Site. -- Any property or portion thereof which contains or may contain contaminants and is eligible to participate in the voluntary remediation program as provided under this article.

2.57 Site Assessment. -- Characterization of a site through an evaluation of its physical and environmental context, (e.g., subsurface geology, soil properties and structures, hydrology, and surface characteristics) to determine if a release has occurred, the levels of the chemical(s) of concern in environmental media, and the likely physical distribution of the chemical(s) of concern. The site assessment collects data as needed on ground water and surface water quality, land and resource use, potential receptors and generates information to support remedial action decisions.

2.58 Site Assessment Costs. -- Costs incurred in connection with site assessment activities including but not limited to: waste disposal costs, professional fees and expenses of those evaluating contamination, the cost of identifying a site history and prior land use, the costs of archaeological investigations, and attorneys fees incurred in evaluating a site or negotiating a voluntary remediation agreement.

2.59 Systemic Toxicant. -- A harmful substance or agent that may enter the body and injure an organ or organ system and having an effect other than causing cancer. Most chemicals that produce systemic toxicity do not cause a similar degree of toxicity in all organs but usually demonstrate major toxicity to one or two organs.

2.60 Total Dissolved Solids. -- All material that passes through the standard glass fiber filter as provided in the current edition of Standard Methods for the Examination of Water and Wastewater.

2.61 Trade Secrets. -- Any information protected from disclosure under W. Va. Code §29B-1-4(1).

2.62 Trophic Level. -- The biological energy transfer level; the position in a trophic pyramid or food chain.

2.63 Voluntary Remediation. -- A series of measures that are self-initiated by a person to identify and address potential sources of contamination of property and to establish that the property complies with applicable remediation standards. Brownfield remediation is a subset of voluntary remediation.

2.64 Voluntary Remediation Program. -- The program for the voluntary assessment and remediation of sites under the Act.

2.65 Weight-of-Evidence Approach. -- The process by which measurement endpoints are related to an assessment endpoint to evaluate whether a significant risk of harm is posed to the environment. The approach is planned and initiated at the problem formulation stage and results are integrated at the risk characterization stage.

§60-3-3. Eligibility.

3.1. Eligibility criteria for voluntary remediation program. -- Any site is eligible to participate in the voluntary remediation program except the following:

3.1.a. Any site that is subject to a unilateral order issued by the U.S. Environmental Protection Agency pursuant to §§104 through 106 of the Comprehensive Environmental Response, Compensation and Liability Act;

3.1.b. Any site that has been listed or proposed to be listed on the National Priorities List developed by the U.S. Environmental Protection Agency pursuant to Title I of the Comprehensive Environmental Response, Compensation and Liability Act; provided that any site that has been formally delisted by the Environmental Protection Agency is eligible to participate in the voluntary remediation program;

3.1.c. Any site that is subject to a unilateral enforcement order under §3008 or §7003 of the Resource Conservation and Recovery Act;

3.1.d. Any site that is subject to a unilateral enforcement order for corrective action issued pursuant to any provision of Chapter 22 of the West Virginia Code; or

3.1.e. Any site where the release which is subject to remediation was created through gross negligence or willful misconduct by the applicant.

3.2. Eligibility Criteria for Brownfield Sites. -- A site may participate in the voluntary remediation program as a brownfields property if the following conditions are satisfied and the applicant qualifies as a brownfield applicant under this rule:

3.2.a. The site meets the requirements of subsection 3.1 of this rule;

3.2.b. The applicant did not cause or contribute to contamination on the site; and

3.2.c. The site meets either of the following:

3.2.c.1. As of July 1, 1996, the site is an industrial or commercial property which is abandoned; or

3.1.c.2. As of July 1, 1996, the site is an industrial or commercial property that is not being actively used by the owner.

3.3. Eligibility Determination. In deciding the acceptability of an application the secretary shall determine whether the eligibility criteria of this section have been satisfied.

3.4. Appeal of Rejection of Application.

3.4.a. The applicant may appeal the rejection of the application by filing a notice of appeal with the Environmental Quality Board in accordance

with the provisions of W. Va. Code §22B-1-7.

3.4.b. For purpose of this appeal, the record of proceedings as referenced in §22B-1-7 shall consist of the application, all correspondence between the secretary and the applicant relating to the application and other documents and correspondence in the applicable files of the secretary relating to this matter.

§60-3-4. Application to Participate in Voluntary Remediation Program.

4.1. Pre-application Conference for Brownfield Applicants. A brownfield applicant shall confer with the secretary and, if a loan is being requested, comply with the loan procedures contained in section 15 of this rule before submitting an application to participate in the voluntary remediation program.

4.2. Contents of Application. Any person who desires to participate in the voluntary remediation program shall submit to the secretary of the Department of Environmental Protection an application on a form provided by the secretary which shall contain, at a minimum, the following information:

4.2.a. The applicant's name. This shall include the applicant's legal name and any other aliases or other names by which the applicant is known or under which the applicant does business;

4.2.b. The applicant's address. This shall include the current address at which the applicant can be reached by mail, and in the event that post office delivery is not feasible, the applicant shall also provide a description of his/her current address that will enable the secretary to locate the applicant;

4.2.c. The applicant's financial capabilities. This shall include, but is not limited to, information that demonstrates the applicant has, or has secured access to, financial resources that are adequate to successfully complete the voluntary remediation and satisfy any contractual obligations entered into by the applicant that relate to the voluntary remediation;

4.2.d. The applicant's technical capabilities. This shall include, at a minimum, information that the applicant is or has contracted with a licensed remediation specialist to perform the work required;

4.2.e. For brownfield applicants, a Notice of Intent to Remediate in accordance with subsection 7.1 of this rule, and a certification that he/she, his/her spouse or other member of his/her immediate family did not cause or contribute to the contamination on the property;

4.2.f. A general description of the site. This shall include, at a minimum, the following:

4.2.f.1. A written description of the site that includes any city, county, and street addresses, and adjacent landmarks, buildings, waterways, former uses or other identifying information;

4.2.f.2. The deed book number and deed number of the site property;

4.2.f.3. County tax map references;

4.2.f.4. Geographic information system data adequate to accurately delineate the voluntary remediation site. All spatial data submitted by the applicant will be in one of three coordinate systems:

4.2.f.4.A. Universal transverse mercator (UTM) zone 17 NAD datum. (Preferred);

4.2.f.4.B. Geographic (Latitude and Longitude); or

4.2.f.4.C. State plane coordinates NAD 27 datum.

4.2.f.5. All geographic information system location data will have a horizontal accuracy within 12.2 meters (40 feet) in accordance with the US Department of the Interior US Geologic Survey National Map Accuracy Standards;

4.2.f.6. Any other identifying information that will serve to clearly and concisely identify the property;

4.2.f.7. Information of which the applicant is aware concerning the nature and extent of any known contamination at the site and immediately contiguous to the site, or wherever the contamination came to be located;

4.2.f.8. Information demonstrating the applicant's legal right to perform the work required for participation in the program (e.g., title report, deed, or access agreement).

4.2.f.9. Where an application covers two or more non-contiguous locations, this information shall be provided for each location.

4.2.g. A site assessment prepared by a licensed remediation specialist which includes information that identifies all actual or potential contaminants reasonably expected to be at and near the site, the nature and extent of the contamination, and potential receptors and pathways for contaminant migration. In no case, however, may an application be denied on the grounds that the site assessment is inadequate if the site assessment satisfies the requirements contained in W. Va. Code §22-22-4(e). Where the secretary determines that additional site assessment information is necessary, the submission of such additional information may be addressed in the voluntary remediation agreement.

4.2.h. An applicant may appeal the secretary's rejection of an application to the Environmental Quality Board in accordance with W. Va. Code §22B-1-7.

4.2.i. Other information as requested by the secretary.

4.3. Application Fee.

4.3.a. Each applicant shall pay an application fee in accordance with this section. The fee is to be submitted at the time the application is filed in the form of a check payable to the Voluntary Remediation Administrative Fund.

4.3.b. Should the applicant withdraw the application at anytime prior to the determination of eligibility by the

secretary, the applicant shall receive a refund of one-half the application fee paid.

4.3.c. If the secretary rejects the application and applicant does not re-submit a revised application within 25 days, the secretary shall refund one-half the application fee within 30 days of the rejection of the application.

4.3.d. The application fee to be paid shall be calculated based upon the points assigned to the property using the following criteria:

4.3.d.1. Size of Property. The total square feet of surface area of the property to be covered by the application, rounded to the nearest 1,000 square feet. For properties less than 1 acre, the assigned points are 10; for properties of one acre or more but less than 5 acres, the assigned points are 20; for properties of 5 acres or more, the assigned points are 30;

4.3.d.2. Years of Operation. The number of years that the property was operated for any non-residential activity. Partial years of operation should be treated as complete years of operation. For properties operated 10 years or less, the assigned points are 10; for properties operated more than 10 years but less than 20, the assigned points are 20; and for properties operated 20 years or more, the assigned points are 30.

4.3.d.3. NAICS Code. Using the North American Industry Classification System published by the U.S. Office of Management and Budget as it applies to the activities that have been conducted on the property, if the property falls within NAICS Subsector Codes 316 (Leather and Allied Product Manufacturing), 322 (Paper Manufacturing), 324 (Petroleum and Coal Products Manufacturing), 325 (Chemical Manufacturing), 326 (Plastics and Rubber Products Manufacturing), 331 (Primary Metal Manufacturing), 332 (Fabricated Metal Products Manufacturing), 333 (Machinery Manufacturing), 334 (Computer and Electronic Product Manufacturing), 335 (Electrical Equipment, Appliance, and Component Manufacturing), 336 (Transportation Equipment Manufacturing), or 339 (Miscellaneous Manufacturing), the assigned points are 30; if the property falls within NAICS Subsector Codes, 1 13 Forestry and Logging, 21 1 (Oil and Gas Extraction), 212 (Mining (except Oil and Gas)), 213 (Supporting Activities for Mining), 221 (Utilities), 3 1 1 (Food Manufacturing), 3 12 (Beverage and Tobacco Product Manufacturing), 3 13 (Textile Mills), 314 (Textile Product Mills), 3 15 (Apparel Manufacturing), 32 1 (Wood Product Manufacturing), 323 (Printing and Related Support Activities), 327 (Nonmetallic Mineral Product Manufacturing), 337 (Furniture and Related Product Manufacturing), 486 (Pipeline Transportation), 448 (Support Activities for Transportation), 5 11 (Publishing Industries), or 562 (Waste Management and Remediation Services), the assigned points are 20, and if the property falls within any other NAICS Subsector Code, the assigned points are 10. If any activity falls in more than one of these groupings, the category which results in the greatest number of points being assigned shall be used;

4.3.d.4. For any of these criteria, if the correct category is not

known, the category resulting in the greatest number of points shall be assumed to apply;

4.3.d.5. Applying the criteria described above, where the total number of points is 30 or 40, the application fee shall be $1,000; 50 or 60, the application fee shall be $3,000; and 70, 80 or 90, the application fee shall be $5,000; and

4.3.d.6. If the application covers 2 or more non-contiguous locations, the application fee shall be $5,000, provided that the locations under consideration display similar contaminant profiles and similar surface and subsurface characteristics. Similar surface/subsurface characteristics shall be construed to be limited to upland, riparian/wetland, karst or other similar land forms as approved by the secretary. If any of the individual locations includes a surface area greater than 2 acres, a separate application and fee must be submitted for that site.

4.4. Confidentiality. -- Information obtained by the department pursuant to this rule shall be available to the public unless the secretary certifies such information to be confidential. The secretary may make such certification where any person shows, to the satisfaction of the secretary, that the information or parts thereof, if made public, would divulge methods, processes or activities entitled to protection as trade secrets.

4.5. Action on Application. -- The secretary shall act upon all applications within 45 days of receipt, unless an extension of time is mutually agreed upon between the secretary and the applicant, and confirmed in writing.

§60-3-5. Licensed Remediation Specialists.

5.1. Professional Responsibilities of Licensed Remediation Specialists.

5.1.a. Any individual who wishes to practice as a licensed remediation specialist in the state of West Virginia must hold a valid remediation specialist license. Each individual shall have the burden of demonstrating to the secretary's satisfaction that he or she meets the requirements for licensing.

5.1.b. It is the licensed remediation specialist's duty to protect the safety, health and welfare of the public in the performance of his or her professional duties. If he or she is unable to meet this duty, the licensed remediation specialist may either sever the relationship with the client or employer or refuse professional responsibility for the work plan, report or design. If the relationship is severed, the applicant shall notify the division within 72 hours of the severing of the relationship Specific areas of professional responsibility are as follows:

5.1.b.1. The licensed remediation specialist is responsible for any release of contaminants during remediation activities undertaken pursuant to and contemplated in the approved remediation agreement, work plans or reports. The act of moving contaminants within a site in the course of remediation activities shall not be considered to be a release;

5.1.b.2. Where a release of contaminants in excess of those identified in the work plan occurs at the site during remediation activities, the licensed

remediation specialist shall immediately notify the division unless the release does not exceed reportable quantities found in 40 CFR Part 302;

5.1.b.3. A licensed remediation specialist shall only perform assignments for which the specialist is qualified by training and experience in those specific technical fields;

5.1.b.4. A licensed remediation specialist shall be objective in work plans, reports and opinions and avoid any conflict of interest with employer, clients and suppliers;

5.1.b.5. A licensed remediation specialist shall not solicit or accept gratuities, directly or indirectly from contractors, agents or other parties dealing directly with the employer or client in regard to professional services being performed at the work site;

5.1.b.6. A licensed remediation specialist shall not accept any type of bribe; falsify or permit misrepresentation of professional qualifications; intentionally provide false information to the secretary; or knowingly associate with one who is engaging in business or professional practices of fraudulent or dishonest nature; and

5.1.b.7. A licensed remediation specialist shall not charge any special fees above usual and customary professional rates for being licensed.

5.1.c. The secretary may revoke a license; suspend a license for not more than five years; or impose lesser sanctions as appropriate for acts or omissions in violations of this rule or W. Va. Code §22-22.

5.2. Application for licensure. -- Any individual who wishes to obtain a license to practice as a licensed remediation specialist must submit a complete and accurate application to the secretary on forms supplied by the secretary. An application fee, as specified in Table 60-3A of this rule, shall be submitted with the application. In order to qualify for the licensed remediation specialist examination, the applicant must demonstrate to the secretary that the following eligibility requirements have been met:

5.2.a. Minimum Education Requirements: All individuals applying for a license shall meet the requirements of one of the following tracks:

5.2.a.1. Standard Track: The individual has earned a baccalaureate, masters, or doctorate degree from an accredited educational institution in one of the following areas: biology, chemistry, earth sciences, environmental sciences, geology, hydrogeology, microbiology, soil sciences, toxicology, scientific subdisciplines of public health, risk assessment, or hazardous waste management, engineering, or in a curriculum determined to be equivalent by the secretary. The charter or accreditation of the recognized educational institution must have been effective as of the date the individual's degree(s) was granted; or

5.2.a.2. Alternative Track: The individual has earned at least a high school diploma, but does not meet the requirements for the standard track.

5.2.b. Minimum Experience Requirements: Each individual shall demonstrate to the secretary's satisfaction that he or she meets the requirements for relevant professional experience. Qualifying relevant professional experience must be work of a professional grade and character that indicates the individual is competent to perform professional services pursuant to the requirements of the Act.

5.2.b.1. Relevant professional experience shall include, at a minimum, practical knowledge of the following:

5.2.b.1.A. Remediation activities;

5.2.b.1.B. Procedures necessary to remediate a site;

5.2.b.1.C. Management of contaminants at a site, including, but not limited to:

5.2.b.1.C.1. Site investigation;

5.2.b.1.C.2. Health and safety protocol; and

5.2.b.1.C.3. Quality assurance.

5.2.b.1.D. Feasibility studies; and

5.2.b.1.E. Remedial design.

5.2.b.2. Standard Track: The individual must have six years of relevant professional experience, one of which is supervisory or project management related.

5.2.b.3. Alternative Track: The individual must have ten years of relevant professional experience, one of which is supervisory or project management related.

5.2.b.4. In addition to the practical knowledge criteria pursuant to paragraph 5.2.b.1 of this rule, the secretary will also consider the following criteria in evaluating whether an individual's remediation and practical experience, considered both individually and collectively, constitute sufficient relevant professional experience:

5.2.b.4.A. Proficiency;

5.2.b.4.B. Broad knowledge of the various remediation technologies;

5.2.b.4.C. Number of individuals and disciplines of other professionals supervised or coordinated;

5.2.b.4.D. Duration of employment;

5.2.b.4.E. Nature of work performed (including, but not limited to, whether such experience includes work at sites where subsurface investigations have occurred); and

5.2.b.4.F. Any other factors the secretary deems relevant.

5.2.b.5. The individual applying for licensing shall also provide the secretary with three professional

references, each of which, at a minimum, address the individual's range of practical knowledge and professional experience with regard to providing professional services under the Act.

5.2.b.6. Work performed during a period of full-time undergraduate study at an educational institution is considered part of the educational program and is not considered acceptable professional experience; provided, however, that the secretary may accept work performed for periods of at least two and one half consecutive months per calendar year when not enrolled as a full-time student, during, or incidental to, undergraduate education as relevant professional experience if the individual did not receive college credits for that work.

5.2.c. Credits: Individuals who have earned degrees from recognized educational institutions in addition to those required to meet the minimum educational requirements set forth in 5.2.a. may request that the secretary credit some or all of that additional education toward the requirements for relevant professional experience in accordance with the following:

5.2.c.1. Standard Track: One year credit for each master's degree, and two years credit for a doctorate degree, if the degrees are from a recognized educational institution in one of the academic areas identified in 5.2.a.1;

5.2.c.2. Alternative Track: One-half year credit for each associate's degree in one of the academic areas identified in 5.2.a.1; and

5.2.c.3. The secretary will grant to an individual up to two years maximum credit for additional education under the Standard Track; or up to one year maximum credit for additional education under the Alternate Track.

5.3. Licensing Examination: The secretary shall be responsible for implementing the following requirements, at a minimum, of the licensed remediation specialist examination:

5.3.a. Frequency and Scheduling: The secretary shall administer a licensing examination at least every six months to all individuals who have met the requirements for licensure. Examinations shall be held at the time(s) and location(s) set by the secretary. The secretary shall provide public notice at least 15 days prior to the application due date for the next scheduled examination;

5.3.b. Examination Format/Content: Examinations shall test the individual's overall regulatory understanding, and overall technical understanding. Overall regulatory understanding means an understanding of the relevant West Virginia Department of Environmental Protection regulations and related written policies and Federal environmental regulations. Overall technical understanding means demonstrating an understanding of basic concepts and methods in those scientific and technical fields related to assessment, containment, and remediation actions;

5.3.c. The secretary shall prepare the licensing examination;

5.3.d. The secretary shall

initially develop a minimum of three separate examinations. No single examination shall be repeated until the other two examinations have been given;

5.3.e. After any of the individual examinations have been used twice, the secretary shall prepare a minimum of three new examinations;

5.3.f. An individual may take an examination only if the applicable examination fee established by the secretary has been paid. The examination fee, as specified in Table 60-3A of this rule, shall be submitted after an applicant's eligibility to take the exam has been confirmed with the application. Payment shall be made in full by check or money order payable to the West Virginia Department of Environmental Protection. The examination fee is non-refundable, except in the following circumstances:

5.3.f.1. An individual whose failure to appear for the examination is found, by the secretary, to be due to circumstances beyond the individual's reasonable control, shall receive a refund or may request that the application be held open until the individual can take a subsequent examination that occurs within two years of the date the secretary approved the individual's written application.

5.3.g. Examination Procedures and Rules: Each individual shall present some form of photographic identification prior to taking the test. The secretary shall identify whether he or she may use any books, notes, memoranda, scratch paper, non-programmable calculators, or other materials during the examination. No individual may discuss the examination or other procedures, and no individual may make copies of the examination;

5.3.h. The secretary shall establish the passing score prior to administering the examination;

5.3.i. Examination Results: The secretary shall grade the examinations, and the results shall be mailed to each individual within 30 days of the examination. The examination papers will not be returned to the individual;

5.3.j. Reapplication for Examination: Individuals who fail to achieve a passing score on the examination may take a subsequent examination subject to the following procedures:

5.3.j.1. An individual shall be allowed to take a subsequent examination that is scheduled to occur on a date not more than two years after the date the secretary approved the individual's written application, upon receipt by the secretary of the following items:

5.3.j.1.A. A letter stating the individual's intention to take the subsequent examination; and

5.3.j.1.B. The appropriate examination fee;

5.3.j.2. Individuals who seek to take a subsequent examination that is scheduled for a date that is greater than two years after the date the secretary approved the individual's written application must submit the following:

5.3.j.2.A. Licensing application as per the procedures set forth in 5.2; and

5.3.j.2.B. The full application fee described in 5.2 prior to taking the examination.

5.3.k. Waiver of Examination. -- If an individual requests a waiver of the examination for licensure as a Remediation Specialist, the application shall include any and all information that the applicant desires to be considered including but not limited to relevant licenses and certifications. The secretary may issue a one time waiver of the examination for the purpose of submitting an application for a Voluntary Remediation Agreement. This waiver shall only be valid for six months after the effective date of the rule. No remediation workplan shall be implemented unless and until the Remediation Specialist has passed the examination. However, to be eligible for a waiver, these individuals shall meet all other requirements for licensing, including, but not limited to, education, relevant professional experience, and practical knowledge;

5.3.k.1. An examination fee must be submitted regardless of whether the applicant is requesting a waiver of the examination.

5.3.l. Reciprocity. A licensed remediation specialist in another state may be licensed as a remediation specialist in West Virginia without examination provided that the licensing state recognizes West Virginia licensure.

5.3.l.1. An examination fee must be submitted regardless of whether reciprocity applies.

5.4. License renewal.

5.4.a. A licensed remediation specialist in good standing may have his/her license renewed every two years. A renewal application filed in accordance with all appropriate time frames which includes the appropriate license renewal fee found in Table 60-3A will be considered a complete renewal application. A renewal application shall include evidence of continuing education in the environmental remediation field. Such evidence may include two education credits from a US EPA-approved course or any other equivalent experience acceptable to the secretary.

5.4.b. The secretary will provide a license renewal notice to the licensed remediation specialist 90 days prior to his or her license expiration. Any individual who fails to renew their license may not continue to practice as a licensed remediation specialist after the day of license expiration. Any individual who fails to renew their license within 30 days of the expiration must reapply for examination and is subject to the same requirements as a new applicant.

5.4.c. An individual who has completed in a timely manner all of the license renewal requirements will receive a renewed license and may continue to practice as a licensed remediation specialist prior to receiving the renewed license by registered mail.

5.4.d. Where there has been an application timely filed for renewal of a license and the secretary determines that grounds exist for non-renewal of the license,

the secretary shall follow the same procedure for suspension or revocation of licenses in subsection 5.5 of this rule and, pending a final decision by the secretary on such renewal, the license shall remain in effect.

5.5. Suspension and Revocation of Licenses. The provisions set forth in this subsection shall be in addition to and shall not limit the procedures regarding enforcement orders contained in W. Va. Code §22-22-12.

5.5.a. Criteria for suspension or revocation of license. A license issued to a licensed remediation specialist may be suspended or revoked for the following reasons:

5.5.a.1. For fraud by the licensed remediation specialist in the license application process;

5.5.a.2. For fraud or intentional misrepresentation by the licensed remediation specialist in the performance of any work required in a work plan or pursuant to a voluntary remediation agreement;

5.5.a.3. For any act by the licensed remediation specialist in violation of this rule; or

5.5.a.4. Any circumstances that justify revocation of a license under this rule may also justify the non-renewal of such license.

5.5.b. Issuance of Notice of Intent -- If the secretary finds that sufficient grounds exist to suspend or revoke the license of a licensed remediation specialist, prior to the suspension or revocation, the secretary shall notify the licensed remediation specialist of the secretary's intent to suspend or revoke the license. The secretary shall provide the licensed remediation specialist with a Notice of Intent to Suspend or Revoke by certified mail, return receipt requested. The Notice shall set forth the specific reasons for the proposed suspension or revocation and shall state that the licensed remediation specialist may request an informal conference or a contested case hearing as provided in W. Va. Code §29A-5-1 on the proposed suspension or revocation. The purpose of the informal conference and the contested case hearing is to determine the rights, duties, interests and privileges of the licensed remediation specialist. The secretary may appoint an impartial hearing officer to conduct an informal conference or contested case hearing.

5.5.c. Request for Informal Conference or Contested Case Hearing. -- The licensed remediation specialist has 30 calendar days from the receipt of the notice to make a written request for an informal conference or contested case hearing. A request is deemed served the day it is deposited in the United States mail. Failure to respond will result in the imposition of the proposed suspension or revocation. The licensed remediation specialist shall have a right to an informal conference prior to a formal hearing. The licensed remediation specialist may request an informal conference or a contested case hearing, but the request for and holding of an informal conference does not preclude the licensed remediation specialist from requesting a contested case hearing following the disposition reached in the informal conference.

5.5.c.1. The issuance of a notice of intent to suspend or revoke the license of a licensed remediation specialist shall not prevent the licensed remediation specialist from rendering services under the voluntary remediation program pending a final decision from the secretary following an informal conference and, if requested, a contested case hearing.

5.5.d. In all proceedings under this section, the licensed remediation specialist may be represented by counsel. All notice required by this rule shall be sent to counsel in the same manner as is required to be provided to the licensed remediation specialist.

5.5.e. Informal conference. -- If an informal conference is requested within the thirty day period, the secretary shall schedule the conference to be held within 30 days in accordance with the following requirements:

5.5.e.1. The secretary shall notify the licensed remediation specialist and the primary representative of the Department of Environmental Protection who was involved in the decision to suspend or revoke the licensed remediation specialist's license of the time and place of the informal conference. In scheduling the location of the informal conference, the compliance officer shall consider the location of the licensed remediation specialist's business and any particular sites that may have given rise to the decision to revoke or suspend;

5.5.e.2. The secretary shall notify the licensed remediation specialist of the informal conference at least 15 calendar days prior to the date of the informal conference; and

5.5.e.3. The secretary may continue the informal conference upon the agreement of the licensed remediation specialist or for good cause shown.

5.5.f. Informal Conference Procedures. An informal conference, as provided by these regulations, is intended to be an informal discussion of the facts which gave rise to the issuance of the decision to suspend or revoke a license. The secretary shall conduct the conference in the following manner:

5.5.f.1. The secretary shall be guided by, but need not strictly apply, the West Virginia Rules of Civil Procedure and West Virginia Rules of Evidence;

5.5.f.2. A record of the informal conference is not required but any party may request that a record be made at that party's expense. Any other party to the conference may obtain copies of the record at his expense;

5.5.f.3. During an informal conference the licensed remediation specialist may submit to the secretary any evidence or demonstration of mitigating circumstances as to why the secretary should alter the decision to suspend or revoke the license; and

5.5.f.4. At any review proceedings which may occur later, no evidence as to any oral statement made by one party at the informal conference may be introduced as evidence by another party, nor may any statement be used to impeach a witness, unless the statement is or was available as competent evidence

independent of its introduction during the informal conference.

5.6. Written Decision.

5.6.a. If the licensed remediation specialist and the secretary are able to reach an agreement, the secretary shall prepare a written decision signed by the licensed remediation specialist and the secretary implementing the decision reached in the informal conference.

5.6.b. If the licensed remediation specialist and the secretary are unable to reach an agreement, within 30 calendar days following the informal conference, the secretary shall issue and furnish to the licensed remediation specialist a written decision affirming, modifying or dismissing the initial proposal to suspend or revoke the license and give the specific reasons for the decision. The notice of decision by the secretary shall be sent to the licensed remediation specialist by certified mail return receipt requested.

5.6.c. Within 30 calendar days of the receipt of the secretary's written decision, the licensed remediation specialist may demand a formal hearing as provided herein to determine the rights and privileges of the licensed remediation specialist. The licensed remediation specialist must serve a request in writing upon the secretary within 30 days of receipt of the written decision. A request is deemed served on the day it is deposited in the United States mail. Failure to request a formal hearing on the written decision within the time specified shall cause the decision to become a final unappealable order of the secretary.

5.7. Contested Cases, Right to a Formal Hearing. As set forth above, within thirty (30) calendar days after notification of a written decision rendered as a result of an informal conference, the licensed remediation specialist may request a formal hearing before the secretary in accordance with the Administrative Procedures Act, W. Va. Code §29A-5-1 et seq. If requested the secretary shall grant the request and schedule a contested case hearing.

5.8. Appeals. An appeal from any final order or ruling entered in a contested case in accordance with these regulations shall be to the Circuit Court of Kanawha County in accordance with the provisions of the Administrative Procedures Act, W. Va. Code §29A-5-1 et. seq.

5.9. Alternative Procedure. When imminent or substantial harm is threatened or posed at a voluntary remediation site which in the secretary's opinion is attributable to the negligence or incompetence of the licensed remediation specialist at the site, the secretary may, in lieu of the Notice of Intent under subdivision 5.5.b. of this rule, issue an order in accordance with W. Va. Code §22-22-12(a)(1). If a request for reconsideration is filed as provided in W. Va. Code §22-22-12(b), the secretary shall conduct a contested case hearing within ten days of the filing of such request.

§60-3-6. Voluntary Remediation Agreement.

6.1. Any person who desires to participate in the voluntary remediation program shall execute a voluntary remediation agreement with the secretary of the Department of Environmental Protection. The agreements contained in

Appendix 60-3A and 60-3B meet the requirements of this section. Additional provisions and modifications consistent with this rule may be agreed to by the applicant and the secretary. Except as provided in subsection 6.4 of this rule, the Voluntary Remediation Agreement shall provide for the following:

6.1.a. The services of a licensed remediation specialist for the supervision of all activities described in the agreement, including the supervision of remediation contractors;

6.1.b. The recovery of all reasonable costs incurred by the Department of Environmental Protection attributable to the implementation of the agreement in excess of fees submitted with the permit application. Recoverable costs shall include the following:

6.1.b.1. Costs incurred in review and oversight of work plans and reports submitted pursuant to the agreement;

6.1.b.2. Costs incurred as the result of field activities attributable to the agreement;

6.1.b.3. Such other costs incurred by the Department of Environmental Protection in implementing and overseeing activities under the agreement;

6.1.b.4. All recoverable costs shall be billed against any deposit and subsequently by separate invoice; and

6.1.b.5. Recoverable costs shall be determined by the number of hours worked under the agreement by each primary employee multiplied by 2.5 times the hourly rate of each such employee and then adding the direct expenses incurred by each such employee.

6.1.c. A schedule for the payment of recoverable costs;

6.1.d. A description of any work plan or report that is to be submitted under the agreement for review by the secretary, including the final report which shall provide all information necessary to verify that all work contemplated by the agreement has been completed: provided, however, that at the discretion of the applicant, work plans describing the work to be performed at the site may be submitted for approval by the secretary with the execution of the agreement;

6.1.e. The identification of appropriate tasks, deliverables and schedules for the submission of any work plans and other deliverables and for the performance of the remediation;

6.1.f. A listing of all environmental statutes and rules for which compliance is mandated;

6.1.g. A listing of the technical standards as determined in the guidance document to be applied in evaluating the site assessment, the work plans and reports, with reference to the proposed future land use to be achieved;

6.1.h. A listing of the applicable standards to be achieved at the site;

6.1.i. Where applicable, a description of any engineering or institutional controls and any land use covenant to be imposed for the property;

6.1.j. The reopening of the voluntary remediation agreement upon consent of the parties or the occurrence of one or more of the conditions described in section 16 of the Act;

6.1.k. The modification of the voluntary remediation agreement upon the agreement of the parties; and

6.1.l. Field adjustments which achieve equal performance may be implemented by the licensed remediation specialist provided he or she notifies the division within 15 days.

6.2. The voluntary agreement shall recognize the right of the applicant to terminate the agreement, in its sole discretion, upon 15 days advance written notice of termination to the Department of Environmental Protection and shall include provisions for the recovery of costs incurred by the Department of Environmental Protection before the notice of termination is issued.

6.3. The voluntary remediation agreement may provide a mechanism for alternate dispute resolution between the parties to the agreement, including, but not limited to arbitration or mediation of any disputes under the agreement.

6.4. For a site where the applicant intends to demonstrate that the site meets all applicable standards without further remediation, in lieu of the requirements of subsection 6.1 of this rule, the voluntary remediation agreement shall provide for the following:

6.4.a. The payment of an agreed sum to cover all reasonable costs incurred by the Department of Environmental Protection attributable to the agreement in excess of fees submitted with the permit application;

6.4.b. A listing of all environmental statutes and rules for which compliance is mandated;

6.4.c. A listing of the technical standards as determined in the guidance document that are applied in evaluating the site assessment with reference to the proposed future land use to be achieved;

6.4.d. A listing of the applicable standards to be achieved at the site;

6.4.e. The reopening of the agreement upon the occurrence of one or more of the conditions described in section 16 of this rule; and

6.4.f. Where applicable, a description of any engineering or institutional controls and any land use covenant to be imposed for the property.

6.5. The voluntary remediation agreement shall reflect the secretary's determination of eligibility in accordance with section 3 of this rule.

6.6. At the discretion of the applicant, the voluntary remediation agreement may address all or only a portion of a site. At the discretion of the secretary

the voluntary remediation agreement may cover two or more non-contiguous sites; provided that the sites display similar contaminant profiles and similar surface and subsurface characteristics. Similar surface and subsurface characteristics shall be construed to be limited to upland, riparian/wetland, karst or other similar land forms as approved by the secretary.

6.7. Where the applicant is a person other than the current owner of the site, and the voluntary remediation agreement contemplates the imposition of a land use covenant as provided in section 13 of this rule, the agreement shall have appended to it a provision signed by the current owner(s) of the site authorizing and agreeing to cooperate in the execution and filing of a land use covenant in accordance with the voluntary remediation agreement.

6.8. Upon execution of the voluntary remediation agreement by the parties, the secretary shall not initiate any enforcement action against the applicant or any person described in section 18 of the Act for the contamination that is the subject of the agreement, unless there is an imminent threat to the public. Upon final adoption of this rule, the secretary intends to issue a policy statement to the effect that no enforcement action shall be initiated against any applicant from the time the application is filed until the voluntary remediation agreement is signed so long as the applicant acts in good faith to negotiate a reasonable agreement.

6.9. At the applicant's discretion, he or she may in the interest of minimizing environmental contamination and promoting effective cleanups, begin cleanup of soil and groundwater before the voluntary remediation agreement is approved provided that he or she notifies the secretary.

§60-3-7. Public Involvement/Public Notification. -- Except to the extent incorporated by reference in subdivision 7.12.b, the requirements of subsections 7.1 through 7.8 of this section shall apply only to brownfield applicants as that term is defined in section 2 of this rule. The provisions of subsections 7.9 through 7.12 of this section shall be applicable only to applicants who are not brownfield applicants.

7.1. Notice of Intent to Remediate. -- All brownfield applicants shall file a Notice of Intent to Remediate a brownfield site with the secretary. The notice shall be part of and filed with the application to perform a brownfield remediation.

7.1.a. The Notice of Intent to Remediate shall contain, to the extent known, the following:

7.1.a.1. The name and business address of the brownfield applicant, including street address or route number;

7.1.a.2. Geographic location of site and any name by which the site is locally known;

7.1.a.3. Current and former uses of site;

7.1.a.4. Proposed future use of site;

7.1.a.5. Present and suspected contaminants on site;

7.1.a.6. Proposed methods to remediate the site;

7.1.a.7. Proposed methods to control possible health exposure;

7.1.a.8. Location/address where interested persons may review the notice;

7.1.a.9. Name, address and telephone number of brownfield applicant contact for questions from interested individuals; and

7.1.a.10. Name, address and telephone number of Department of Environmental Protection contact where comments and questions can be received.

7.2. Department of Environmental Protection Notice to the Public.

7.2.a. Upon receipt of a Notice of Intent to Remediate, the Department of Environmental Protection shall publish a summary of the notice in a Department of Environmental Protection publication of general circulation. Information contained in the summary shall meet the requirements set forth in subsection 7.1 of this rule.

7.2.b. The summary also shall include information on the public's right under the Voluntary Remediation and Redevelopment Act to become involved in the development of the remediation and reuse plans for the site.

7.2.c. The Department of Environmental Protection shall issue a news release summarizing the Notice. The news release shall be sent to media outlets serving the general area where the remediation is proposed.

7.2.d. The Department of Environmental Protection also may post the Notice and information required under this section on the Department of Environmental Protection's Internet Website.

7.3. Notice to Governmental Agencies.

7.3.a. Upon receipt of a Notice of Intent to Remediate, the secretary shall notify the municipality and the county commission where the site is located.

7.3.b. Notice shall be issued to the county and/or municipal land use agency, or the area's Regional Planning and Development Council created under W. Va. Code §8-25-1.

7.3.c. Notice may be issued to the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, state Bureau for Public Health and other state or federal agencies that may have an interest in the remediation project.

7.3.d. The secretary shall notify the government agencies identified in this section of the Department of Environmental Protection's final decision on a Certificate of Completion.

7.4. Notice of Intent to Remediate Comment Period and Information Meeting.

7.4.a. The secretary shall require a 30-day comment period and information meeting on all Brownfield Notices of Intent to Remediate filed with the

Department of Environmental Protection. Costs incurred under this section shall be paid by the brownfield applicant.

7.4.b. To notify the public of the start of the 30-day comment period, the brownfield applicant shall:

7.4.b.1. Erect a sign on the proposed brownfield site informing the community the site is being considered for participation in the state's brownfield program, under the Voluntary Remediation and Redevelopment Act;

7.4.b.2. The sign must be placed on the property so it is clearly visible and legible, and shall be, at a minimum, three feet by four feet;

7.4.b.3. The sign shall state: "This site is under consideration for environmental cleanup and participation in the state's brownfield program under the Voluntary Remediation and Redevelopment Act;"

7.4.b.4. The sign shall include the telephone number and address of the Department of Environmental Protection's brownfield office;

7.4.b.5. Publish a commercial box advertisement in a local newspaper of general circulation in the county where the brownfield remediation is proposed once a week for four consecutive weeks;

7.4.b.6. The advertisement shall be, at a minimum, four inches by four inches;

7.4.b.7. The advertisement shall contain information as set forth in subsection 7.1 of this rule, plus the time, date and location of the information meeting;

7.4.b.8. The brownfield applicant shall send a copy of the advertisement to the municipality and the county commission, the county and/or municipal land use agency, or the area's Regional Planning and Development Council created under W. Va. Code §8-25-1.

7.4.b.9. The Department of Environmental Protection shall draft the advertisement and send it to the brownfield applicant for publication; and

7.4.b.10. The brownfield applicant shall submit certified and notarized proof of publication to the Department of Environmental Protection no later than four weeks after the last publication date. The certification of publication shall be made part of the final brownfield remediation agreement file.

7.4.c. The information meeting is to occur by day 21 of the 30-day comment period, provided that a minimum of 15 days notice is given for such meeting. The information meeting shall address how remediation issues are applied to the site, site risk issues including key risk assessment assumptions, uncertainties, populations considered, the context of site risk to other risks, and how the remedy will address site risks.

7.4.d. The information meeting for the purpose of informing the public shall occur in the community where the proposed brownfield remediation is to occur.

7.5. Public Inspection of Brownfield Notice of Intent to Remediate.

7.5.a. A Brownfield Notice of Intent to Remediate filed with the Department of Environmental Protection shall be available for public inspection and copying.

7.5.b. The Notice shall be available upon request at the Department of Environmental Protection's Division of Waste Management in Charleston, and in the municipal and/or county commission offices where the remediation is proposed. Copies of the Notice also may be placed in the county library.

7.6. Request to Participate in Remediation and Reuse Planning.

7.6.a. Any person may ask to be involved in the development of a brownfield remediation and reuse plan.

7.6.b. Requests to participate in a brownfield remediation and reuse plan shall be made in writing to the secretary during the 30-day comment period.

7.6.c. Each person who files a request may participate in the development of the remediation and reuse plan, in person or by representative.

7.7. Brownfield Public Involvement Plan.

7.7.a. The brownfield applicant shall establish a Public Involvement Plan if requested by the public, county, municipality, or the secretary.

7.7.b. The brownfield applicant, in consultation with the persons requesting to be involved in the remediation and reuse of a brownfield site, shall develop a Public Involvement Plan within 30 days of receiving notice from the secretary that a request to participate, as provided in subsection 7.6 of this rule, has been received.

7.7.c. The brownfield applicant shall submit the Public Involvement Plan to the secretary for his/her review and approval prior to its implementation.

7.7.d. The Public Involvement Plan shall include, but is not limited to:

7.7.d.1. Provisions for further meetings in the community; and

7.7.d.2. Opportunities for participants to review and comment on each work plan as well as review and comment on the voluntary agreement before it is finalized and accepted by the secretary.

7.7.e. The secretary shall consider comments from participants and the brownfield applicant's responses to comments regarding the voluntary agreement, work plans, and reports before deciding whether to approve the submission.

7.7.f. Means of communicating with a community, may include, but is not limited to:

7.7.f.1. Brownfield applicant point-of-contact with public;

7.7.f.2. Establish and maintain mailing and telephone list of

interested individuals;

7.7.f.3. Newsletter;

7.7.f.4. Doorstep notice to residents and businesses;

7.7.f.5. Newspaper, radio, and television advertisements;

7.7.f.6. News releases to local media;

7.7.f.7. Presentations to local civic organizations; and

7.7.f.8. Citizen advisory panel for development of remediation and reuse plan.

7.7.g. The Public Involvement Plan shall remain in effect until the Certificate of Completion is issued, or until the brownfield applicant withdraws from the brownfields program.

7.8. Technical Assistance. -- At any time during the life of the Public Involvement Plan, the participants other than brownfield applicants may petition the secretary for technical assistance related to:

7.8.a. Review of site-related documents;

7.8.b. Explaining technical information to panel members;

7.8.c. Translating technical information into language understandable to non-technical persons;

7.8.d. Providing assistance in communicating the concerns of the non-brownfield applicant members of the panel to the appropriate persons; or

7.8.e. Such other areas deemed appropriate by the secretary.

7.8.e.1. Upon receipt of such petition, the secretary and the brownfield applicant, by mutual agreement, will develop a technical assistance component to the Public Involvement Plan. Comments from other participants shall be considered in the development of such component. The applicant shall be responsible for expenses incurred in this process.

7.9. Public Notice of Applications for Voluntary Remediation Projects. -- Except for applications from brownfield applicants, upon receipt of an application to conduct a voluntary cleanup under the Act, the Department of Environmental Protection shall publish a summary of the application in a Department of Environmental Protection publication of general circulation. Information contained in the summary shall include:

7.9.a. The name and business address of the applicant, including a street address or route number;

7.9.b. Geographic location of site and/or, if one exists, the locally used name of the area;

7.9.c. Current use of site;

7.9.d. Suspected contaminants on site;

7.9.e. Proposed methods to clean up site;

7.9.f. Proposed methods to control possible health exposure;

7.9.g. Location address of where interested persons may review

application;

7.9.h. Name, address and telephone number of applicant contact for questions from interested individuals; and

7.9.i. Name, address and telephone number of Department of Environmental Protection contact where comments and questions can be received.

7.9.i.1. The Department of Environmental Protection shall issue a news release summarizing the application. The news release shall be sent to media outlets serving the general area where the remediation is proposed.

7.10. Public Inspection of Voluntary Application.

7.10.a. A voluntary cleanup application filed with the Department of Environmental Protection shall be available for inspection and copying by the public.

7.10.b. The application shall be available upon request at the Department of Environmental Protection's Office of Waste Management in Charleston and in the municipal and/or county commission offices where the remediation is proposed. Copies of the application also may be placed in the county library.

7.11. Public Involvement for Site Remediation Loans.

7.11.a. In the event an applicant to participate in the voluntary remediation program becomes a brownfield applicant, he/she shall be required to comply with subsections 7.4, 7.6, 7.7, and 7.8 of this rule.

7.12. Public Involvement/Public Notification in Development of Remediation Goal.

7.12.a. In the development of remediation goals pursuant to subdivisions 9.3.d and 9.4.a of this rule, the secretary shall require a 30-day comment period and information meeting.

7.12.b. To notify the public of the start of the 30-day comment period, the applicant shall comply with paragraphs 7.4.b.5; 7.4.b.6; 7.4.b.7; 7.4.b.8; 7.4.b.9; 7.4.b.10; and subdivisions 7.4.c and 7.4.d of this rule.

7.12.c. The applicant shall respond to comments received during the comment period and submit the responses to the secretary and any commenters.

7.12.d. The secretary shall review the comments and applicant's responses when making a decision. The secretary shall notify the parties who provided comments during the comment period of his/her decision.

§60-3-8. Risk Protocol.

This section establishes a risk protocol for conduct of human health and ecological risk assessments. It describes general requirements for risk assessments and specific requirements for baseline human health and ecological risk assessments, residual risk assessments, and application of probabilistic risk assessment methods.

8.1. General Requirements for Risk Assessments. Risk assessments shall consider existing and reasonably anticipated future human exposures and significant adverse effects to ecological receptors of concern in accordance with this rule.

8.1.a. Risk assessments may be conducted using either deterministic (single point value) or probabilistic risk assessment methodologies as agreed to in the Voluntary Remediation Agreement.

8.1.b. Risk assessments, to the extent practicable, shall consider the range of probabilities of risks potentially occurring, the range of size of populations likely to be exposed, current and reasonably anticipated future land and water uses, and quantitative and/or qualitative descriptions of uncertainties in accordance with subsections 8.1 and 8.2 of this rule.

8.1.c. Appropriate sources of toxicity information include the following:

8.1.c.1. For human health risk assessments, in order of preference,:

8.1.c.1.A. U.S. EPA Integrated Risk Information System (IRIS);

8.1.c.1.B. U.S. EPA Superfund Health Risk Technical Support Center (SHRTSC) provisional criteria;

8.1.c.1.C. Other scientifically valid documents or information developed from governmental or non-governmental sources and approved by the secretary.;

8.1.c.2. For ecological risk assessments:

8.1.c.2.A. U.S. EPA AQUIRE Data Base;

8.1.c.2.B. U.S. EPA IRIS Data Base;

8.1.c.2.C. U.S. EPA HEAST Data Base;

8.1.c.2.D. U.S. EPA ASTER Data Base;

8.1.c.2.E. U.S. EPA PHYTOTOX Data Base;

8.1.c.2.F. U.S. EPA Terrestrial Toxicity Data Base (TERRATOX);

8.1.c.2.G. U.S. Fish and Wildlife Service Technical Reports;

8.1.c.2.H. Oak Ridge National Laboratory Toxicological Benchmark Technical Reports;

8.1.c.2.I. Other U.S. EPA documents acceptable to the secretary;

8.1.c.2.J. ATSDR Toxicological Profiles;

8.1.c.2.K. Other peer-reviewed technical publications; and

8.1.c.2.L. Data developed in accordance with a peer-reviewed scientific testing protocol and approved by the secretary.

8.1.d. Risk assessments may include the use of fate and transport models subject to secretary approval of the model and the data to be used for the parameters specified in the model.

8.1.d.1. The secretary shall insure that any fate and transport model approved for use is capable of simulating those site conditions and contaminant

properties that might have a significant impact on site-specific contaminant fate or transport.

8.1.d.2. Sensitivity analyses of models and data used in model parameters shall be included in risk assessments. Sensitivity analyses shall be based on the range of conditions which historically occurred at the site.

8.1.d.3. For models not included in division guidance documents, a description shall be included in the risk assessments.

8.1.d.4. Where available, the department shall give preference to the use of peer-reviewed models and data for which on-site validation is demonstrated.

8.1.e. The use of population risk estimates in addition to individual risk assessments is provided for as follows:

8.1.e.1. For human health risk assessments, risk estimates shall initially be made at the level of the individual. A population-based risk assessment may be conducted where the applicant determines it would be practicable and of assistance in evaluating the appropriateness of the remedial action; and

8.1.e.2. For ecological risk assessments, risk estimates shall be made: (i) at the individual level where any endangered and threatened species is significantly impacted by the proposed activities at the site; and (ii) at the level of the population for all ecological receptors of concern exposed to contaminants at the site.

8.2. Sampling protocol, data requirements and sampling methods. -- The applicant shall use appropriate sampling approaches and data quality requirements and statistical methods as approved by the secretary to support the risk assessment and remedy selection process.

8.2.a. Characterization of site contamination. A sufficient number of environmental media samples shall be collected and analyzed as to provide a reasonable characterization of the nature and distribution of site contaminants. The number and location of the samples to be collected shall be of sufficient quantity and quality to calculate the appropriate exposure point concentration as defined in subparagraph 8.4.b.3.B and subdivision 8.5.c of this rule.

8.2.b. Media to be sampled. Samples shall be collected and analyzed from those media that are reasonably anticipated to have been impacted from contaminants at the site, considering the nature of the site operations and the nature of the contaminants of potential concern at the site.

8.2.c. Contaminants for analyses. Not all samples will need to be analyzed for the same contaminants. Samples collected shall be analyzed for those contaminants that are reasonably anticipated to be encountered, considering the nature of the site operations and the nature of the substances used or disposed of at the site.

8.2.d. Data validation. The quality of the analytical data to be used shall be validated by review of at least ten percent of the data or some other percentage agreed to by the secretary in accordance with standard

EPA protocols. Standard EPA protocols for validation may need to be modified, with the secretary's approval, depending on the type of analyses performed (e.g., Contract Laboratory Protocol or SW-846).

8.2.e. The 95th percentile upper confidence limit on the mean concentration, or the maximum value of the site contaminant concentration data shall be a reasonable estimate of a plausible exposure point concentration for this contaminant. If a contaminant can be shown to have dissimilar distributions of concentrations in different areas, then the areas should be subdivided. For example "hot spots" may be considered separately.

8.3. Quantification of cumulative risks posed by multiple exposure pathways. (Reserved)

8.4. Baseline Human Health Risk Assessments (BHHRA). A BHHRA may be used to provide a characterization of the risks to human health posed by contaminants at the site, given a full evaluation of site-specific conditions.

8.4.a. The BHHRA may be used either to:

8.4.a.1. Assess the need for remedial action considering site-specific conditions; or

8.4.a.2. Demonstrate the acceptability of current site conditions with respect to the remediation standards specified in this rule.

8.4.b. BHHRAs shall include, but are not limited to, the following information:

8.4.b.1. A conceptual site model showing contaminant sources, release mechanisms, transport routes and media, potential human receptor populations, and reasonably potential exposure scenarios based on current and reasonably anticipated land and water uses;

8.4.b.2. Data quality objectives for the human health risk assessment based on the conceptual site model;

8.4.b.3. An exposure assessment that evaluates the potential for and magnitude of human exposure, considering both the current and reasonably anticipated future land and water uses at, and in close proximity to the site. An exposure assessment shall include:

8.4.b.3.A. An exposure pathway analysis which identifies complete exposure pathways from contaminants to receptor populations shall be performed. The nature and extent of site contamination, the presence or absence of media that could transport such site contamination, the presence or absence of receptor populations that could be exposed to the contamination, and the likely exposure routes shall be identified; and

8.4.b.3.B. If, following the performance of the exposure pathway analysis, the potential exists for exposure of receptor populations to site contaminants, the magnitude of the exposure shall be quantified in accordance with division guidance documents. At a minimum, exposure levels that approximate an estimate of central tendency and reasonable upper bound of the exposure distribution shall be developed.

8.4.b.4. A toxicity analysis shall be performed if the potential for human exposure to site contaminants is identified and quantified in accordance with subparagraph 8.4.b.3.B of this rule. The toxicity analysis shall include a summary of current information regarding the carcinogenic and non-carcinogenic effects of the identified contaminants of concern as well as current slope factors and reference doses from the sources described in subdivision 8.1.c of this rule.

8.4.b.5. Risk Characterization. If the potential exists for human exposure to site contaminants, the exposure quantification information shall be integrated with the dose-response assessment (toxicity analysis) to provide a characterization of the potential risks present at the site. The risk characterization shall include a quantification of risks from individual contaminants. The applicant shall include a quantification of cumulative risks posed by multiple contaminants using the most sensitive exposure pathway for each constituent. The risk characterization shall analyze the following:

8.4.b.5.A. Non-Carcinogenic Risk: In quantifying risks from individual systemic toxicants at the site, a hazard quotient shall be developed for each contaminant . In quantifying the risks from cumulative exposure to multiple contaminants at the site, a hazard index for exposures to multiple contaminants shall be developed. In developing the hazard index for multiple contaminants, additivity shall be assumed only for those contaminants that affect the same target organ or act by the same method of toxicity;

8.4.b.5.B. Carcinogenic Risk: In quantifying risks from carcinogens at the site, the excess lifetime cancer risk shall be estimated above and beyond the risk associated with background exposures. Such risk estimates are presumed to be additive unless an alternative mechanism is appropriate; and

8.4.b.5.C. A discussion of any available facility-specific human health studies, and consideration of any other non-quantified (qualitative) risks shall be included as appropriate.

8.4.b.6. Uncertainty Analysis: As part of performing the site-specific risk assessment under this section, the qualitative, and to the extent practicable, the quantitative uncertainty embodied in the analysis shall be identified. The likelihood of overestimating or underestimating risk shall be identified for each element of the analysis. At a minimum, this shall include consideration of:

8.4.b.6.A. The analytical characterization of the site;

8.4.b.6.B. The exposure assessment, including the size of the potentially exposed population; and

8.4.b.6.C. The dose-response assessment, including the toxicological criteria used in the analysis.

8.5. Baseline Ecological Risk Assessment. A site-specific De Minimus screening ecological evaluation as specified in subsection 9.5 of this rule may be performed by the applicant as part of the site investigation to determine if a complete exposure pathway exists and there are

ecological receptors of concern. If, after this evaluation, a potentially significant complete exposure pathway is identified, then the applicant shall complete the uniform ecological evaluation as specified in subsection 9.6 of this rule to determine if site concentrations exceed benchmark levels. If the applicant proposes remediation goals that exceed benchmark levels, then, at the secretary's discretion, a baseline ecological assessment may be required to evaluate potential risks to ecological receptors and to develop appropriate remediation standards based on these risks. If a baseline ecological risk assessment is determined to be necessary, it shall address, but not be limited to, the following information:

8.5.a. Problem Formulation. The purpose (goals) of the assessment shall be identified and the problem defined. This step includes identification of potential contaminants of concern, potential ecological effects, potential ecological receptors of concern, potential exposure pathways, and initial assessment and measurement endpoints; all with respect to current and reasonably anticipated future land and water uses. A conceptual site model shall be developed to depict how the site conditions might affect ecological components of the natural environment;

8.5.b. Data Quality. Data quality objectives for the site based on the conceptual site model shall be developed;

8.5.c. Exposure Analysis. An exposure assessment that evaluates the potential for and magnitude of ecological effects to receptors of concern considering current and reasonably anticipated future conditions at the site shall be performed. Exposure is analyzed by describing the source and releases, the distribution of the stressor in the environment, and the extent and pattern of contact or co-occurrence. The end product of this analysis is an exposure profile which summarizes the magnitude and spatial and temporal patterns of exposure for the scenarios described in the conceptual site model;

8.5.d. Ecological Response Analysis. An ecological response analysis shall be developed which includes a summary of current information regarding the toxicological and ecological effects of the identified contaminants of ecological concern, as well as ecological benchmark values. Appropriate sources of toxicity information are identified in paragraph 8.1.c.2 of this rule;

8.5.e. Ecological Risk Characterization. If the potential exists for significant ecological risks due to exposure to site contaminants, the exposure quantification information in subdivision 8.5.c of this rule shall be integrated with the ecological response analysis to provide a characterization of the risks presented at the site, considering current and reasonably anticipated future land and water uses. The risk characterization shall include a quantitative evaluation of ecological risks potentially associated with the site, a weight-of-evidence analysis of risk, a discussion of available site-specific ecological studies, and consideration of the non-quantified (qualitative) risks as appropriate; and

8.5.f. Uncertainty Analysis. Qualitative and/or quantitative uncertainty analyses shall be used as appropriate for each element of the risk assessment.

8.6. Residual Risk Assessments (RRA). Conditions that will be present at the site following implementation of the proposed remedy, should one be needed, shall be considered in residual human health and ecological risk assessments.

8.6.a. In a situation where a baseline risk assessment has been conducted and where no further action is the proposed remedy, the base line risk assessment may serve as the residual risk assessment.

8.6.b. A RRA shall include an assessment of the risks under current and reasonably anticipated future land and water use scenarios, given:

8.6.b.1. The exposure conditions that will be present following remediation and the concentrations of untreated ~~waste~~ constituents or treatment residuals remaining at the conclusion of any excavation, treatment, or off-site disposal; and/or

8.6.b.2. The exposure conditions that will result following implementation of any institutional or engineering controls necessary to manage risks from treatment residuals or untreated hazardous constituents.

8.6.c. The RRA shall be conducted following the same basic steps outlined in subsections 8.4 and 8.5 of this rule, except that the conditions used to define the site shall reflect post-remediation conditions, including site-specific numeric remediation standards and site-specific exposure conditions that incorporate any engineering and institutional controls proposed as part of the remedial action.

8.7. Probabilistic Assessment: Probabilistic techniques may be applied to human health and ecological risk assessments. At a minimum, before the commencement of a probabilistic risk assessment, the applicant shall discuss with the secretary the sources and characteristics of the distributions proposed for use in the assessment. The probabilistic risk assessment shall include, but not be limited to, information regarding:

8.7.a. All formulae used to estimate exposure point values, toxicity (cancer slope factor, reference dose) values, ecological benchmark values, hazard indices, and incremental lifetime cancer risks;

8.7.b. A combination of input parameters expressed as either point estimates or distributions. For each input parameter expressed as a distribution, the following information shall be provided:

8.7.b.1. The shape of the full distribution;

8.7.b.2. To the extent practicable, the mean, standard deviation, minimum, 5th percentile, 10th percentile, median, 90th percentile, 95th percentile, and maximum of the specified distribution;

8.7.b.3. Justification for the use of each distribution clearly explaining the rationale for its use and the rejection of other relevant distributions; and

8.7.b.4. The extent to which input distributions and their parameters capture and separately represent both stochastic variability and knowledge uncertainty. This information shall comprise a portion of, but not be a

replacement for a comprehensive discussion in the body of the baseline risk assessment of the qualitative and quantitative sources of uncertainty.

8.7.c. A description of any correlations between or among input variables that are known or expected to have the practical effect of significantly affecting the risk assessment;

8.7.d. For each output distribution resulting from the probabilistic risk assessment, the following information:

8.7.d.1. The shape of the full distribution and location of the acceptable risk level; and

8.7.d.2. To the extent practicable, the mean, standard deviation, minimum, 5th percentile, 10th percentile, median, 90th percentile, 95th percentile, and maximum of the specified distribution.

8.7.e. A probabilistic sensitivity analysis for all key input distributions conducted so as to distinguish, to the extent possible, the effects of variability from the effects of uncertainty in the input variables;

8.7.f. Justification for the selection of any point estimate value incorporated into the probabilistic assessment and the rationale for its selection and for the rejection of other relevant point estimate values;

8.7.g. Probabilistic methods may be applied to:

8.7.g.1. Environmental media contaminant concentration data;

8.7.g.2. Transport and fate modeling;

8.7.g.3. Exposure estimation;

8.7.g.4 Ecological response estimation; or

8.7.g.5 Risk characterization.

8.7.h. The plausible upper-bound exposure condition is equal to approximately the 90th percentile of the exposure distribution. The central-tendency exposure case is the 50th percentile of the exposure distribution. Risk assessments utilizing only deterministic (single point value) methods shall provide both central tendency and plausible upper-bound estimates of exposures and risk.

§60-3-9. Remediation Standards. -- This section shall be used for developing risk-based soil and groundwater remedial objectives for site remediation. The purpose of these procedures is to provide for the adequate protection of human health and the environment relative to the current and the reasonably anticipated future uses of the site while incorporating site-related information, to the extent practicable, which may allow for more cost-effective site remediation based on identified site risks.

9.1. Types of remediation standards. Each applicant who responds to the release of a regulated substance at a site shall select and attain compliance with one or a combination of the following remediation standards in each of subdivisions 9.1.a and 9.1.b:

9.1.a. Human Health:

9.1.a.1. A De Minimis Risk-Based Standard is one in which contaminant levels pose no significant risks to human health based on any current or reasonably anticipated future land and water use as provided in subsection 9.2 of this rule. If these levels are below natural background, background levels will be considered the De Minimis levels;

9.1.a.2. A Uniform Risk-Based Standard is one which uses pre-approved analytical methodologies established by the secretary to input exposure factors and other site- specific variables to calculate compound-specific remediation levels that will be protective of human health based on any current or reasonably anticipated future land and water use, as provided in subsection 9.3 of this rule. If these levels are below anthropogenic background levels, such background levels will be considered the uniform risk-based levels;

9.1.a.3. A Site-Specific Risk-Based Standard is one which uses a site-specific analysis of present contamination, and develops a remedial approach that considers the remedy selection criteria in subdivision 9.8.a of this rule and is protective of human health based upon any current, or reasonably anticipated future land and water use; or

9.1.a.4. The applicant may use a combination of the remediation standards to implement a site remediation plan and may choose to use the Site-Specific Risk-Based Standard whether or not efforts have been made to attain the De Minimis or Uniform Risk-Based standards.

9.1.a.5. In all cases the presence of free product at a site shall require remediation.

9.1.b. Ecological:

9.1.b.1. A De Minimis Ecological Screening Evaluation is an evaluation of the nature and extent of contaminants to determine if potential exposure pathways are completed. If contaminants and ecological receptors of concern do not form complete exposure pathways, no significant risk to ecological receptors is assumed.

9.1.b.2. A Uniform Ecological Evaluation -- where contaminant concentrations are compared to benchmark values which reflect no significant risks to ecological receptors of concern. If these benchmark values are below anthropogenic background levels, such background levels will be considered the Uniform Ecological Standard. Where an applicant proposes a remediation standard based on other existing standards which exceed the benchmark levels and the secretary feels those other existing standards are not protective of ecological receptors of concern, he or she may require a site specific ecological risk assessment in order to establish remediation standards.

9.1.b.3. A Site-Specific Ecological Risk-Based Standard which, based on a site-specific analysis of present contamination, develops a remedial approach that considers the remedy criteria in subdivision 9.8.a of this rule and is protective of ecological receptors of concern for the current, or reasonably anticipated future land and water use.

9.1.b.4. The applicant may use a combination of the remediation standards to implement a site remediation plan and may propose to use the Site-Specific Risk-Based Standard whether or not efforts have been made to attain the De Minimis Risk-Based Standards.

9.2. Human Health -- De Minimis Standard. The De Minimis Standard establishes contaminant levels that do not present a significant risk to human health. If on the basis of the site assessment, these standards are found to be met, no remedial action or further characterization is required and the site is eligible for issuance of a Certificate of Completion by the secretary or by a Licensed Remediation Specialist as provided by in this rule. If at any time during characterization or remedial action the site is shown to meet the De Minimis standard, no further action is required and the site is eligible for issuance of the Certificate of Completion.

9.2.a. De Minimis Standards for Soils. The De Minimis Standards for both surface (<2ft depth) and subsurface (>2ft depth) soils shall be the higher numerical value of the following:9.2.a.1 or 9.2.a.2, and must not exceed 9.2.a.3 unless it is shown to the satisfaction of the secretary that migration of soil contaminants to groundwater will not result in an exceedance of De Minimis Groundwater Standards.

9.2.a.1. Risk-Based Concentrations (RBCs)for human health for residential or industrial site uses that consider direct contact exposures (ingestion, dermal, and inhalation). When such risk-based concentrations exceed soil saturation concentrations (CSAT), soil saturation concentrations shall be considered as alternatives to RBCs. All RBCs are presented in Table 60-3B;

9.2.a.2. Natural background levels for each constituent as determined by sampling and statistical analyses completed using secretary approved methods and/or data sources.

9.2.a.3. De Minimis Soil Standards for the migration of each constituent from soil to groundwater presented in Table 60-3B.

9.2.b. De Minimis Standards for Groundwater. The De Minimis standards for groundwater shall be determined as follows:

9.2.b.1. Groundwater contaminant concentration limits established in Title 46-Series 12 of the Code of State Rules (46CSR12);

9.2.b.2. For those contaminants where a concentration limit has not been established in 46CSR12, the higher numerical value of the following:

9.2.b.2.A. The Risk-Based Concentrations (RBCs) for human health for residential site uses will be used as presented in Table 60-3B; or

9.2.b.2.B Natural background levels for each constituent as determined by sampling and statistical analyses completed using secretary approved methods and/or data sources.

9.2.c. Carcinogens. For individual known or suspected carcinogens, remediation standards derived under subdivisions 9.2.a and 9.2.b of this rule shall

be established at levels which represent an excess upper-bound lifetime cancer risk of one in one million ($1x10^{-6}$) for residential land uses and one in one hundred thousand (1×10^{-5}) for industrial land uses.

9.2.d. Systemic toxicants. For individual systemic toxicants, remediation standards shall represent levels to which the human population could be exposed without appreciable risk of deleterious effect, where the hazard quotient shall not exceed 1.

9.2.e. If a contaminant exhibits both carcinogenic and noncarcinogenic effects, then the more protective risk-based standard (i.e., the lower of the two values) shall be used as the remediation standard.

9.2.f. Should soil or groundwater concentrations meet De Minimis levels, and no exposure pathways exist in addition to those considered in the De Minimis Table 60-3B, then no further action shall be required and the Certificate of Completion can be issued.

9.3. Human Health-Uniform Risk-Based Standard. This Standard sets forth uniform, approved methodologies, exposure factors, and other input variables needed to calculate site risks for residential or nonresidential land uses. The secretary recognizes that there may be instances where the pre-established input variables may not be applicable to a site, and thus will allow for site-specific variables to replace the default variables with adequate technical justification. Typical parameters that may require site-specific input include soil attenuation factors, site-specific hydrogeologic properties, and institutional controls used to manage potential exposure to site contamination.

9.3.a. Uniform Risk-Based Standards for Surface Soils/Sediments. Surface soil remediation standards for residential or industrial land uses shall be derived by applying site-specific information to the equations and constants from the secretary's Uniform Risk-Based Guidance or other equations and constants approved by the secretary considering reasonably anticipated future land and water use.

9.3.b. Uniform Risk-Based Standards for Subsurface Soils. Subsurface soil remediation values shall be derived based on:

9.3.b.1. Migration potentials;

9.3.b.2. Leaching potentials; and

9.3.b.3. Soil saturation concentrations. The equations and constants described in the secretary's Uniform Risk-Based Guidance or other equations and constants approved by the secretary shall be applied.

9.3.c. Uniform Risk-Based Standard for Groundwater. Groundwater remediation values shall be derived based on:

9.3.c.1. Current or reasonably anticipated future land and water use;

9.3.c.2. The potential for the groundwater to serve as a source of drinking water. Groundwater that has a background total dissolved solids content greater than 2500 milligrams per liter (mg/l), or where the applicant can demonstrate to the secretary's satisfaction that the aquifer is not being used, cannot be used for future drinking water sources, and is not hydrologically connected to an aquifer being

used for drinking water shall not be considered a current or potential source of drinking water; and

9.3.c.3. Migration potentials. The equations and constants described in the secretary's uniform Risk Based Guidance shall be applied.

9.3.d. Carcinogens. For individual known or suspected carcinogens, remedial standards derived under subdivisions 9.3.a, 9.3.b, and 9.3.c of this rule shall be established at levels which represent an excess upper-bound lifetime risk of between one in ten thousand to one in one million ($1x10^{-4}$ to $1x10^{-6}$). If carcinogenic risk greater than $1x10^{-6}$ is considered for development of residential remediation goals or greater than 1×10^{-5}, for development of industrial remediation goals, public notification shall be required as specified in subsection 7.12 of this rule.

9.3.e. Systemic Toxicants. For individual systemic toxicants, remedial standards derived under subdivisions 9.3.a, 9.3.b, and 9.3.c of this rule shall represent levels to which the human population could be exposed without appreciable risk of deleterious effect, where the hazard quotient shall not exceed one.

9.3.f. If a contaminant exhibits both carcinogenic and noncarcinogenic effects, then the more conservative risk-based standard (i.e., the lower of the two values) shall be used as the remediation standard.

9.3.g. Cumulative Site Risk. Cumulative upper-bound estimate of site risk per receptor from exposure to known or suspected carcinogens shall not exceed one in ten thousand ($1x10^{-4}$); and where multiple systemic toxicants affect the same target organ or act by the same method of toxicity, the upper-bound estimate of hazard index shall not exceed 1, or 10 where it is not determined whether multiple systemic toxicants affect the same organ.

9.3.h. Should Uniform Risk-Based soil or groundwater concentrations be met, no further action shall be required with regard to those media.

9.4. Human Health-Site-Specific Risk-Based Standard. Site-Specific Risk-Based Standards will be determined using one or a combination of a BHHRA as described in subsection 8.4 of this rule or a RRA as described in subsection 8.6 of this rule. In establishing the remediation standard under this section, the potential for exposure to site contaminants under current and reasonably anticipated future land and water use and the application of institutional and engineering controls shall be considered.

9.4.a. Carcinogens. For individual known or suspected carcinogens, remedial standards derived under subsection 9.4 shall be established at levels which represent an excess upper-bound lifetime risk of between one in ten thousand to one million ($1x10^{-4}$ to $1x10^{-6}$). If carcinogenic risk greater than $1x10^{-6}$ for individual carcinogens is considered for development of residential remediation goals, or greater than 1×10^{-5} for development of industrial remediation goals, public notification shall be required as specified in subsection 7.12 of this rule.

9.4.b. Systemic toxicants. For individual systemic toxicants, remedial standards shall represent levels to which the human population could be exposed without appreciable risk of deleterious effect, where

the hazard quotient shall not exceed one. Where multiple systemic toxicants affect the same target organ or act by the same method of toxicity, the hazard index shall not exceed 1, or 10 where it is not determined whether multiple systemic toxicants affect the same organ.

9.4.c. If a contaminant exhibits both carcinogenic and noncarcinogenic effects, then the more protective risk-based standard (i.e., the lower of the two values) shall be used as the remediation standard.

9.4.d. If probabilistic risk assessment methods are used in establishing the remedial standards or demonstrating the acceptability of the proposed remedial alternative, exposure levels shall approximate the 90th percentile of the exposure distribution.

9.4.e. Groundwater. Remedial standards for groundwater shall be established using the following considerations:

9.4.e.1. Potential receptors based on the current and reasonably anticipated future use of groundwater;

9.4.e.2. The potential for groundwater to serve as a drinking water source, as defined in paragraph 9.3.c.2 of this rule;

9.4.e.3. Site-specific sources of contaminants;

9.4.e.4. Natural environmental conditions affecting the fate and transport of contaminants, such as natural attenuation processes, as determined by appropriate scientific methods; and

9.4.e.5. Institutional and engineering controls.

9.4.f. Soil. Remedial standards for soil/sediments shall be established using the following considerations:

9.4.f.1. Potential receptors based on the current and reasonably anticipated use of the site;

9.4.f.2. Site-specific sources of contaminants;

9.4.f.3. Natural environmental conditions affecting the fate and transport of contaminants, such as natural attenuation processes, as determined by approved scientific methods; and

9.4.f.4. Institutional and engineering controls.

9.4.g. The secretary shall incorporate the equations and constants for risk-based standards into a guidance document, along with other relevant information for establishing and applying such standards to specific sites. The guidance document shall be revised from time to time as needed to incorporate scientific advancements and new or alternative risk assessment and methods. The guidance document, any subsequent revisions, and any alternative risk assessment methods proposed by an applicant will be reviewed by independent scientists recognized as experts in relevant risk assessment disciplines. The secretary shall incorporate as appropriate the comments of scientific reviewers into the guidance document or decisions regarding risk-based standards or methods.

9.5. Ecological -- De Minimis Screening Evaluation. This standard sets forth uniform, pre-approved methodologies, exposure assumptions, and other input variables needed to evaluate whether complete exposure pathways exist for aquatic and terrestrial ecological receptors of concern. The secretary recognizes that there may be instances where the pre-established input variables may not be applicable to a site, and thus will allow for site-specific variables to indicate whether an ecological risk assessment is needed.

9.5.a. Typical parameters that shall be considered when evaluating whether or not to perform an ecological risk assessment include but are not limited to the following:

9.5.a.1. Evaluate whether a complete exposure pathway exists. If no complete exposure pathway exists because either the contamination is restricted in movement or there are no ecological receptors of concern, then no ecological risk exists (e.g., if the majority of the site is paved with roads and buildings, no pathway exists);

9.5.a.2. Some sites may be screened out and not require evaluation given their size, estimated risk to ecological receptors, or lack of valued ecological receptors, including threatened or endangered species;

9.5.a.3. Local conditions should be considered for assessing whether a site is degrading an aquatic environment. In cases where the site does not present an ecological risk over and above "local conditions" and further release of contaminants into the aquatic environment has been stopped, there will not be a need for further evaluation;

9.5.a.4. Define what level of ecological resource is considered valued; and

9.5.a.5. If for each contaminated media, harm is readily apparent and a condition of no significant risk of harm to the site biota and habitats clearly does not exist, further ecological risk characterization would be redundant and is not required. The applicant can then proceed directly to the remedy evaluation.

9.5.b. The following are conditions which may be considered indicators of the need for an ecological risk assessment:

9.5.b.1. Stressors have migrated off-site and become widely distributed in the environment;

9.5.b.2. Wildlife or ecological resources of concern are exposed or have potential for significant exposure to stressors from a site, either on or off-site;

9.5.b.3. Remediation of stressors at a site has the potential to expose ecological resources of concern to impacts;

9.5.b.4. A potential exists for indirect or cumulative impacts to ecosystems of concern;

9.5.b.5. Rare or sensitive species of concern are potentially impacted;

9.5.b.6. Adverse ecological effects have been observed in an otherwise high quality habitat; and

9.5.b.7. Projected land use involves sensitive ecosystems.

9.5.c. Should the ecological screening evaluation indicate no complete

exposure pathways exist or other conditions specified in subdivision 9.5.a. of this rule or the Screening Ecological Evaluation Guidance are met, no further action shall be required and the Certificate of Completion can be issued.

9.6. Ecological-Uniform Ecological Evaluation. The Uniform Ecological Evaluation establishes benchmark levels that do not present a significant risk to potential ecological receptors. If during initial screening, these standards are found to be met, no remedial action or further characterization is required and the site is eligible for issuance of a Certificate of Completion by the secretary or by a Licensed Remediation Specialist. If at any time during characterization or remedial action the site is shown to meet the Uniform Ecological Evaluation, no further action is required and the Certificate of Completion can be issued. If site contaminants exceed benchmark criteria, the applicant can propose remediation goals protective of ecological receptors of concern. If the applicant chooses to remediate to benchmark levels, the following shall be used:

9.6.a. Uniform Standards for Soils. Uniform Standards for soils (0-4 ft) shall be the highest of the following numerical values:

9.6.a.1. Benchmarks for relevant ecological receptors that consider direct contact exposures, as presented in division guidance documents; or

9.6.a.2. Natural or anthropogenic background levels for each constituent as determined by sampling and statistical analyses completed using secretary approved methods and/or data sources.

9.6.b. Uniform Standards for Sediments. Uniform Standards for sediments (0-6 inches) shall be the highest of the following numerical values:

9.6.b.1. Benchmarks for relevant ecological receptors that consider direct contact exposures, as presented in division guidance documents; or

9.6.b.2. Natural or anthropogenic background levels for each constituent as determined by sampling and statistical analyses completed using secretary approved methods and/or data sources.

9.6.c. Uniform Standards for Surface Water. The Uniform standards for surface water shall be the highest of the following numerical value:

9.6.c.1. Federal Ambient or State Water Quality Criteria;

9.6.c.2. For those contaminants where a Federal or State Water Quality Criteria has not been established, applicable NOAEL (No Observable Adverse Effect Level) or LOAEL (Lowest Observable Adverse Effect Level) values will be used, as presented in division guidance documents; or

9.6.c.3. Natural or anthropogenic background levels for each constituent as determined by sampling and statistical analyses completed using secretary-approved methods and/or data sources.

9.6.d. Uniform Standards for Groundwater. Where groundwater is expected to impact surface water bodies of

concern, the Uniform standards for groundwater shall be the highest of the following numerical value:

9.6.d.1. Federal Ambient or State Water Quality Criteria;

9.6.d.2. For those contaminants where a Federal or State Water Quality Criteria has not been established, applicable NOAEL (No Observable Adverse Effect Level) or LOAEL (Lowest Observable Adverse Effect Level) values will be used, as presented in division guidance documents; or

9.6.d.3. Anthropogenic background levels for each constituent as determined by sampling and statistical analyses completed using secretary-approved methods and/or data sources.

9.7. Ecological-Site-Specific Risk-Based Standard. Site-Specific Risk-Based Standards shall be developed using the procedures and factors established by this section.

9.7.a. In establishing the remediation standard under this section, the potential for exposure of ecological receptors of concern to site contaminants under current and reasonably anticipated future land and water use and the application of institutional and engineering controls shall be considered.

9.7.b. For individual toxicants, remedial standards shall represent levels to which sensitive (i.e., threatened or endangered) ecological population(s) could be exposed without appreciable risk of deleterious effect, where the hazard index shall not exceed one. For non-sensitive ecological receptors, a weight-of-evidence approach shall be used to establish acceptable remedial standards.

9.7.c. If probabilistic risk assessment methods are used in establishing the remedial standards or demonstrating the acceptability of the proposed remedial alternative, exposure levels shall approximate the 90th percentile of the exposure distribution.

9.7.d. Remedial standards for soil, sediment, surface water, or groundwater shall be established using the following considerations:

9.7.d.1. Potential receptors of concern based on the current and reasonably anticipated use of the site;

9.7.d.2. Site-specific sources of contaminants;

9.7.d.3. Natural environmental conditions affecting the fate and transport of contaminants, such as natural attenuation processes, as determined by approved scientific methods; and

9.7.d.4. Institutional and engineering controls.

9.7.e. The secretary shall incorporate the equations and constants into a guidance document, along with other relevant information for establishing and applying such standards to specific sites. The guidance document shall be revised from time to time as needed to incorporate scientific advancements and new or alternative risk assessment methods. The guidance document, any subsequent revisions, and any alternative risk

assessment methods proposed by an applicant will be reviewed by independent scientists recognized as experts in relevant risk assessment disciplines. The department shall incorporate as appropriate the comments of scientific reviewers into the guidance document. These services will be contracted through arrangements made by the secretary with a nonprofit organization governed by a board of secretaries representing diverse interests of West Virginia.

9.8. Remediation measures. Any of the remediation standards may be attained through one or more remediation activities that can include treatment, removal, engineering or institutional controls, and natural attenuation and including, but not limited to, innovative or other demonstrated measures.

9.8.a. Remedy evaluation. In selecting a remedial action from among alternatives that achieve the goal of cost effective protection of human health and the environment, the following factors shall be balanced ensuring that no single factor predominates over the others. The remedy that protects human health and the environment shall be selected using the following criteria:

9.8.a.1. The effectiveness of the remedy in protecting human health and the environment;

9.8.a.2. The reliability of the remedial action in achieving the standards over the long term;

9.8.a.3. Short-term risks to the affected community, those engaged in the remedial action effort, and to the environment posed by the implementation of the remedial action;

9.8.a.4. The acceptability of the remedial action to the affected community;

9.8.a.5. The implementability and technical practicability of the remedial action from an engineering perspective;

9.8.a.6. Meets protectiveness goal at lowest cost; and

9.8.a.7. Considers net environmental benefits of the remedial action.

9.9. Natural Attenuation. Any person may request that the secretary approve a remediation plan based upon natural processes of degradation and attenuation of contaminants. A request submitted to the secretary under this paragraph shall include a description of site-specific conditions, including written documentation of projected groundwater use in the contaminated area based on current state or local government planning efforts; the technical basis for the request; and any other information requested by the secretary to thoroughly evaluate the request. In addition, the person making the request must demonstrate to the satisfaction of the secretary:

9.9.a. That the contaminant has the capacity to degrade or attenuate under the site-specific conditions;

9.9.b. That the contaminant area, such as a groundwater plume or soil volume, is not increasing in size; or, because of natural attenuation processes, that the rate of contaminant degradation is demonstrably

more rapid than the rate of contaminant migration; and that all sources of contamination and free product have been controlled or removed where practicable;

9.9.c. That the time and direction of contaminant travel can be predicted with reasonable certainty;

9.9.d. That contaminant migration will not result in any violation of applicable groundwater standards at any existing or reasonably foreseeable receptor;

9.9.e. If the contaminants have migrated onto adjacent properties, the owner must demonstrate that:

9.9.e.1. Such properties are served by an existing public water supply system dependent on surface waters or hydraulically isolated groundwater, or

9.9.e.2. The owners of such properties have consented in writing to allow contaminant migration onto their property.

9.9.f. That, if the contaminant plume is expected to intercept surface waters, the groundwater discharge beyond the sediment/water interface will not possess contaminant concentrations that would result in violations of standards for surface waters contained in 46 CSR 1;

9.9.g. That the person making the request will put in place a groundwater monitoring program sufficient to track the degradation and attenuation of contaminants and contaminant by-products within and down-gradient of the plume and to detect contaminants and contaminant by-products prior to their reaching any existing or foreseeable receptor. Such monitoring program shall provide for placing one or more monitoring wells at least one year's time of travel upgradient of the receptor, and at least one monitoring well shall be placed at a location no farther away from the leading edge of the contaminated groundwater at the site than such contamination is likely to travel in five years;

9.9.h. That all necessary access agreements needed to monitor groundwater quality pursuant to subdivision 9.9.g. of this section have been or can be obtained; and

9.9.i. That the proposed corrective action plan would be consistent with all other environmental laws.

§60-3-10. Work Plan.

10.1. Submittal of Work Plans. The applicant, or the applicant's licensed remediation specialist or contractor, shall submit to the secretary the appropriate work plans and reports as required by the parties' voluntary remediation agreement.

10.2. Action on Work Plans.

10.2.a. The secretary may, based upon accuracy, quality, and completeness, either approve or disapprove a work plan or report submitted from the applicant or the applicant's licensed remediation specialist or contractor.

10.2.b. If the secretary disapproves a work plan or report, the secretary must, within 5 days of its disapproval, notify the applicant in writing that its work plan or report has been disapproved. Such written notice shall include a list specifying the reasons that the

work plan or report was disapproved, and shall specify all additional information needed for the work plan or report to obtain approval.

10.2.c. If the secretary disapproves a work plan or report as submitted, the applicant must resubmit the work plan or report or terminate the agreement pursuant to W. Va. Code §22-22-9.

10.3. Timing of Submittal and Review.

10.3.a. The secretary shall either approve or disapprove all work plans and reports within 30 days of receipt or within a shorter period if specified in the parties' voluntary remediation agreement. Any such action taken on a work plan or report must be confirmed in writing and received by the applicant within the 30-day period or within such shorter period specified in the parties' voluntary remediation agreement. An extension of time for approval or disapproval of work plans or report may be mutually agreed to between the applicant and the secretary. If an extension of time is mutually agreed to by the secretary and applicant, it must be confirmed in writing.

10.3.b. If work plans or reports are resubmitted, the secretary shall approve or disapprove the resubmitted work plans or reports within 30 days of receipt or within such shorter period specified in the parties' voluntary remediation agreement. Any action taken on resubmitted work plans or reports must be confirmed in writing and received by the applicant within the 30-day period for acting on a resubmitted application, or within such shorter time specified in the parties' voluntary remediation agreement. An extension of time or action on resubmitted work plans or reports may be mutually agreed to between the applicant and the secretary. If an extension of time is mutually agreed to by the secretary and applicant, it must be confirmed in writing. If resubmitted work plans or reports are not approved by the secretary, then the secretary and the applicant may mutually agree, in writing, to a schedule for additional review of the resubmitted work plans or reports.

10.3.c. If work plans or reports are not approved or disapproved within 30 days of receipt by the secretary or within such shorter time specified in the parties' voluntary remediation agreement, or if resubmitted work plans or reports are not approved or disapproved within 30 days of receipt by the secretary or within such shorter time specified in the parties' voluntary remediation agreement, then the work plans or reports will be deemed approved unless such work plans or reports are determined to be materially inaccurate.

10.4. Notice. Any notice required to be given under the provisions of this section must be in writing and sent via United States certified mail, or as specified in the parties' voluntary remediation agreement. Notice is complete upon receipt.

10.5. Completeness and Quality of Work Plans. In reviewing work plans for quality and completeness, the secretary may require such work plans to include each of the following:

10.5.a. Documentation of the investigation conducted by the applicant in preparing the work plan;

10.5.b. A description of assessments and other work, if any, to be performed by the applicant to further determine the nature and extent of the actual or threatened release;

10.5.c. A description of risk assessments, if any, to be conducted to show the appropriateness of the proposed remedy for the site;

10.5.d. A statement of work to be conducted to accomplish the proposed remediation in accordance with the risk protocol and remediation standards established under sections 8 and 9 of this rule, and a schedule for the implementation of all tasks set forth in the proposed statement of work;

10.5.e. The applicant's verification sampling plan to determine the adequacy of the remediation; and

10.5.f. Other necessary supporting plans or information as deemed appropriate by the party conducting the remediation.

§60-3-11. Final Report.

11.1. This rule sets forth the requirements for the submittal and contents of the Final Report for a voluntary remediation program. The Final Report may be prepared and submitted when all applicable standards developed for the site have been met.

11.2. Sites may be subdivided for the purpose of preparing Final Reports.

11.3. The Final Report shall include all data and information needed to document and verify that all applicable standards have been met and that all activities specified in the Voluntary Remediation Agreement have been completed. Supporting documentation, such as sample collection records, field monitoring data, laboratory reports, relevant correspondence, and permits, should be placed in one or more appendices to the Final Report. The use of maps, drawings, photographs, tables, and other aids to visualization and data presentation is encouraged.

11.4. Earlier reports, plans, and/or other relevant documents may be incorporated into the Final Report by reference if these items previously have been submitted to the Division. In such cases a complete bibliographic reference shall be provided for each document being incorporated by reference.

11.5. The names, addresses, telephone numbers, and facsimile transmission numbers shall be provided for the current owners and operators of the site, the owners and/or operators conducting the remediation (if different), and the licensed remediation specialist. Individual names and titles for management contacts for each listed firm or organization also shall be provided.

11.6. The site location shall be clearly identified by providing the street address, legal description (including lot and block numbers), and a site location map.

11.7. Ongoing work, such as site cover or treatment system operation and maintenance or groundwater or surface water monitoring, shall be described. This shall include descriptions of planned activities and schedules.

11.8. If institutional controls, such as deed restrictions or land use covenants, are part of the remediation program, copies of appropriate documents to be recorded shall be appended to the Final Report. A site map showing the area(s) subject to institutional controls shall be provided.

11.9. The completeness and accuracy of the Final Report shall be certified, in writing, by an authorized agent of the applicant and by the licensed remediation specialist. The form of this certification shall be as follows:

I hereby certify that the information presented in this report is, to the best of my knowledge and belief, true, accurate, and complete having been prepared under a system and organization designed to produce true, accurate, and complete information.

If the authorized agent and the licensed remediation specialist are the same, a single signature will be sufficient.

§60-3-12. Certificate of Completion.

12.1. Completion of Remediation.

12.1.a. A voluntary remediation is complete when a site meets applicable standards and all work has been completed as contemplated in the voluntary remediation agreement.

12.1.b. When a site meets applicable standards and all work required by the voluntary remediation agreement to meet applicable standards has been completed, the licensed remediation specialist shall issue a final report to the applicant. Such report shall explain how the compliance with the requirements of the voluntary remediation agreement has been demonstrated.

12.1.c. The applicant to whom a final report has been issued may do either of the following:

12.1.c.1. Request a certificate of completion from the secretary, as provided in subsection 12.2 of this rule; or

12.1.c.2. Request a certificate of completion from the licensed remediation specialist, when applicable, as provided in subsection 12.4 of this rule.

12.2. Issuance of Certificate of Completion by the secretary.

12.2.a. Upon receiving the request provided in paragraph 12.1.c.1 of this rule, the secretary must evaluate the final report provided by the applicant, and determine, within sixty days, whether the final report was properly issued by the licensed remediation specialist. When reviewing a final report, the secretary shall only consider whether:

12.2.a.1. The site meets applicable standards for those areas of the site and for those contaminants identified in the voluntary remediation agreement; and

12.2.a.2. The applicant has complied with the voluntary remediation agreement and any approved work plans for the site.

12.2.b. If the secretary agrees that the final report was properly

issued, a certificate of completion shall be issued by the secretary within 60 days of receipt of a request for a certificate of completion from the applicant.

12.2.c. If the secretary does not agree that the final report was properly issued, he must promptly provide written notification to the applicant stating in detail the reasons why the report was not deemed properly issued and indicating the further action that must be taken to allow the certificate to be issued. Upon receipt of such notification, the applicant may:

12.2.c.1. Instruct the licensed remediation specialist to take the further action identified by the secretary;

12.2.c.2. Appeal the secretary's decision to the Environmental Quality Board in accordance with the provisions of W. Va. Code §22B-1-7; or

12.2.c.3. Terminate the voluntary remediation agreement.

12.3. Contents of the Certificate of Completion.

12.3.a. The certificate of completion shall attach or incorporate the following:

12.3.a.1. A description of the site to which the certificate of completion pertains;

12.3.a.2. A description of the contaminants for which applicable standards are met at the site;

12.3.a.3. The voluntary remediation agreement under which the site was remediated and/or evaluated;

12.3.a.4. The final report of the licensed remediation specialist; and

12.3.a.5. Any land use covenant or deed restriction imposed for purposes of meeting applicable standards including, where applicable, a description of any institutional or engineering controls employed at the site for purposes of meeting applicable standards.

12.3.b. The certificate of completion shall provide that:

12.3.b.1. The site that is described in the certificate of completion meets the applicable standards as provided in section 6 of this rule;

12.3.b.2. The applicant and the persons identified in section 18 of the Act (1) are relieved of liability to the state for the release that caused the contamination that was the subject of the voluntary remediation, and the state shall not institute any civil, criminal or administrative action arising from the release and resulting contamination, as long as the site continues to meet applicable standards in effect at the time the certificate was issued; and (2) shall not be subject to citizen suits or contribution actions with regard to the contamination that was the subject of the voluntary remediation agreement;

12.3.b.3. Where the agreement imposes an obligation that continues beyond the effective date of the certificate and such obligations are no longer satisfied with the result that the applicable

standards approved for the site are no longer being met, or continued compliance with the applicable standard is threatened, the secretary shall initiate action to insure the site is brought into compliance in accordance with section 14 of this rule to rescind the covenant contained in this certificate as it would apply to the then current owner or operators of the site and their successors and assigns;

12.3.b.4. Except as provided in paragraph 12.3.b.3 of this rule, a certificate of completion may be revoked or, in lieu thereof, further remediation may be required of any site described in the certificate of completion only where the secretary has determined that a reopener has been triggered in accordance with section 16. Where a certificate is revoked under this provision, it shall be revoked only as to the then current owner or operator of the site, their successors and assigns except in the case where fraud was committed in demonstrating attainment at the site as provided in subdivision 16.1.a of this rule. In this latter case, the certificate is revoked as it would apply to any person; and

12.3.b.5. The duties and benefits of the certificate of completion are transferable to successors and assigns of the applicant, subject to the obligations of any land use covenant referred to in the certificate of completion.

12.3.c. The certificate of completion contained in Appendix 60-3C meets the requirements of this section. Additional provisions and modifications which differ from the form in Appendix 60-3C but which are consistent with this rule may be agreed to by the applicant and the secretary.

12.4. Certificates of Completion Issued by Licensed Remediation Specialists.

12.4.a. A licensed remediation specialist may issue a certificate of completion for any site that complies with the de minimus standards set forth in subsections 9.2 and 9.5 of this rule, provided that a final report is issued and the secretary is given notice of the licensed remediation specialist's intention to issue a certificate of completion for the site.

12.4.b. A certificate of completion issued by a licensed remediation specialist shall comply with subsection 12.3 of this rule.

12.4.c. The secretary may object to the issuance of a certificate of completion by a licensed remediation specialist within 30 days of receipt of notice of the certificate's issuance, as provided in subdivision 12.4.a. of this rule. If the secretary objects to issuance of the certificate, the applicant may take any of the actions allowed under subdivision 12.2.c. of this rule. If the secretary fails to object within the 30 day period, the licensed remediation specialist may issue the certificate of completion.

12.5. Effective Date.

12.5.a. A certificate of completion issued by the secretary shall become effective when signed by the secretary or, where applicable, upon the filing of any land use covenant required by the certificate, whichever shall last occur.

12.5.b. A certificate of completion issued by a licensed remediation specialist shall become effective when

signed by the licensed remediation specialist after notice to the secretary in accordance with subsection 12.4 of this rule, or, where applicable, upon the filing of any land use covenant required by the certificate, whichever shall last occur.

§60-3-13. Land Use Covenants.

13.1. Any limitation on the use of a property that is required in order to meet applicable environmental standards shall be contained in a land use covenant. Such use restrictions may include prohibiting residential development of some or all of the site, or requiring maintenance of engineering or institutional controls.

13.2. Contents of a land use covenant

13.2.a. A land use covenant shall:

13.2.a.1. State that the instrument is an environmental covenant executed pursuant to the Uniform Environmental Covenants Act, W. Va. Code § 22-22B-1 et seq.;

13.2.a.2. Contain a legally sufficient description of the real property subject to the covenant;

13.2.a.3. Describe the activity and use limitations on the real property;

13.2.a.4. Identify every owner of record of a fee interest in the property;

13.2.a.5. Identify every holder of the land use covenant within the meaning of W. Va. Code § 22-22B-2;

13.2.a.6. Contain the notarized signature(s) of the agency, every holder and, unless waived by the agency, every owner of the fee simple of the real property subject to the covenant;

13.2.a.7. Identify the name and location of any administrative record for the work performed under the Act at the real property subject to the covenant;

13.2.a.8. State whether residential or non-residential exposure assumptions were used to comply with a site-specific remediation standard;

13.2.a.9. Provide requirements for notice within 10 days following transfer of a specified interest in, or concerning proposed changes in use of, applications for building permits for, or proposals for any site work affecting the contamination on, the property subject to the covenant;

13.2.a.10. Contain a provision that the applicant, and his assigns and successors, are relieved of all civil liability to the state for the release of contaminants and remediation activities, as long as the property meets applicable standards in effect at the time the covenant was issued;

13.2.b. A land use covenant may:

13.2.b.1. Provide a brief narrative description of the contamination and remedy; including the contaminants of concern, the pathways of exposure, limits on exposure and the location and extent of the contamination;

13.2.b.2. Grant rights of access to the property for purposes of

implementation or enforcement of the covenant;

13.2.b.3. Provide requirements for periodic reporting describing compliance with the covenant;

13.2.b.4. Provide limitations on amendments or termination of the covenant in addition to those specified in W. Va. Code § 22-22B-9 and § 22-22B-10;

13.2.b.5. Provide rights of the holder in addition to its right to enforce the covenant pursuant to W. Va. Code § 22-22B-11

13.2.c. In addition to other conditions for its approval of an environmental covenant, the agency may require those persons specified by the agency who have interests in the real property to sign the covenant.

13.3. The applicant for participation in the remediation program shall cause the land use covenant to be recorded in the deed book of each county in which any portion of the site is located and shall provide a certified copy of the recorded covenant to the Secretary and to each of the parties named in section 3-5 of this rule.

13.4. The land use covenant form contained in Appendix 60-3D meets the requirements of this section. Additional provisions or modifications that are not inconsistent with this rule, the Voluntary Remediation and Redevelopment Act or the Uniform Environmental Covenants Act may be agreed to by the holders and the secretary.

13.5. A copy of a land use covenant shall be provided by the persons required, and in the manner required, by the agency to:

13.5.a. Each person that signed the covenant;

13.5.b Each person holding a recorded interest in the real property subject to the covenant;

13.5.c Each person in possession of the real property subject to the covenant;

13.5.d Each municipality or other unit of local government in which real property subject to the covenant is located; and

13.5.e. Any other person the agency requires.

13.6. The validity of a covenant is not affected by failure to provide a copy of the covenant as required under section 13.5 if this rule.

13.7 The duration, amendment and termination of a land use covenant shall be governed by the provisions regarding environmental covenants set forth in the Uniform Environmental Covenants Act, W. Va. Code § 22-22B-1 et seq.

§60-3-14 Procedure where Certificate of Completion or Land Use Covenant is Violated.

14.1. If at any time the secretary determines that an obligation imposed by the certificate of completion or by any land use covenant issued pursuant to the Act is not being satisfied with the result that the

remediation standard approved for the site is no longer being met, or continued compliance with the remediation standard is threatened, the secretary shall issue notice of such determination by providing written notice through certified/registered mail to the current owner or operator of the site. Such notice shall identify the obligations that are not being satisfied and the appropriate corrective action that must be taken.

14.2. Any person aggrieved by the secretary's determination under subsection 14.1 of this rule may appeal such ruling to the Environmental Quality Board in accordance with the provisions of W. Va. Code §22B-1-7.

14.3. The covenant set forth in the certificate of completion and the provisions regarding relief from liability in any land use covenant shall no longer apply to the current owner or operator of the site and their successors and assigns upon the expiration of 60 days from the date of issuance of notice as provided in subsection 14.1 of this rule, or 60 days from issuance of a final order of the Environmental Quality Board affirming the action of the secretary where an appeal is taken as provided in subsection 14.2 of this rule, unless prior to such time the current owner or operator takes action to assure that all obligations imposed by the Certificate are satisfied.

§60-3-15 Loans from Brownfields Revolving Fund.

15.1. Loan Applications.

15.1.a. Any person who satisfies the criteria set forth in subsection 3.2 of this rule may apply, after conferring with the secretary as provided in W. Va. Code §22-22-5(a), to the secretary for a loan to perform a site assessment at a brownfield site. The application shall be on a form prescribed by the secretary which, at a minimum, shall require the following information:

15.1.a.1.
Name of applicant and business;

15.1.a.2.
Name of current owner(s) of record of the property;

15.1.a.3.
Size and location of property;

15.1.a.4.
Description of past and current uses of property;

15.1.a.5.
. Nature of contamination; and

15.1.a.6.
. Financial capability of applicant.

15.1.b. The secretary shall act upon a completed application within 60 days of receiving it. The secretary may approve the application, reject the application, or accept the application subject to correction. The applicant shall be given a reasonable amount of time to make corrections specified by the secretary.

15.1.c. Each loan shall be memorialized in a written document that identifies the amount of the loan, the interest rate, and the repayment schedule.

15.2. Qualifying Activities:

15.2.a. Money may be

loaned to an applicant from the Revolving Fund for the site assessment of a brownfield property; or

15.2.b. Money may be loaned to an applicant from the Revolving Fund for activities at brownfield sites other than site assessments to the extent monies are appropriated to, or received by, the Revolving Fund for purposes other than site assessments.

15.3. Loan Conditions.

15.3.a. The secretary shall require periodic reports from each applicant of all expenditures of funds loaned to the applicant from the Brownfield Revolving Fund;

15.3.b. Where the applicant is the owner of the property upon which the site assessment is to be performed, the secretary shall require a deed of trust to be executed or any other collateral of equal or greater value to secure the loan; and

15.3.c. Where the applicant is not the owner of the property upon which the site assessment is to be performed, the secretary shall require appropriate collateral to secure the loan, except where the applicant is a development authority or other public entity.

15.4. Repayment.

15.4.a Loans shall be repaid at a rate of interest determined by the secretary at the time the application is approved. The loans shall be low interest. For a public entity, the interest rate shall be from 0% to 3%. For a private entity the interest rate shall be the prime rate less three percent; and

15.4.b. Loans shall be repaid in equal installments over a period of no longer than 10 years, as allowed by the secretary.

§60-3-16. Reopener Provisions.

16.1. A voluntary remediation agreement shall be reopened in accordance with the procedures set forth in this section upon a determination by the secretary that one or more of the following conditions has occurred:

16.1.a. Fraud was committed in demonstrating attainment at the site with regard to a standard set forth in the voluntary remediation agreement or in these rules that resulted in avoiding the need for further remediation at the site;

16.1.b. New information confirms the existence of an area of previously unknown contamination which contains contaminants that have been shown to exceed the standards applied to the previous remediation at the site;

16.1.c. The level of risk is increased significantly beyond the established level of protection at the site due to substantial changes in exposure conditions, such as, a change in land use, or new information is obtained about a contaminant associated with the site which revises exposure assumptions beyond the acceptable range:

16.1.c.1. This condition applies only where the level of risk is increased by a factor of at least five or the hazard index exceeds 1, or 10 where it is not determined whether multiple systemic

toxicants affect the same organ.

16.1.d. The release that is addressed by the voluntary remediation agreement occurred after July 1, 1996, on a site not used for industrial activity prior to that date and (1) the remedy relied, in whole or in part, upon institutional or engineering controls instead of treatment or removal of contamination; and (2) treatment, removal or destruction has become technically and economically practicable; or

16.1.e. The remediation method failed to meet the remediation standard or combination of standards identified in the voluntary remediation agreement or these rules.

16.2. If at any time the secretary determines that one of the reopener conditions in subsection 16.1 has been triggered, the secretary shall issue notice of such determination by providing written notice through certified/registered mail to the initial remediator and the current occupant, and any other person who has asked to be notified of any actions regarding the site.

16.3. Any person aggrieved by the secretary's determination under subsection 16.2, may appeal such ruling to the Environmental Quality Board in accordance with the provisions of W. Va. Code §22B-1-7.

16.4. The Certificate of Completion previously issued for the site shall become null and void upon the expiration of 60 days from the date of issuance of notice as provided in subsection 16.1 or 60 days from issuance of a final order of the Environmental Quality Board where an appeal is taken as provided in subsection 16.2, unless prior to such time at least one of the following occurs:

16.4.a. Where the initial remediator seeks to maintain the certificate of completion then in effect, the initial remediator shall:

16.4.a.1. Enter into an agreement with the secretary to reopen and revise the voluntary agreement to the extent necessary to return the site to its previously agreed to state of remediation; or

16.4.a.2. Agree to reopen and revise the voluntary agreement to the extent necessary to achieve an alternative appropriate standard as determined by the secretary;

16.4.b. Where some person other than the initial remediator seeks to maintain the certificate of completion then in effect, such person shall:

16.4.b.1. Enter into a voluntary agreement with the secretary in accordance with the requirements of these rules which contains such provisions as are necessary to assure that the property meets the state of remediation previously agreed to or another appropriate standard as determined by the secretary.

§60-3-17. Appeals of Rulings of the Secretary.

17.1. If at any time the secretary determines that an obligation imposed by the certificate of completion or by any land use covenant issued pursuant to the Act is not being satisfied, with the result that the remediation standard approved for the site is no longer being met, or continued compliance with the remediation standard is

threatened, the secretary shall issue notice of such determination by providing written notice through certified/registered mail to the current owner or operator of the site. Such notice shall identify the obligations that are not being satisfied and the appropriate corrective action that must be taken.

17.2. Any person aggrieved by the secretary's determination under subsection 17.1 of this rule may appeal such ruling to the Environmental Quality Board in accordance with the provisions of W. Va. Code §22B-1-7.

17.3. The covenant set forth in the certificate of completion and the provisions regarding relief from liability in any land use covenant shall no longer apply to the current owner or operator of the site and their successors and assigns upon the expiration of 60 days from the date of issuance of notice as provided in subsection 17.1 of this rule, or 60 days from issuance of a final order of the Environmental Quality Board affirming the action of the secretary where an appeal is taken as provided in subsection 17.2 of this rule, unless prior to such time the current owner or operator takes action to assure that all obligations imposed by the Certificate are satisfied.

APPENDIX 60-3A

WEST VIRGINIA VOLUNTARY REMEDIATION AGREEMENT FOR NO FURTHER ACTION INVESTIGATION ACTIVITIES

[For Brownfields and Non-Brownfields Sites]

I. INTRODUCTION

1. The West Virginia Department of Environmental Protection (WVDEP), by its Secretary, and _____ ("applicant") hereby enter into this Voluntary Remediation Agreement ("Agreement"), pursuant to the Voluntary Remediation and Redevelopment Act, W.Va. Code §22-22-1 et seq. (the "Act"), for the purpose of investigating and, if warranted, remediating the property that is the subject of this Agreement ("the site").

II. JURISDICTION

2. This Agreement is entered into by and between the WVDEP, by its Secretary, and _____, applicant, pursuant to W.Va. Code §22-22-7.

3. The Parties agree to the following terms and conditions as satisfying the requirements of the Act for the investigation and remediation of the site. The applicant reserves all rights it may have under common law, the West Virginia Code and federal statutes to seek contribution or indemnity. The WVDEP reserves all rights it may have under common law, the West Virginia Code and federal statutes to seek contribution or indemnity from persons other than the applicant and those persons identified in W. Va. Code §22-22-18.

4. By entering into this Agreement, the applicant neither admits nor denies liability.

III. STATEMENT OF ELIGIBILITY

5. The Secretary has determined that the application submitted by applicant is complete and that applicant is eligible to participate in the voluntary remediation program [Add for brownfields locations: and that the site qualifies as a brownfields site]. However, neither the Secretary's determination of eligibility nor the entry into this Agreement precludes any finding by the Secretary at a later date that the site poses an imminent and substantial threat to human health or the environment within the meaning of W.Va. Code §22-22-7(d). In addition, if it is determined that applicant withheld or misrepresented information that would be relevant to the applicant's eligibility, the Secretary may withdraw from this Agreement.

IV. PARTIES BOUND

6. This Agreement shall apply to and be binding upon the applicant, its officers, secretaries, principals, employees, agents, successors, subsidiaries and assigns and upon WVDEP, its employees, agents and successors. The signatories to this Agreement certify that they are fully authorized to execute and legally bind the parties they represent.

7. The applicant shall provide a copy of this Agreement to any subsequent owners or successors before ownership rights are transferred.

V. DEFINITIONS

8. "Day" or "calendar day" means the 24-hour period between 12:00 A.M. - 12:00 A.M.

9. "No further action" means a site is eligible to receive a Certificate of Completion on the basis of site assessment sampling or sampling data developed under a Voluntary Remediation Agreement which demonstrates that the site meets applicable standards.

10. "Rules" means those rules adopted by the Secretary of the Department of Environmental Protection pursuant to the Voluntary Remediation and Redevelopment Act, W. Va. Code §22-22-1 through 22-22-21.

11. "Site" shall be used in the manner as defined by W.Va. Code §22-22-2 and for purposes of this Agreement means the property located in _____, West Virginia, and is more particularly described in the Application for Participating in the Voluntary Remediation Program attached and incorporated herein as Exhibit "A". [OPTIONAL LANGUAGE – Submitted to WVDEP and accepted by letter dated , 200 .]

12. All other terms contained in this Agreement shall be used in the manner as defined by W.Va. Code §22-22-2 or the rules.

VI. STATEMENT OF PURPOSE

13. This Agreement sets forth necessary terms and conditions to satisfy the requirements of the Act for the investigation and, if warranted, the remediation of the site.

14. The activities conducted by the applicant under this Agreement are subject to approval by WVDEP as provided herein. Applicant shall provide all necessary information for the site. The activities conducted by the applicant shall be consistent with this Agreement, all applicable laws and regulations and any appropriate guidance documents.

VII. EVALUATION OF SITE ASSESSMENT

15. Applicant has submitted a site assessment as a part of the application. The site assessment was accompanied by a final report prepared by _____, a licensed remediation specialist, which states that the site meets the applicable standard described in paragraph 16 of this Agreement.

16. The parties agree that the applicable standard for this site, consistent with [insert cite to rule relating to remediation standards] is as follows:

[Insert appropriate standard and, where applicable, a description of any engineering or institutional controls for this site, as agreed upon by the Parties.]

17. The statutes and regulations for which compliance is mandated in connection with the investigation or remediation of this site are as follows:

[Insert appropriate list of statutes and rules.]

[OPTIONAL LANGUAGE-If applicable]

(a) Air Pollution Control Act, W.Va. Code §§ 22-5-1 et seq.;
(b) Water Pollution Control Act, W. Va. Code §§ 22-11-1 et seq.;
(c) Groundwater Protection Act, W. Va. Code §§ 22-12-1 et seq.;
(d) Hazardous Waste Management Act, W. Va. Code §§ 22-18-1 et seq;
(e) Section 103(a) of Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C.A. §§ 9603(a)
(f) Section 304 of Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C.A. §§ 11001 to 11050;
(g) Occupational Safety & Health Act, 29 U.S.C.A. §§ 651 to 678;
(h) Resource Conservation and Recovery Act, as amended, et. seq., 42 U.S.C.A. §§ 6901, et seq.; and
(i) Toxic Substances Control Act, 15 U.S.C.A. §§ 2601, et seq.;
and any applicable regulation promulgated thereunder.

18. The WVDEP has reviewed the final report and the site assessment submitted as a part of the application to participate in the Voluntary Remediation Program and has concluded that the site meets the applicable standard described in paragraph 16 of this Agreement. [If applicable - include a description of the technical standards applied in evaluating the site assessment with reference to proposed future land uses.]

19. Nothing herein shall be construed as restricting the inspection or access authority of DEP under any law or regulation.

VIII. RECORD PRESERVATION

20. The applicant agrees to preserve, for a minimum of three years from the effective date of this Agreement, all documents required by this Agreement and any other documents generated or used to prepare the documents required by this Agreement. Upon request by WVDEP, the applicant shall make available to WVDEP such records, or copies of any such records.

IX. RESERVATION OF RIGHTS

21. WVDEP and applicant reserve all rights and defenses they may have pursuant to any available legal authority unless expressly waived herein.

22. Nothing herein is intended to release, discharge, or in any way affect any claims, causes of action or demands in law or equity which the parties may have against any person, firm, partnership or corporation, not a party to this Agreement, for any liability it may have arising out of or relating in any way to, the generation, storage, treatment, handling, transportation, release or disposal of any materials, hazardous substances, hazardous waste, contaminants, or pollutants at, to, or from the site. The parties to this Agreement expressly reserve all rights, claims, demands, and causes of action they have against any and all other persons and entities who are not parties to this Agreement, and as to each other for matters not covered hereby.

23. The applicant reserves the right to seek contribution, indemnity, or any other available remedy against any person found to be responsible or liable for contributions, indemnity, or otherwise for any amounts which have been or will be expended by the applicant in connection with the site.

24. WVDEP acknowledges that, pursuant to W.Va. Code §22-22-18, applicant, upon receipt of the Certificate of Completion, is not liable for claims for contribution concerning matters addressed in the Voluntary Remediation Work Plan.

X. PUBLIC NOTIFICATION/INVOLVEMENT

25. [For brownfield applicants, insert provision requiring compliance with approved-public involvement plan, where appropriate]

XI. ADMINISTRATIVE COSTS

26. Applicant agrees to reimburse WVDEP for all of its reasonable administrative costs associated with this Agreement in the amount of $_____within 30 days of the effective date of this Agreement with a check made payable to the Voluntary Remediation Fund and be mailed along with a transmittal letter stating the site name and address to the West Virginia Department of Environmental Protection; Attention: _____, _____, West Virginia. Reimbursable costs under this provision shall be those costs for

which reimbursement is required under the rules.

XII. [IF APPLICABLE] LAND USE COVENANTS

27. [Insert provisions describing restrictions on future use of property and attach copy of land use covenant that is to be recorded for the site.]

XIII. EFFECTIVE DATE AND SUBSEQUENT MODIFICATION

28. The effective date of this Agreement shall be the date on which the applicant receives notice that this Agreement has been signed by the Secretary of WVDEP.

29. This Agreement may be amended by mutual agreement of WVDEP and the applicant. Amendments shall be in writing and shall be effective when the applicant receives notice that the amendment has been signed by the Secretary of WVDEP.

30. If the Secretary determines that there is an imminent threat to the public, he or she may unilaterally modify or amend this Agreement.

XIV. TERMINATION AND SATISFACTION

31. Upon completion of the final report prepared by the licensed remediation specialist, the applicant may seek a Certificate of Completion from the Secretary. Upon receipt of a request for a Certificate of Completion, the Secretary shall determine that the site meets applicable standards for those areas of the site and for those contaminants identified in the voluntary remediation agreement and that the applicant has complied with the voluntary remediation agreement and any approved work plans for the site. Upon making this determination, the Secretary shall issue a Certificate of Completion which conforms substantially to Appendix 60-3C of the rule. Where a land use covenant is required by this Agreement, such Certificate of Completion shall not become effective until it is properly filed with the Clerk of the County Commission of the county in which the property is located.

If the Secretary determines that the certificate should not be issued because the work required by this Agreement and any approved work plans has not been completed or because the site does not meet applicable standards the Secretary shall initiate the procedures relating to denial of a certificate as provided in the rules.

32. The provisions of this Agreement shall be satisfied and this Agreement shall end when the Secretary issues the Certificate of Completion.

XV. REOPENER

33. This Agreement may be reopened upon agreement of the parties or upon occurrence of one or more of the conditions of W.Va. Code §22-22-15 and the rules implementing that

section.

XVI. GOVERNING LAW

34. This Agreement will be governed by the laws of the State of West Virginia.

_____ APPLICANT

Printed Name:_____

Title: _____

Date: _____

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

By: _____

Title: _____

Date: _____

[Include if applicant is not owner of the site and agreement calls for land use covenant:

_____, as owner of the site referenced in the above Agreement hereby acknowledges that said Agreement requires the imposition of a land use covenant and, in consideration of the benefits accruing to the site from said Agreement, I hereby agree to the imposition of such land use covenant and agree to cooperate in the execution and filing of such land use covenant.

_____ _____

Owner Date

APPENDIX 60-3B

WEST VIRGINIA VOLUNTARY REMEDIATION AGREEMENT FOR INVESTIGATION AND REMEDIATION ACTIVITIES

[For Brownfields and Non-Brownfields Sites]

I. INTRODUCTION

1. The West Virginia Department of Environmental Protection (WVDEP), by its Secretary, and _____ ("applicant") hereby enter into this Voluntary Remediation Agreement ("Agreement"), pursuant to the Voluntary Remediation and Redevelopment Act, W.Va. Code §22-22-1 et seq. ("the Act"), for the purpose of investigating and remediating the property that is the subject of this Agreement ("the Site").

II. JURISDICTION

2. This Agreement is entered into by and between the WVDEP, by its Secretary, and _____, applicant, pursuant to W.Va. Code §22-22-7.

3. The Parties agree to the following terms and conditions as satisfying the requirements of the Act for the investigation and remediation of the site. The applicant reserves all rights under common law, the West Virginia Code and federal statutes to seek contribution or indemnity. The WVDEP reserves all rights it may have under common law, the West Virginia Code and federal statutes to seek contribution or indemnity from persons other than the applicant and those persons identified in W. Va. Code §22-22-18.

4. By entering into this Agreement, the applicant neither admits nor denies liability.

III. STATEMENT OF ELIGIBILITY

5. The Secretary has determined that the application submitted by the applicant is complete and that applicant is eligible to participate in the voluntary remediation program. However, neither the Secretary's determination of eligibility nor the entry into this Agreement precludes any finding by the Secretary at a later date that the site poses an imminent and substantial threat to human health or the environment within the meaning of W.Va. Code §22-22-7(d). In addition, if it is determined that applicant withheld or misrepresented information that would be relevant to the applicant's eligibility, the Secretary may withdraw from this Agreement.

IV. PARTIES BOUND

6. This Agreement shall apply to and be binding upon the applicant, its officers, secretaries, principals, employees, agents, successors, subsidiaries, and assigns and upon WVDEP, its employees, agents and successors. The signatories to this Agreement certify that they are fully authorized to execute and legally bind the parties they represent. No change in ownership, corporate, or partnership status of the applicant shall in any way alter its status or responsibilities under this Agreement unless the applicant or WVDEP withdraws from this Program as provide herein.

7. The applicant shall provide a copy of this Agreement to any subsequent owners or successors before ownership rights are transferred. The applicant shall provide a copy of this Agreement to all contractors, subcontractors, laboratories, and consultants which are retained to conduct any work performed under this Agreement, within fourteen (14) days after the effective date of this Agreement or within fourteen (14) days of the date of retaining their services.

V. DEFINITIONS

8. "Day" or "calendar day" means the 24-hour period between 12:00 A.M. - 12:00 A.M.

9. "No further action" means a site is eligible to receive a Certificate of Completion on the basis of site assessment sampling or sampling data developed under a Voluntary Remediation Agreement which demonstrates that the site meets applicable standards.

10. "Rules" mean those rules adopted by the Secretary of the Department of Environmental Protection pursuant to the Voluntary Remediation and Redevelopment Act, and promulgated at 60 CSR 3 as the Voluntary Remediation and Redevelopment Rule.

11. "Site" shall be used in the manner as defined by W.Va. Code §22-22-2(dd) and for purposes of this Agreement means the property located in _____, West Virginia, and is more particularly described in the Application for Participating in the Voluntary Remediation Program attached and incorporated herein as Exhibit "A". [OPTIONAL LANGUAGE – Submitted to WVDEP and accepted by letter dated , 200 .]

12. All other terms contained in this Agreement shall be used in the manner as defined by W.Va. Code §22-22-2 or the Rules.

VI. STATEMENT OF PURPOSE

13. This Agreement sets forth necessary terms and conditions to satisfy the requirements of the Act for the investigation and remediation of the Site.

14. The activities conducted by the applicant under this Agreement are subject to approval by WVDEP as provided herein. Applicant shall provide all necessary information for

the Site. The activities conducted by the applicant shall be consistent with this Agreement, all applicable laws and regulations and any appropriate guidance documents.

VII. WORK TO BE PERFORMED

15. All work to be performed by the applicant pursuant to this Agreement shall be under the direction and supervision of a licensed remediation specialist. The licensed remediation specialist may be designated by applicant as applicant's project manager pursuant to Paragraph 33. Prior to the initiation of Site work, the applicant shall notify WVDEP, in writing, regarding the name and title of the licensed remediation specialist, if different from the licensed remediation specialist designated in the application, and of any contractors and/or subcontractors to be used in carrying out the terms of this Agreement.

16. Applicant shall submit a Voluntary Remediation Work Plan which when implemented provides for the attainment of the applicable standard specified in Paragraph 18 of this Agreement.

(OPTIONAL LANGUAGE-If applicable)

Prior to the filing of the application and prior to the execution of this Agreement, applicant has undertaken work at the site. The following documents have been accepted and approved by the licensed remediation specialist in support of the requirements of the Act for the investigation and remediation of the site:

[List of documents and reports submitted]

(OPTIONAL LANGUAGE-If applicable)

For the purposes of remediation and preparing Final Reports the Site may be divided into separate areas, and different human health and ecological remediation standards; e.g., De Minimis, Uniform Risk-Based, Site-Specific Risk-Based, may be utilized for these individual areas. Applicant currently contemplates that the Site will be subdivided into the following areas:

[Description of the subdivided areas]

17. The Voluntary Remediation Work Plans submitted with this Agreement includes the following:

[List by Site or Subdivided Areas, if applicable]

18. The parties agree that the applicable standard for this Site, consistent with Section 9 of the rule, is as follows:

[Insert applicable standard and, where applicable, engineering or institutional controls for this site, as agreed upon by the Parties.]

[List by Site or Subdivided Areas, if applicable]

[OPTIONAL LANGUAGE-If applicable]

The parties agree that the applicable standard(s) for this Site will be determined upon approval of the work plan(s) and report(s) described in Paragraph 20 of this Agreement. The parties agree that the future determination of standard(s) will be described in a modification to the Agreement.

19. The statutes and regulations for which compliance is mandated in connection with the investigation or remediation of this Site are as follows:

[Insert appropriate list of statutes and rules.]

[OPTIONAL LANGUAGE-If applicable]

(a) Air Pollution Control Act, W.Va. Code §§ 22-5-1 et seq.;
(b) Water Pollution Control Act, W. Va. Code §§ 22-11-1 et seq.;
(c) Groundwater Protection Act, W. Va. Code §§ 22-12-1 et seq.;
(d) Hazardous Waste Management Act, W. Va. Code §§ 22-18-1 et seq;
(e) Section 103(a) of Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C.A. §§ 9603(a)
(f) Section 304 of Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C.A. §§ 11001 to 11050;
(g) Occupational Safety & Health Act, 29 U.S.C.A. §§ 651 to 678;
(h) Resource Conservation and Recovery Act, as amended, et. seq., 42 U.S.C.A. §§ 6901, et seq.; and
(i) Toxic Substances Control Act, 15 U.S.C.A. §§ 2601, et seq.;
and any applicable regulation promulgated thereunder.

VIII. SUBMITTAL AND APPROVAL OF WORK PLANS OR REPORTS

20. The applicant shall submit the following work plans or reports in accordance with the schedule provided in this Agreement:

[List of work plans and/or reports to be submitted]

[OPTIONAL LANGUAGE - If Applicable]

When additional work plans or reports are planned as a follow-up to initial activities, the applicant shall submit the subsequent work plans, reports (including final reports), and schedules in accordance with a modification to this Agreement.

21. The Secretary may, based upon accuracy, quality, and completeness, either approve or disapprove a work plan or report submitted by applicant.

22. If the Secretary disapproves a work plan or report, the Secretary must, within 5 days

of its disapproval, notify the applicant in writing that its work plan or report has been disapproved. Such written notice shall include a list specifying the reasons that the work plan or report was disapproved, and shall specify all additional information needed for the work plan or report to obtain approval.

23. If the Secretary disapproves a work plan or report as submitted, the applicant must resubmit the work plan or report or terminate this Agreement as provided in Paragraph 74.

24. The Secretary shall either approve or disapprove all work plans and reports within 30 days of receipt [shorter period may be specified]. Any such action taken on a work plan or report must be confirmed in writing and received by the applicant within the 30-day period [may be shorter period specified]. An extension of time for approval or disapproval of work plans or reports may be mutually agreed to by and between the applicant and the Secretary. If an extension of time is mutually agreed to by the Secretary and applicant, it must be confirmed in writing.

25. After work plans or reports are submitted, the Secretary shall approve or disapprove the resubmitted work plans or reports within thirty (30) days of receipt, or within such shorter period specified in the party's voluntary remediation agreement. Any action taken on resubmitted work plans or reports must be confirmed in writing and received by the applicant within the thirty (30)-day period for acting on a resubmitted application, or within such shorter time specified in the party's voluntary remediation agreement. An extension of time or action on resubmitted work plans or reports may be mutually agreed to between the applicant and the Secretary. If an extension of time is mutually agreed to by the Secretary and the applicant, it must be confirmed in writing. If resubmitted work plans or reports are not approved by the Secretary, then the Secretary and the applicant may mutually agree, in writing, to a schedule for additional review of the resubmitted work plans or reports.

26. If work plans or reports are not approved or disapproved within 30 days of receipt by the Secretary [shorter time may be specified], or if resubmitted work plans or reports are not approved or disapproved within 30 days of receipt by the Secretary [shorter time may be specified], then the work plans or reports will be deemed approved unless such work plans or reports are determined to be materially inaccurate.

27. Notice. Any notice required to be given under the provisions of this section must be in writing and sent via United States certified mail [alternate method may be specified]. Notice is complete upon receipt.

28. If the applicant desires to proceed with the implementation of the approved work plan, the applicant must notify the Secretary in writing not more than 90 days after the work plan is approved. After providing such notice, the applicant shall initiate the work detailed in the Voluntary Remediation Work Plan according to the schedule as set forth in the Secretary's Notice of Approval. Upon the Secretary's receipt of notice that the applicant intends to proceed, the fully approved Voluntary Remediation Work Plan shall be deemed incorporated into and

made an enforceable part of this Agreement.

29. Upon completion of the work contemplated by all work plans, the applicant shall submit to the Secretary the final report prepared by the licensed remediation specialist. The final report shall include all information necessary to verify that all work contemplated by the work plan has been completed and all information required by the rules.

[OPTIONAL SECTION - IX. PUBLIC NOTIFICATION/INVOLVEMENT]

30. [For brownfield applicants, insert provision requiring compliance with approved Public Involvement Plan, where appropriate].

IX. ADDRESSES FOR ALL CORRESPONDENCE

31. Documents, including reports, approvals, notifications, disapprovals, and other correspondence, to be submitted under this Agreement, may be sent by certified U. S. mail, return receipt requested, hand delivery, overnight mail or by courier service to the following addresses or to such addresses as the applicant or WVDEP may designate in writing.

Documents to be submitted to WVDEP should be sent to:
[Insert name of Project Manager]

West Virginia Department of Environmental Protection
Division of Land Restoration
601 57th Street
Charleston, WV 25304

Phone No. (304) 926-0455

Documents to be submitted to the applicant should be sent to:

_____

_____

_____

Attn:_____

Phone No. _____

XI. COMPLIANCE WITH APPLICABLE LAWS

32. All work undertaken by the applicant pursuant to this Agreement shall be performed in compliance with all applicable federal, state and local laws, ordinances and regulations, including, but not limited to, all Occupational Safety and Health Administration, Department of Transportation and Resource Conservation and Recovery Act regulations. The applicant shall be responsible for obtaining all permits which are necessary for the performance of any work hereunder.

33. Completion of the work performed in accordance with this Agreement shall satisfy all applicable remediation requirements of Chapter 22 of the West Virginia Code, including the following: the Surface Coal Mining and Reclamation Act, W. Va. Code §22-3-1 et seq.; the Air Pollution Control Act, W. Va. Code §22-5-1 et seq.; the Water Pollution Control Act, W. Va. Code §22-11-1 et seq.; the Groundwater Protection Act, W. Va. Code §22-12-1 et seq.; the Solid Waste Management Act, W. Va. Code §22-15-1 et seq.; the Underground Storage Tank Act, W. Va. Code §22-17-1 et seq.; and the Hazardous Waste Management Act, W. Va. Code §22-18-1 et seq.

XII. PROJECT MANAGER/LICENSED REMEDIATION SPECIALIST

34. The WVDEP Project Manager for the Site is identified in Paragraph 30 of this Agreement. The applicant has designated (insert name of LRS) as the applicant's Licensed Remediation Specialist (LRS) and [OPTIONAL – Insert name as] Project Manager for the Site. The licensed remediation specialist shall be responsible for the supervision of all activities under this Agreement. The WVDEP project manager will be the WVDEP designated representative at the Site. To the maximum extent possible, communications between the applicant and WVDEP and all documents (including reports, approvals, and other correspondence) concerning the activities performed pursuant to the terms and conditions of this Agreement shall be directed through the project managers. During the implementation of this Agreement, the project managers shall, whenever possible, operate by consensus and shall attempt in good faith to resolve disputes informally through discussion of the issues. Each party has the right to change its respective project manager or licensed remediation specialist and shall notify the other party of such change within seventy-two (72) hours.

35. The absence of the applicant's or WVDEP's project manager or licensed remediation specialist from the Site shall not be cause for the stoppage of work. The applicant's project manager or licensed remediation specialist or his supervisor or licensed remediation specialists shall reasonably be available by telephone while work is being performed. The applicant shall designate a person to be in charge who will be available on-site when field work is being performed.

XIII. QUALITY ASSURANCE

36. The applicant shall use quality assurance, quality control, and chain of custody procedures in accordance with the Quality Assurance Project Plan approved for use by WVDEP throughout any work plan sample collection and analysis activities under this Agreement, unless

WVDEP agrees otherwise.

37. Applicant shall provide the WVDEP project manager with reasonable advance notice of all sampling and analysis as detailed in the work plan. To provide quality assurance and maintain quality control, the applicant shall:

a) Use laboratories certified by WVDEP;

b) Ensure that all sampling and analyses are performed according to US EPA methods, the approved Quality Assurance Project Plan, or other methods deemed satisfactory by WVDEP; and

c) Ensure that any laboratories used by the applicant for analyses participate in a documented Quality Assurance/Quality Control program that complies with US EPA guidance documents. As part of such a program, and upon request by WVDEP, such laboratories shall perform analyses of samples provided by WVDEP to demonstrate the quality of analytical data for each such laboratory.

[OPTIONAL LANGUAGE - If applicable]

The applicant may use a mobile laboratory (if it is certified by WVDEP) with the advance written approval of the WVDEP Project Manager.

38. In the event any laboratory fails to perform the activities required above, WVDEP reserves the right to reject any data not gathered pursuant to the requirements listed above, and to require that the applicant utilize a different laboratory.

XIV. SAMPLING AND DATA/DOCUMENT AVAILABILITY

39. The applicant shall, upon request, make the results of all sampling, including raw data and/or tests or other data generated by the applicant, or on the applicant's behalf, available to WVDEP. WVDEP shall make available to the applicant the quality-assured results of sampling and/or tests or other data similarly generated by WVDEP.

40. At the request of WVDEP, the applicant shall permit an authorized representative of WVDEP to take samples of wastes, soils, air surface water and groundwater at the Site. For each sample taken, the authorized representative shall provide the applicant a receipt describing the sample obtained and, if requested, a portion of each sample equal in weight or volume to the portion retained.

XV. ACCESS

41. To the extent that the Site or other areas where work is performed hereunder is presently owned or controlled by parties other than those bound by this Agreement, the applicant

shall obtain, or use its best efforts to obtain, access agreements from the present owners. Best efforts shall include, at a minimum, a certified letter from the applicant to the present owner of such property requesting access agreements to permit the applicant or any authorized representative of the WVDEP access to such property. Such agreement shall provide access for authorized representatives of the WVDEP as specified below. In the event such access agreements are not obtained, the applicant shall so notify the WVDEP, which may then, at its discretion, assist the applicant in gaining access.

42. Upon presentation of proper credentials, authorized representatives of the WVDEP shall be provided access by the applicant to the Site and other areas where work is to be performed under this Agreement at all reasonable times. Such access shall be related solely to the work being performed on the Site and shall include, but not be limited to: inspecting records, operating logs and contracts related to the Site; reviewing the progress of the applicant in carrying out the terms of this Agreement; conducting such tests, inspections and sampling as WVDEP may deem necessary consistent with this Agreement. The applicant shall permit WVDEP's authorized representatives to inspect and copy all records, files, photographs, documents and other writings, including all sampling and monitoring data, which pertain to this Agreement over which the applicant exercises control. All persons with access to the Site pursuant to this Agreement shall comply with any applicable the health and safety plans.

43. Nothing herein shall be construed as restricting the inspection or access authority of WVDEP under any law or regulation.

XVI. RECORD PRESERVATION

44. The applicant agrees to preserve, during the pendency of this Agreement, and for a minimum of three years after its termination, all documents required by this Agreement and any other documents generated or used to prepare the documents required by this Agreement. Upon request by WVDEP, the applicant shall make available to WVDEP such records, or copies of any such records.

45. The applicant may assert a confidentiality claim for any information submitted pursuant to this Agreement on the grounds that such information, or parts thereof, if made public would divulge methods, processes, or activities entitled to protection as trade secrets. If no such confidentiality claim accompanies the information when it is submitted to the WVDEP, it may be made available to the public by WVDEP without further notice to the applicant. The applicant agrees not to assert any confidentiality claim with regard to any physical or analytical data regarding environmental conditions at the Site.

XVII. DISPUTE RESOLUTION

46. The parties shall use their best efforts to, in good faith, resolve all disputes or differences of opinion informally. The period of informal resolution shall not exceed thirty (30) days from the time that either party commences informal resolution by verbally citing the dispute

with reference to this paragraph to the other party, unless the parties agree otherwise in writing. If, however, the parties are unable to resolve the dispute informally, the applicant may present written notices of such dispute to WVDEP and set forth specific points of dispute and the position of the applicant. This written notice shall be submitted no later than 10 calendar days after the expiration of the informal dispute resolution period. The applicant's project manager will notify the WVDEP project manager immediately by phone or other appropriate methods of communication, prior to written notice, when she/he believes that the parties are unable to resolve a dispute. If either party requests, within 14 days receipt of written notice of the dispute by WVDEP, disputes will be submitted to a mutually-approved impartial third party for non-binding mediation.

47. After the parties have attempted in good faith to resolve disputes pursuant to the terms of Paragraph 46, any unresolved disputes arising out of or relating to this agreement, or the breach thereof, shall be settled by binding arbitration and judgment on the arbitrator's decision may be entered in any court having jurisdiction. The applicant shall notify WVDEP in writing of any unresolved disputes which they believe require arbitration. Within 5 days, the parties shall agree to an arbitrator. If the parties fail to agree to an arbitrator, the arbitration shall be administered by the American Arbitration Association. In selecting a mediator or arbitrator, the parties shall attempt to select persons with experience in environmental matters, including but not limited to a licensed remediation specialist.

48. The applicant shall make a written submission in support of its position to the agreed arbitrator within 10 days of the arbitrator's selection, and the other party may make a written response in support of its position within 7 days thereafter. Upon notice to the parties, the arbitrator may request additional information or make specific inquiry of either party. Within 30 days of the written response under this paragraph, the arbitrator shall render a decision on the dispute and notify each of the parties of the decision. The applicant agrees to pay for the services of any mediator and arbitrator used by the parties in attempting to resolve disputes arising out of or relating to this agreement. Each party shall pay its own legal fees in conducting mediation or arbitration.

49. Until the dispute is resolved, any actions concerning that element of work in dispute shall be halted. The resolution of the dispute shall be incorporated into the work plan and made an enforceable part thereof. The time schedule for the work in dispute shall be extended by the amount of time needed for resolution. Elements of work and/or obligations not affected by the dispute shall be completed in accordance with the schedule contained in the work plan.

50. Elements of work and any actions required as a result of such dispute resolution shall immediately be incorporated, if necessary, into the appropriate plan or procedure, and into this Agreement. The applicant shall proceed with all remaining work according to the modified plan or procedure.

XVIII. FORCE MAJEURE

51. The applicant shall cause all work or required reporting to be performed within the

time limits set forth herein, unless performance is delayed by events which constitute a force majeure. "Force Majeure" shall mean conditions or circumstances beyond the reasonable control of applicant which could not have been overcome by due diligence and shall include, without limitation, acts of God, action or inaction of other governmental agencies, or administrative or judicial tribunals or other third parties, or strikes or labor disputes (provided, however, applicant shall not be required to concede to any labor demands), which prevent or delay applicant from complying with the work plan.

52. The applicant shall notify WVDEP by telephone within three (3) working days and by writing no later than seven (7) working days after any event, which the applicant contends is a Force Majeure. Such notification shall describe the anticipated length of the delay, the cause or causes of the delay, the measures taken or to be taken by the applicant to minimize the delay, and the timetable by which these measures will be implemented. The applicant shall have the burden of demonstrating that the event is a Force Majeure. The decision of whether an event is a Force Majeure shall be made by the Secretary, or the Secretary's designate. The decision shall be immediately communicated to the applicant.

53. If a delay is attributable to a Force Majeure, the time period for performance under this Agreement shall be extended, in writing, by the amount of time that is attributable to the event constituting the Force Majeure.

XIX. RESERVATION OF RIGHTS

54. WVDEP and applicant reserve all rights and defenses they may have pursuant to any available authority unless expressly waived herein.

55. Nothing herein is intended to release, discharge, or in any way affect any claims, causes of actions or demands in law or equity which the parties may have against any person, firm, partnership or corporation, not a party to this Agreement for any liability it may have arising out of or relating in any way to, the generation, storage, treatment, handling, transportation, release or disposal of any materials, hazardous substances, hazardous waste, contaminants, or pollutants at, to, or from the Site. The parties to this Agreement expressly reserve all rights, claims, demands, and causes of action they have against any and all other persons and entities who are not parties to this Agreement, and as to each other for matters not covered hereby.

56. The applicant reserves the right to seek contribution, indemnity, or any other available remedy against any persons found to be responsible or liable for contributions, indemnity, or otherwise for any amounts which have been or will be expended by the applicant in connection with the Site.

57. The WVDEP reserves the right to bring an action, including an administrative action, against the applicant for any violation of statutes or regulations except for the specific violations or releases that are being remediated in the work plan.

58. The WVDEP reserves the right to withdraw its approval of the work plan at any time during the implementation of the work plan if:

a) WVDEP determines that the applicant has failed to substantially comply with the terms and conditions of this Agreement or the work plan;

b) The applicant declines to implement the work plan after being notified of its approval by the WVDEP; or

c) WVDEP determines that a hazardous substance or petroleum has become an imminent or substantial threat to human health or the environment.

Upon WVDEP's withdrawal of its approval, this Agreement shall be terminated and WVDEP reserves the right to bring any action to enforce any statute or regulation under Chapter 22 of the West Virginia Code, including an action regarding the violations or releases that were the subject of this Agreement.

59. The WVDEP acknowledges that, pursuant to W. Va. Code §22-22-18, applicant, upon receipt of the Certificate of Completion, is not liable for claims for contribution concerning matters addressed in the Voluntary Remediation Agreement or any related work plan.

XX. ADMINISTRATIVE COSTS

60. Applicant agrees to reimburse WVDEP for all of its reasonable administrative costs associated with implementation of this Agreement at the rate of 2.5 times the hourly rate of the primary employee assigned to the site plus the actual and direct expenses of such employee. Within 60 calendar days of the approval of the work plan, WVDEP shall send the applicant an itemized list of estimated in-house costs that WVDEP expects to incur under this Agreement. The applicant agrees that a reasonable estimate of WVDEP contractor costs will be provided as described in the following paragraph. Itemization will be in standard WVDEP format. The estimated costs may include the preparation of the itemized list of administrative costs. Upon request, the applicant shall have the right to examine any documentation in WVDEP's possession used to develop the itemized list of costs. Requests for such documentation shall be made in writing and must be received by WVDEP within two (2) weeks from the date the applicant receives the estimate of costs.

61. WVDEP agrees to allow the applicant to review and comment on the scope of work and associated cost estimates for outside contractors prior to WVDEP's authorization of the said contractor to proceed with the associated work. WVDEP will strive where possible to use cost effective and qualified outside contractor(s). "Outside contractors" are defined as individuals, partnerships or corporations paid by WVDEP to assist in the oversight of the activities under this agreement (e.g., risk assessment), but shall not include WVDEP employees. Cost estimates and invoices from outside contractors shall be submitted to the applicant within two (2) weeks from

the date the WVDEP receives the cost estimate or invoice. The applicant shall raise any and all objections regarding cost estimates or invoiced work to the WVDEP within two (2) weeks from the date the applicant receives the forwarded estimates/invoice(s) from the WVDEP or within two (2) weeks of the receipt by the applicant of any back-up documentation of the said cost estimates/invoices which is contained in WVDEP files and requested by the applicant, whichever shall last occur. Notwithstanding any other provision of this Agreement, the process for the review of and objection to any cost estimates pursuant to this paragraph may extend the period otherwise provided in this Agreement for the WVDEP review of the submitted work plan or report by no more than an additional 30 days.

62. Applicant shall pay these costs in accordance with the following provisions. The $_____ application fee shall be credited against the first accounting. WVDEP shall periodically send an accounting of contractor, subcontractor and laboratory costs to applicant. Said accounting shall itemize all costs incurred by WVDEP for the previous calendar quarter. Applicant shall pay said amount within _____ days of receipt of the accounting. WVDEP shall also periodically send an accounting of WVDEP's primary employee time charged to this site to applicant. Applicant shall pay said amount within ____ days of receipt of the accounting.

63. Checks should be made payable to the Voluntary Remediation Fund and mailed along with a transmittal letter stating the site name and address to the West Virginia Department of Environmental Protection: Attention: Director, Division of Land Restoration, Charleston, West Virginia. In addition, a copy of the check and transmittal letter should be mailed to the WVDEP project manager.

XXI. NOTICE OF BANKRUPTCY

64. As soon as applicant has knowledge of its intention to file bankruptcy or no later than 7 days prior to the actual filing of a voluntary or involuntary bankruptcy petition, applicant shall notify WVDEP of its intention to file a bankruptcy petition.

XII. INDEMNIFICATION

65. The applicant agrees to indemnify and save and hold the State of West Virginia, its agencies, departments, agents, and employees, harmless from and all claims or causes of action arising from, or on account of, acts or omissions of the applicant, its officers, employees, receivers, trustees, agents, or assigns, in carrying out the activities pursuant to this Agreement.

XXIII. EFFECTIVE DATE AND SUBSEQUENT MODIFICATION

66. The effective date of this Agreement shall be the date on which the applicant receives the notice that this Agreement has been signed by the Secretary of WVDEP.

67. This Agreement may be amended by mutual agreement of WVDEP and the applicant. Amendments shall be in writing and shall be effective when the applicant receives

notice that the amendment has been signed by the Secretary of WVDEP.

68. If the Secretary determines that there is an imminent threat to the public, he or she may unilaterally modify or amend this Agreement.

XXIV. EXTENSIONS OF TIME PERIODS

69. Any written response shall be deemed timely performed if hand delivered or postmarked by the last day of any time period prescribed herein. Whenever a party has the right or is required to do some act or make some response within a prescribed period after the service of a notice or other paper on him and the notice or paper is served upon him by United States mail, three (3) days shall be added to the prescribed period.

70. Whenever any party is called upon to respond or otherwise act in a certain number of days, and if the final day occurs on a Saturday, Sunday or legal holiday (whether state or national), such time limitation shall automatically extend to the next business day after such Saturday, Sunday, or holiday.

71. Any time periods specified in this Agreement may be extended only by agreement of the parties.

XXV. TERMINATION AND SATISFACTION

72. Upon completion of the final report prepared by the LRS, the applicant may seek a Certificate of Completion from the Secretary. Upon receipt of a request for a Certificate of Completion, the Secretary shall determine that the site meets applicable standards for those areas of the site and for those contaminants identified in the voluntary remediation agreement and that the applicant has complied with the voluntary remediation agreement and any approved work plans for the site. Upon making this determination, the Secretary shall issue a Certificate of Completion which conforms substantially to Appendix 60-3C of the rules. Where a land use covenant is required by this Agreement, such Certificate of Completion shall not become effective until it is properly filed with the Clerk of the County Commission of the county in which the property is located.

If the Secretary determines that the certificate should not be issued because work required by this Agreement and any approved work plans has not been completed or because the site does not meet applicable standards, the Secretary shall initiate the procedures relating to denial of a certificate as provided in the rules.

73. The provisions of this Agreement shall be satisfied and this Agreement shall terminate when the Secretary issues the Certificate of Completion.

74. Nothing in this Agreement shall restrict the State of West Virginia from seeking other appropriate relief to protect human health or the environment from pollution or contamination at or from this Site not remediated in accordance with this Agreement.

75. Applicant may, in its sole discretion, terminate this Agreement by providing to the Secretary fifteen (15) days advance written notice of termination. Only those costs incurred or obligated by the Secretary before the notice of termination is received are recoverable if the Agreement is terminated. If the applicant terminates this Agreement, then the applicant shall pay WVDEP's costs associated with the voluntary remediation within 31 days after receiving notice that the costs are due and owing.

XXVI. [IF APPLICABLE] LAND USE COVENANTS

76. [Insert provisions describing restrictions on future use of property and attach copy of land use covenant that is to be recorded for the site].

XXVII. REOPENER

77. Upon agreement of the parties or upon occurrence of one or more conditions of W. Va. Code §22-22-15, this Agreement may be reopened in accordance with W. Va. Code §22-22-15 and the rules implementing that section.

XXVIII. PRECEDENCE OF AGREEMENT

78. In the event that conflict arises among the terms and conditions of this Agreement, the State of Work, or the approved work plan, this Agreement shall govern and the terms and conditions hereunder shall determine the parties' rights and responsibilities.

XXIX. GOVERNING LAW

79. This Agreement will be governed by the laws of the State of West Virginia.

_____ (Applicant)

Printed Name:_____

Title: _____

Date: _____

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

By: _____

Title: _____

Date: _____

[Include if applicant is not owner of the site and Agreement calls for a land use covenant:

_____, as owner of the site referenced in the above Agreement hereby acknowledges that said Agreement requires the imposition of a land use covenant and, in consideration of the benefits accruing to the site from said Agreement, I hereby agree to the imposition of such land use covenant and agree to cooperate in the execution and filing of such land use covenant.

_____ _____

Owner Date

APPENDIX 60-3C

STATE OF WEST VIRGINIA
VOLUNTARY REMEDIATION PROGRAM
CERTIFICATE OF COMPLETION AND COVENANT

[Applicant] entered into a Voluntary Remediation Agreement with the Secretary of the Department of Environmental Protection, dated _____ ("Agreement"). The Agreement was entered into to address the release of any contaminants at _____("Site") located at _____, in _____ District, _____ County, West Virginia. The following documents are incorporated as a part of this Certificate and Covenant:

- The application dated _____ and the site assessment submitted with the application
- The Agreement dated _____
- A map depicting the site (See Exhibit A)
- A list of the contaminants for which the remediation standards specified in the Agreement have been met (See Exhibit B)
- The final report submitted for the site dated _____, issued by a licensed remediation specialist.
- [If applicable] A description of any institutional or engineering controls that were used to achieve a remediation standard (See Exhibit C)
- [If applicable] The land use covenant that is to be recorded for this site (See Exhibit D).

This Certificate of Completion is issued pursuant to W.Va. Code §22-22-13 to [Applicant] in recognition of the completion of the work required under the Agreement.

Pursuant to W. Va. Code §22-22-7(f), 22-22-13, 22-22-14, and 22-22-18, the Secretary of the West Virginia Department of Environmental Protection (hereinafter, "WVDEP"), in the name of and on behalf of the State of West Virginia, now covenants not to bring any civil, criminal or administrative action or claim, resulting from or based upon the release or threatened release of contaminants that were the subject of the Voluntary Remediation Agreement. This covenant shall bar actions against [applicant], [applicant]'s successors and assigns, and those persons identified in W. Va. Code §22-22-18, from all public and private claims arising under Chapter 22 of the West Virginia Code or rules adopted thereunder in connection with the release or threatened release that was the subject of the Voluntary Remediation Agreement. This covenant shall not apply to [applicant]'s predecessors in title.

CONDITIONS

This Certificate and the covenant it contains are subject to the terms and conditions set forth below: 1. The following conditions, contained in W.Va. Code §22-22-15, which may cause the Voluntary Remediation Agreement to be reopened:

a) fraud was committed in demonstrating attainment of a standard at the site that resulted in avoiding the need for further remediation of the site;

b) new information confirms the existence of an area of previously unknown contamination which contains contaminants that have been shown to exceed the standards applied to the previous remediation at the site;

c) the level of risk is increased significantly beyond the established level of protection at the site due to substantial changes in exposure conditions, such as, a change in land use, or new information is obtained about a contaminant associated with the site which revises exposure assumptions beyond the acceptable range. This condition applies only where the level of risk is increased by a factor of at least five or the hazard index exceeds 1, or 10 where multiple systemic toxicants do not affect the same organ;

d) the release occurred after the effective date of this Article on a site not used for industrial activity prior to the effective date of this Article; the remedy relied, in

whole or in part, upon institutional or engineering controls instead of treatment or removal of contamination; and treatment, removal or destruction has become technically and economically practicable; or

e) the remediation method failed to meet the remediation standard or combination of standards.

For purposes of this paragraph, "new information" means any information obtained directly or indirectly by the department from any person after issuance of a Certificate of Completion, but does not include information the department has received in the application for participation in the voluntary remediation program, including any site assessment, [optional: during the execution of the voluntary remediation agreement or any work plan developed under such an agreement] or other information available to the department under the voluntary remediation program prior to the execution of the Certificate of Completion. Information that does not qualify as new information may be considered by the Secretary along with new information if necessary, to determine whether any of the conditions for reopening set out in section 16 of this rule, have occurred.

Where one of the foregoing conditions is found to exist for a portion but not all of the site, this certificate and covenant shall continue to apply to all portions of the site that were unaffected by the occurrence of that condition.

2. To the extent that the Agreement or any of the documents referenced in this certificate impose obligations that continue after the execution of this certificate, there shall be continued compliance with such obligations.

3. This certificate and covenant do not preclude the State of West Virginia from taking any unilateral action at the site, under any existing or future statutory authority, to protect human health and the environment; provided however, in no event shall the State have a right of recovery against [applicant] or any other person to whom the covenant herein applies to the extent that such right of recovery arises under Chapter 22 of the West Virginia Code, and relates

to matters covered by the Agreement.

4. This certificate and covenant do not preclude the State from seeking recovery of such sums as the [applicant] has agreed to pay the WVDEP under the Agreement.

WHEREFORE, the Secretary of the Department of Environmental Protection, on behalf of the State of West Virginia, issues this certificate and covenant, with all aforementioned privileges, responsibilities, conditions and reservations, this date of _____, to [applicant].

Secretary, Department of Environmental Protection

APPENDIX 60-3D

LAND USE COVENANT

This is an environmental covenant executed pursuant to the Voluntary Remediation and Redevelopment Act, West Virginia Code Chapter 22, Article22, and the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B, to restrict the activities on, and uses of, the following described property:

[Insert legally sufficient description of the real property subject to the covenant. If the description is longer than one page, it may be included as an attachment.]

Activities on and uses of the above describe property that may result in excessive human exposure or in the release of a contaminant that was contained as part of the remedial action related to this covenant are prohibited. Those activities and uses include, but are not limited to:

[Insert list of prohibited activities]

The current owners of record of the property, and their contact information, are:

[Insert identity and address of all owners of record]

Any person, including a person that owns an interest in the real property, the state or federal agency determining or approving the environmental response project pursuant to which an environmental covenant is created, or a municipality or other unit of local government may be a holder of an environmental covenant. The following are all of the holders of this covenant:

[Insert identity and address of all holders]

The facts regarding the remediation response project at this property are: *[Provide a brief narrative description of the contamination and remedy, including the contaminants of concern, the pathways of exposure, limits on exposure and the location and extent of the contamination and state whether residential or non-residential exposure assumptions were used to comply with a site-specific remediation standard.]*

The owner(s) of the property shall provide written notice to the Secretary of the Department of Environmental Protection within 10 days following transfer of a specified interest in the property subject to this covenant, changes in use of the property, application for building permits regarding the property, or proposals for any site work affecting the contamination on the property.

The *[owner(s) or applicant(s)]* shall conduct inspections of the property to monitor compliance with this Land Use Covenant at least __ *[insert number]*time*[s]* per year, and shall submit two (2)

signed copies of the inspection monitoring report to the WVDEP, DLR headquarters in Charleston, within thirty (30) days of the inspection.

This covenant relieves the applicant and subsequent successors and assigns from all civil liability to the state as provided under West Virginia Code Article 22 of Chapter 22 and shall remain in effect so long as the property complies with the applicable standards in effect at the time this covenant was issued.

This covenant shall not be amended, modified or terminated except by written instrument executed by and between the Owner at the time of the proposed amendment, modification or termination, and the Secretary of the West Virginia Department of Environmental Protection, or his successor in accordance with regulations promulgated by the Secretary or his successor. Within 5 days of executing an amendment, modification or termination of this Land Use Covenant, the Owner shall record such amendment, modification or termination with the Clerk of the [County] Commission, and within 5 days thereafter, the Owner shall provide a true copy of the recorded amendment, modification or termination to the Secretary of the Department of Environmental Protection.

The administrative record for the environmental response project reflected in this covenant is maintained in the *[insert the name and address of the appropriate agency office]* and is entitled *[insert title of administrative record]*.

The West Virginia Department of Environmental Protection is granted full right of access to the property for the purpose of implementation or enforcement of this covenant.

All restrictions and other requirements described in this covenant shall run with the land and shall be binding upon all holders and their grantees, lessees, authorized agents, employees or persons acting under their direction or control.

IN WITNESS WHEREOF, the following holders have executed this covenant on the dates indicated.

SIGNED: Date:

I, _____, a Notary Public in and for the County of _____, State of _____, do hereby certify that the holder(s) whose (name is) (names are) signed above, this day executed this document in my presence or this day acknowledged same to be the true act and deed of said holder(s).

Given under my hand this the _____ day of _____, 20____.

Notary Public

[The document must contain the notarized signature(s) of the agency, every holder and, unless waived by the agency, every owner of the fee simple of the real property subject to the covenant.]
[Repeat the Signature and Notary materials as many times as needed. If several holders sign before the same Notary, their signatures may be listed together and only one Notarization, referring to all such holders, will be needed for those signatures.]
[This covenant, and any amendment or termination of this covenant, must be recorded in every county in which any portion of the real property subject to the covenant is located. For purposes of indexing, a holder shall be treated as a grantee.]

TABLE 60-3A

LICENSED REMEDIATION SPECIALIST FEES

APPLICATION FEE -	**$300.00**
BIENNIAL RENEWAL FEE -	**$200.00**
EXAMINATION FEE -	**$250.00**

60CSR3

TABLE 60–3B

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)		Industrial Soil[1,4] (mg/kg)		Ground Water[2,4] (ug/L)		to Groundwater[3,4] (mg/kg)
Acetaldehyde	75-07-0	1.1E+01	c	1.6E+02	nc	1.7E+00	c	8.3E-03
Acetochlor	34256-82-1	1.2E+03	nc	1.8E+04	nc	7.3E+02	nc	8.1E+00
Acetone	67-64-1	1.4E+04	nc	5.6E+04	nc	5.5E+03	nc	2.2E+01
Acetonitrile	75-05-8	6.2E+02	nc	2.0E+03	nc	1.2E+02	nc	5.7E-01
Acetophenone	98-86-2	4.1E+03	nc	2.5E+04	nc	6.1E+02	nc	3.2E+00
Acrolein	107-02-8	1.0E-01	nc	3.4E-01	nc	4.2E-02	nc	2.0E-04
Acrylamide	79-06-1	1.1E-01	c	5.5E+00	c	1.5E-02	c	7.5E-05
Acrylonitrile	107-13-1	2.1E-01	c	5.2E+00	c	3.9E-02	c	1.6E-04
Alachlor	15972-60-8	6.0E+00	c	3.1E+02	c	2.0E+00	gws	1.7E-02
Alar	1596-84-5	9.2E+03	nc	1.3E+05	nc	5.5E+03	nc	2.4E+01
Aldicarb	116-06-3	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	2.1E-01
Aldicarb sulfone	1646-88-4	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	1.5E-01
Aldrin	309-00-2	2.9E-02	c	1.5E+00	c	4.0E-03	c	3.9E-01
Aluminum	7429-90-5	7.5E+04	nc	1.0E+06	max	3.7E+04	nc	1.1E+06
4-Aminopyridine	504-24-5	1.2E+00	nc	1.8E+01	nc	7.3E-01	nc	4.2E-03
Aniline	62-53-3	8.5E+01	c	4.3E+03	c	1.2E+01	c	1.4E-01
Antimony and compounds	7440-36-0	3.1E+01	nc	8.2E+02	nc	6.0E+00	gws	5.4E+00
Antimony trioxide	1309-64-4	3.1E+01	nc	8.2E+02	nc	1.5E+01	nc	
Arsenic	7440-38-2	3.9E-01	c	2.7E+01	c	1.0E+01	gws	5.8E+00
Assure	76578-14-8	5.5E+02	nc	7.9E+03	nc	3.3E+02	nc	7.3E+01
Atrazine	1912-24-9	2.2E+00	c	1.1E+02	c	3.0E+00	gws	8.6E-02
Azobenzene	103-33-3	3.7E+00	c	1.5E+02	c	1.0E-01	c	5.9E-03
Barium and compounds	7440-39-3	1.5E+04	nc	2.9E+05	nc	2.0E+03	gws	1.6E+03
Baygon	114-26-1	2.4E+02	nc	3.5E+03	nc	1.5E+02	nc	8.4E-01
Baythroid	68359-37-5	1.5E+03	nc	2.2E+04	nc	9.1E+02	nc	6.5E+03
Bentazon	25057-89-0	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	6.0E+00
Benzaldehyde	100-52-7	1.7E+03	Csat	1.7E+03	Csat	6.1E+02	nc	3.2E+00
Benzene	71-43-2	6.6E-01	c	1.5E+01	c	5.0E+00	gws	3.4E-02
Benzidine	92-87-5	2.1E-03	c	1.1E-01	c	2.9E-04	c	3.3E-05
Benzoic acid	65-85-0	2.4E+05	nc	1.0E+06	max	1.5E+05	nc	5.9E+02
Benzyl alcohol	100-51-6	3.1E+04	nc	4.4E+05	nc	1.8E+04	nc	1.5E+02
Benzyl chloride	100-44-7	8.9E-01	c	2.3E+01	c	6.6E-02	c	4.0E-04
Beryllium and compounds	7440-41-7	1.5E+02	nc	3.7E+03	nc	4.0E+00	gws	6.3E+01
1,1-Biphenyl	92-52-4	3.0E+03	nc	3.0E+04	nc	3.0E+02	nc	9.6E+01
Bis(2-chloroethyl)ether	111-44-4	2.1E-01	c	6.0E+00	c	8.0E+01	gws	5.6E-01
Bis(2-chloroisopropyl)ether	108-60-1	2.9E+00	c	8.1E+01	c	2.7E-01	c	1.8E-03
Bis(chloromethyl)ether	542-88-1	1.9E-04	c	4.4E-03	c	5.2E-05	c	2.1E-07
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	3.5E+01	c	1.8E+03	c	6.0E+00	gws	3.6E+03
Bromodichloromethane	75-27-4	1.0E+00	c	2.4E+01	c	1.8E-01	c	1.5E-03
Bromoform (tribromomethane)	75-25-2	6.1E+01	c	3.1E+03	c	8.5E+00	c	6.4E-02
Bromomethane	74-83-9	3.9E+00	nc	1.3E+01	nc	8.7E+00	nc	4.2E-02
Bromophos	2104-96-3	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	1.5E+01
1,3-Butadiene	106-99-0	5.9E-02	c	1.3E+00	c	1.2E-01	c	2.6E-03

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
1-Butanol	71-36-3	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	1.6E+01
Butylate	2008-41-5	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	5.2E+01
n-Butylbenzene	104-51-8	8.2E+01	Csat	8.2E+01	Csat	6.1E+01	nc	7.2E+00
sec-Butylbenzene	135-9-88	7.8E+01	Csat	7.8E+01	Csat	6.1E+01	nc	5.6E+00
tert-Butylbenzene	98-06-6	1.3E+02	nc	1.4E+02	Csat	6.1E+01	nc	5.5E+00
Butyl benzyl phthalate	85-68-7	1.2E+04	nc	1.8E+05	nc	7.3E+03	nc	1.7E+04
Cadmium and compounds	7440-43-9	3.9E+01	nc	1.0E+03	nc	5.0E+00	gws	7.5E+00
Caprolactam	105-60-2	3.1E+04	nc	4.4E+05	nc	1.8E+04	nc	1.1E+02
Carbaryl	63-25-2	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	3.0E+01
Carbazole	86-74-8	2.4E+01	c	1.2E+03	c	3.4E+00	c	4.7E-01
Carbon disulfide	75-15-0	3.6E+02	nc	4.7E+02	Csat	1.0E+03	nc	8.3E+00
Carbon tetrachloride	56-23-5	2.4E-01	c	5.3E+00	c	5.0E+00	gws	6.1E-02
Carbosulfan	55285-14-8	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	2.2E+02
Chloranil	118-75-2	1.2E+00	c	6.1E+01	c	1.7E-01	c	7.4E-04
Chlordane (Technical)	12789-03-6	1.6E+00	c	1.1E+02	c	2.0E+00	gws	9.6E+00
Chloroacetic acid	79-11-8	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	3.0E-01
4-Chloroaniline	106-47-8	2.4E+02	nc	3.5E+03	nc	1.5E+02	nc	9.7E-01
Chlorobenzene	108-90-7	1.3E+02	nc	3.1E+02	Csat	1.0E+02	gws	1.3E+00
Chlorobenzilate	510-15-6	1.8E+00	c	9.1E+01	c	2.5E-01	c	2.7E-02
p-Chlorobenzoic acid	74-11-3	1.2E+04	nc	1.8E+05	nc	7.3E+03	nc	3.6E+01
2-Chloro-1,3-butadiene	126-99-8	3.6E+00	nc	1.2E+01	nc	1.4E+01	nc	1.2E-01
1-Chlorobutane	109-69-3	7.1E+01	nc	2.4E+02	nc	2.4E+02	nc	2.0E+00
Chloroethane	75-00-3	3.0E+00	c	6.5E+01	c	3.9E+00	c	2.1E-02
Chloroform	67-66-3	2.5E-01	c	5.2E+00	c	1.7E-01	c	1.1E-03
Chloromethane	74-87-3	4.8E+01	nc	1.6E+02	nc	1.9E+02	nc	1.3E+00
4-Chloro-2-methylaniline	95-69-2	8.4E-01	c	4.3E+01	c	1.2E-01	c	1.0E-03
beta-Chloronaphthalene	91-58-7	3.9E+03	nc	2.7E+04	nc	4.9E+02	nc	3.2E+01
o-Chloronitrobenzene	88-73-3	1.4E+00	nc	4.5E+00	nc	1.5E-01	nc	9.6E-04
p-Chloronitrobenzene	100-00-5	1.0E+01	nc	3.8E+01	nc	1.2E+00	nc	7.9E-03
2-Chlorophenol	95-57-8	6.4E+01	nc	2.4E+02	nc	3.0E+01	nc	6.1E-01
2-Chloropropane	75-29-6	1.8E+02	nc	6.0E+02	nc	2.1E+02	nc	1.3E+00
o-Chlorotoluene	95-49-8	1.6E+02	nc	2.5E+02	Csat	1.2E+02	nc	1.3E+00
Chlorpyrifos	2921-88-2	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	6.3E+01
Chlorpyrifos-methyl	5598-13-0	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	3.1E+01
Chromium III	16065-83-1	1.2E+05	nc	1.0E+06	max	5.5E+04	nc	2.0E+09
Chromium VI	18540-29-9	2.1E+02	c	4.5E+03	c	1.1E+02	nc	4.2E+01
Cobalt	7440-48-4	9.0E+02	c	1.9E+04	c	7.3E+02	nc	6.6E+02
Copper and compounds	7440-50-8	3.1E+03	nc	8.2E+04	nc	1.5E+03	nc	1.0E+03
Crotonaldehyde	123-73-9	5.3E-03	c	1.1E-01	c	5.9E-03	c	3.2E-04
Cyanazine	21725-46-2	5.8E-01	c	2.9E+01	c	8.0E-02	c	5.3E-04
Cyanide and compounds	74-90-8	1.1E+01	nc	3.5E+01	nc	2.0E+02	gws	4.0E+01
Cyanogen	460-19-5	2.3E+03	Csat	2.3E+03	Csat	1.5E+03	nc	7.9E+00
Cyanogen bromide	506-68-3	7.0E+03	nc	1.8E+05	nc	3.3E+03	nc	1.8E+01
Cyclohexane	110-82-7	6.8E+01	Csat	6.8E+01	Csat	1.2E+04	nc	3.1E+02

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Cyclohexanone	108-94-1	3.1E+05	nc	1.0E+06	max	1.8E+05	nc	1.2E+03
Cyhalothrin/Karate	68085-85-8	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	3.5E+03
Cypermethrin	52315-07-8	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	1.6E+03
Dacthal	1861-32-1	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	5.6E+00
Dalapon	75-99-0	1.8E+03	nc	2.6E+04	nc	2.0E+02	gws	1.3E+00
DDD	72-54-8	2.4E+00	c	1.7E+02	c	2.8E-01	c	1.1E+01
DDE	72-55-9	1.7E+00	c	1.2E+02	c	2.0E-01	c	3.5E+01
DDT	50-29-3	1.7E+00	c	1.2E+02	c	2.0E-01	c	2.1E+01
Diazinon	333-41-5	5.5E+01	nc	7.9E+02	nc	3.3E+01	nc	4.3E-01
Dibenzofuran	132-64-9	7.8E+01	nc	2.0E+03	nc	3.7E+01	nc	1.1E+01
1,4-Dibromobenzene	106-37-6	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	7.8E+00
Dibromochloromethane	124-48-1	7.6E+00	c	6.8E+02	c	8.0E-01	c	1.8E-02
1,2-Dibromo-3-chloropropane	96-12-8	8.0E-01	c	7.1E+01	c	2.0E-01	gws	1.0E-03
1,2-Dibromoethane	106-93-4	2.7E-02	c	6.2E-01	c	5.0E-02	gws	2.6E-04
Dibutyl phthalate	84-74-2	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	5.0E+03
Dicamba	1918-00-9	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	4.5E+00
1,2-Dichlorobenzene	95-50-1	1.5E+02	Csat	1.5E+02	Csat	6.0E+02	gws	1.2E+01
1,3-Dichlorobenzene	541-73-1	3.5E+01	nc	1.3E+02	nc	6.0E+02	gws	1.2E+01
1,4-Dichlorobenzene	106-46-7	2.0E+00	c	4.5E+01	c	7.5E+01	gws	2.2E+00
3,3-Dichlorobenzidine	91-94-1	1.1E+00	c	5.5E+01	c	1.5E-01	c	4.9E-03
1,4-Dichloro-2-butene	764-41-0	7.9E-03	c	1.8E-01	c	1.2E-03	c	7.2E-06
Dichlorodifluoromethane	75-71-8	9.4E+01	nc	1.9E+02	Csat	3.9E+02	nc	5.3E+00
1,1-Dichloroethane	75-34-3	6.1E+02	nc	1.6E+03	Csat	9.1E+02	nc	5.9E+00
1,2-Dichloroethane	107-06-2	3.5E-01	c	7.7E+00	c	5.0E+00	gws	2.8E-02
1,1-Dichloroethylene	75-35-4	1.3E+02	nc	4.3E+02	nc	7.0E+00	gws	5.9E-02
1,2-Dichloroethylene (cis)	156-59-2	4.3E+01	nc	1.5E+02	nc	7.0E+01	gws	4.0E-01
1,2-Dichloroethylene (trans)	156-60-5	5.4E+01	nc	1.8E+02	nc	1.0E+02	gws	6.2E-01
2,4-Dichlorophenol	120-83-2	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	1.1E+00
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	4.9E+02	nc	7.0E+03	nc	2.9E+02	nc	2.3E+00
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	6.9E+02	nc	1.2E+04	nc	7.0E+01	gws	1.7E+00
1,2-Dichloropropane	78-87-5	6.4E-01	c	1.4E+01	c	5.0E+00	gws	3.0E-02
1,3-Dichloropropene	542-75-6	7.0E-01	c	1.6E+01	c	4.0E-01	c	2.5E-03
2,3-Dichloropropanol	616-23-9	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	4.6E-01
Dichlorvos	62-73-7	1.7E+00	c	8.5E+01	c	2.3E-01	c	1.1E-03
Dicofol	115-32-2	1.1E+00	c	5.6E+01	c	1.5E-01	c	1.9E-02
Dicyclopentadiene	77-73-6	1.9E+01	nc	6.2E+01	nc	1.4E+01	nc	3.8E-01
Dieldrin	60-57-1	3.0E-02	c	1.5E+00	c	4.2E-03	c	3.6E-03
Diethylene glycol, monobutyl ether	112-34-5	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	1.6E+00
Diethylene glycol, monoethyl ether	111-90-0	3.7E+03	nc	5.2E+04	nc	2.2E+03	nc	8.8E+00
Di(2-ethylhexyl)adipate	103-23-1	4.0E+02	c	2.1E+04	c	4.0E+02	gws	7.8E+02
Diethyl phthalate	84-66-2	4.9E+04	nc	7.0E+05	nc	2.9E+04	nc	4.5E+02
Diethylstilbestrol	56-53-1	1.0E-04	c	5.2E-03	c	1.4E-05	c	3.3E-04

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Difenzoquat (Avenge)	43222-48-6	4.9E+03	nc	7.0E+04	nc	2.9E+03	nc	1.4E+04
1,1-Difluoroethane	75-37-6	1.1E+03	Csat	1.1E+03	Csat	8.3E+04	nc	5.7E+02
Diisopropyl methylphosphonate	1445-75-6	3.9E+02	Csat	3.9E+02	Csat	2.9E+03	nc	1.5E+01
3,3'-Dimethoxybenzidine	119-90-4	3.5E+01	c	1.8E+03	c	4.8E+00	c	3.0E-01
Dimethylamine	124-40-3	7.9E-02	nc	2.6E-01	nc	4.2E-02	nc	1.7E-04
N-N-Dimethylaniline	121-69-7	4.4E+01	nc	2.0E+02	nc	1.2E+01	nc	8.6E-02
2,4-Dimethylaniline	95-68-1	6.5E-01	c	3.3E+01	c	9.0E-02	c	7.9E-04
2,4-Dimethylaniline hydrochloride	21436-96-4	8.4E-01	c	4.3E+01	c	1.2E-01	c	1.0E-03
3,3'-Dimethylbenzidine	119-93-7	2.1E-01	c	1.1E+01	c	2.9E-02	c	8.9E-03
2,4-Dimethylphenol	105-67-9	1.2E+03	nc	1.8E+04	nc	7.3E+02	nc	9.0E+00
2,6-Dimethylphenol	576-26-1	3.7E+01	nc	5.3E+02	nc	2.2E+01	nc	7.3E-01
3,4-Dimethylphenol	95-65-8	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	1.2E+00
Dimethyl phthalate	131-11-3	6.1E+05	nc	1.0E+06	max	3.7E+05	nc	2.0E+03
4,6-Dinitro-o-cyclohexyl phenol	131-89-5	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	4.1E+01
1,2-Dinitrobenzene	528-29-0	6.1E+00	nc	8.8E+01	nc	3.7E+00	nc	4.7E-02
1,3-Dinitrobenzene	99-65-0	6.1E+00	nc	8.8E+01	nc	3.7E+00	nc	3.7E-02
1,4-Dinitrobenzene	100-25-4	6.1E+00	nc	8.8E+01	nc	3.7E+00	nc	4.7E-02
2,4-Dinitrophenol	51-28-5	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	2.9E-01
Dinitrotoluene mixture	25321-14-6	7.1E-01	c	3.6E+01	c	9.9E-02	c	1.9E-03
2,4-Dinitrotoluene	121-14-2	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	5.7E-01
2,6-Dinitrotoluene	606-20-2	6.1E+01	nc	8.9E+02	nc	3.7E+01	nc	2.5E-01
Dinoseb	88-85-7	6.1E+01	nc	8.8E+02	nc	7.0E+00	gws	3.3E-02
1,4-Dioxane	123-91-1	4.4E+01	c	2.2E+03	c	6.1E+00	c	2.6E-02
Diphenylamine	122-39-4	1.5E+03	nc	2.2E+04	nc	9.1E+02	nc	2.5E+01
1,2-Diphenylhydrazine	122-66-7	6.1E-01	c	3.1E+01	c	8.4E-02	c	2.6E-03
Diquat	85-00-7	1.3E+02	nc	1.9E+03	nc	2.0E+01	gws	8.2E-02
Disulfoton	298-04-4	2.4E+00	nc	3.5E+01	nc	1.5E+00	nc	6.4E-02
1,4-Dithiane	505-29-3	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	3.9E+00
Diuron	330-54-1	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	1.2E+00
Endosulfan	115-29-7	3.7E+02	nc	5.3E+03	nc	2.2E+02	nc	2.0E+01
Endothall	145-73-3	1.2E+03	nc	1.8E+04	nc	1.0E+02	gws	4.4E-01
Endrin	72-20-8	1.8E+01	nc	2.6E+02	nc	2.0E+00	gws	9.9E-01
Epichlorohydrin	106-89-8	7.8E+00	nc	2.6E+01	nc	2.1E+00	nc	8.6E-03
Ethion	563-12-2	3.1E+01	nc	4.4E+02	nc	1.8E+01	nc	6.4E+00
2-Ethoxyethanol	110-80-5	2.4E+04	nc	3.5E+05	nc	1.5E+04	nc	6.5E+01
Ethyl acetate	141-78-6	1.9E+04	nc	2.6E+04	Csat	5.5E+03	nc	3.5E+01
Ethylbenzene	100-41-4	1.1E+02	Csat	1.1E+02	Csat	7.0E+02	gws	8.9E+00
Ethylene diamine	107-15-3	5.5E+03	nc	7.9E+04	nc	3.3E+03	nc	1.6E+01
Ethylene glycol	107-21-1	1.2E+05	nc	1.0E+06	max	7.3E+04	nc	3.0E+02
Ethylene glycol, monobutyl ether	111-76-2	3.1E+04	nc	4.4E+05	nc	1.8E+04	nc	7.4E+01
Ethylene thiourea (ETU)	96-45-7	4.4E+00	c	7.0E+01	nc	6.1E-01	c	2.6E-03
Ethyl ether	60-29-7	2.3E+03	Csat	2.3E+03	Csat	1.2E+03	nc	5.5E+00
Ethyl methacrylate	97-63-2	5.5E+01	Csat	5.5E+01	Csat	5.5E+02	nc	3.0E+01
Fenamiphos	22224-92-6	1.5E+01	nc	2.2E+02	nc	9.1E+00	nc	1.6E-01

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Fluometuron	2164-17-2	7.9E+02	nc	1.1E+04	nc	4.7E+02	nc	8.8E+00
Fluoride	7782-41-4	3.7E+03	nc	5.3E+04	nc	4.0E+03	gws	1.2E+04
Fomesafen	72178-02-0	2.6E+00	c	1.3E+02	c	3.5E-01	c	1.6E-01
Fonofos	944-22-9	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	3.5E+00
Formaldehyde	50-00-0	1.2E+04	nc	1.8E+05	nc	7.3E+03	nc	3.0E+01
Formic Acid	64-18-6	1.1E+05	nc	1.0E+06	max	7.3E+04	nc	2.9E+02
Furan	110-00-9	2.5E+00	nc	8.6E+00	nc	6.1E+00	nc	3.0E-02
Furazolidone	67-45-8	1.3E-01	c	6.5E+00	c	1.8E-02	c	6.6E-04
Furfural	98-01-1	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	4.6E-01
Glycidaldehyde	765-34-4	2.4E+01	nc	3.5E+02	nc	1.5E+01	nc	5.9E-02
Glyphosate	1071-83-6	6.1E+03	nc	8.8E+04	nc	7.0E+02	gws	1.0E+02
Heptachlor	76-44-8	1.1E-01	c	5.5E+00	c	4.0E-01	gws	2.3E+01
Heptachlor epoxide	1024-57-3	5.3E-02	c	2.7E+00	c	2.0E-01	gws	6.7E-01
Hexabromobenzene	87-82-1	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	1.0E+01
Hexachlorobenzene	118-74-1	3.0E-01	c	1.5E+01	c	1.0E+00	gws	2.2E+00
Hexachlorobutadiene	87-68-3	6.2E+00	c	3.2E+02	c	8.6E-01	c	1.9E+00
HCH (alpha)	319-84-6	9.0E-02	c	5.9E+00	c	1.1E-02	c	5.7E-04
HCH (beta)	319-85-7	3.2E-01	c	2.1E+01	c	3.7E-02	c	2.0E-03
HCH (gamma) Lindane	58-89-9	4.4E-01	c	2.9E+01	c	2.0E-01	gws	9.4E-03
HCH-technical	608-73-1	3.2E-01	c	2.1E+01	c	3.7E-02	c	5.2E-03
Hexachlorocyclopentadiene	77-47-4	3.7E+02	nc	5.2E+03	nc	5.0E+01	gws	4.0E+02
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	19408-74-3	7.8E-05	c	4.0E-03	c	1.1E-05	c	1.8E-04
Hexachloroethane	67-72-1	3.5E+01	c	8.8E+02	nc	4.8E+00	c	3.6E-01
Hexachlorophene	70-30-4	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	2.0E+03
1,6-Hexamethylene diisocyanate	822-06-0	1.7E+00	nc	5.5E+00	nc	2.1E-02	nc	5.0E-03
n-Hexane	110-54-3	4.3E+01	Csat	4.3E+01	Csat	1.5E+03	nc	7.0E+01
Hexazinone	51235-04-2	2.0E+03	nc	2.9E+04	nc	1.2E+03	nc	3.4E+01
HMX	2691-41-0	3.8E+03	nc	9.5E+04	nc	1.8E+03	nc	1.4E+02
Hydrazine	302-01-2	1.6E-01	c	8.2E+00	c	2.2E-02	c	9.1E-05
Hydrogen sulfide	7783-06-4	2.3E+02	nc	6.1E+03	nc	1.1E+02	nc	
p-Hydroquinone	123-31-9	8.7E+00	c	4.4E+02	c	1.2E+00	c	2.6E-02
Iron	7439-89-6	5.5E+04	nc	1.0E+06	max	2.6E+04	nc	1.3E+04
Isobutanol	78-83-1	1.3E+04	nc	2.7E+04	Csat	1.8E+03	nc	1.2E+01
Isophorone	78-59-1	5.1E+02	c	2.6E+04	c	7.1E+01	c	4.2E-01
Isopropalin	33820-53-0	9.2E+02	nc	1.3E+04	nc	5.5E+02	nc	1.5E+02
Isopropyl methyl phosphonic acid	1832-54-8	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	1.5E+01
Lead*	7439-92-1	4.0E+02	nc	1.0E+03	nc	1.5E+01	gws	2.7E+02
Lead (tetraethyl)	78-00-2	6.1E-03	nc	8.8E-02	nc	3.7E-03	nc	9.2E-04
Lithium	7439-93-2	1.6E+03	nc	4.1E+04	nc	7.3E+02	nc	4.4E+03
Malathion	121-75-5	1.2E+03	nc	1.8E+04	nc	7.3E+02	nc	8.1E+00
Maleic anhydride	108-31-6	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	1.5E+01
Manganese (non-food)	7439-96-5	3.3E+03	nc	4.8E+04	nc	1.7E+03	nc	2.2E+03
Mephosfolan	950-10-7	5.5E+00	nc	7.9E+01	nc	3.3E+00	nc	7.9E-02

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Mepiquat	24307-26-4	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	1.2E+01
Mercury, inorganic		2.3E+01	nc	6.1E+02	nc	2.0E+00	gws	2.1E+00
Mercury (methyl)	22967-92-6	6.1E+00	nc	8.8E+01	nc	3.7E+00	nc	
Methacrylonitrile	126-98-7	2.1E+00	nc	8.8E+00	nc	1.0E+00	nc	4.2E-03
Methanol	67-56-1	3.1E+04	nc	4.4E+05	nc	1.8E+04	nc	7.5E+01
Methidathion	950-37-8	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	1.6E-01
Methoxychlor	72-43-5	3.1E+02	nc	4.4E+03	nc	4.0E+01	gws	1.6E+02
Methyl acetate	79-20-9	2.2E+04	nc	9.6E+04	nc	6.1E+03	nc	2.5E+01
Methyl acrylate	96-33-3	7.0E+01	nc	1.6E+02	Csat	1.8E+02	nc	1.0E+01
Methyl Tertiary Butyl Ether (MTBE)	1634-04-4	1.5E+02	c	1.1E+04	Csat	1.7E+01	c	7.1E-02
2-Methylaniline (o-toluidine)	95-53-4	2.0E+00	c	1.0E+02	c	2.8E-01	c	5.7E-03
2-Methyl-4-chlorophenoxyacetic acid	94-74-6	3.1E+01	nc	4.4E+02	nc	1.8E+01	nc	9.4E-02
4-(2-Methyl-4-chlorophenoxy) butyric acid	94-81-5	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	2.9E+00
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	2.2E-01
Methylcyclohexane	108-87-2	8.5E+01	Csat	8.5E+01	Csat	6.3E+03	nc	7.6E+02
4,4'-Methylenebisbenzeneamine	101-77-9	1.9E+00	c	9.9E+01	c	2.7E-01	c	5.4E-02
4,4'-Methylene bis(2-chloroaniline)	101-14-4	4.9E+00	c	2.5E+02	c	6.7E-01	c	3.7E-01
4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1	1.1E+01	c	5.4E+02	c	1.5E+00	c	8.7E-01
Methylene bromide	74-95-3	6.7E+01	nc	2.4E+02	nc	6.1E+01	nc	3.1E-01
Methylene chloride	75-09-2	8.9E+00	c	2.1E+02	c	5.0E+00	gws	2.3E-02
4,4'-Methylenediphenyl isocyanate	101-68-8	3.5E+05	nc	1.0E+06	max			
Methyl ethyl ketone	78-93-3	2.2E+04	nc	5.6E+04	Csat	7.0E+03	nc	2.9E+01
Methyl isobutyl ketone	108-10-1	8.9E+03	Csat	8.9E+03	Csat	6.3E+03	nc	5.9E+01
Methyl methacrylate	80-62-6	2.2E+03	nc	3.4E+03	Csat	1.4E+03	nc	6.5E+00
2-Methyl-5-nitroaniline	99-55-8	1.5E+01	c	7.5E+02	c	2.0E+00	c	1.5E-02
Methyl parathion	298-00-0	1.5E+01	nc	2.2E+02	nc	9.1E+00	nc	8.5E-02
2-Methylphenol	95-48-7	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	1.4E+01
3-Methylphenol	108-39-4	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	3.9E+01
4-Methylphenol	106-44-5	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	3.9E+00
Methyl styrene (mixture)	25013-15-4	1.3E+02	nc	2.8E+02	Csat	6.0E+01	nc	1.1E+00
Methyl styrene (alpha)	98-83-9	2.8E+02	Csat	2.8E+02	Csat	4.3E+02	nc	7.9E+00
Metolaclor (Dual)	51218-45-2	9.2E+03	nc	1.3E+05	nc	5.5E+03	nc	8.6E+01
Metribuzin	21087-64-9	1.5E+03	nc	2.2E+04	nc	9.1E+02	nc	4.7E+01
Mirex	2385-85-5	2.7E-01	c	1.4E+01	c	3.7E-02	c	7.1E-01
Molybdenum	7439-98-7	3.9E+02	nc	1.0E+04	nc	1.8E+02	nc	7.4E+01
Monochloramine	10599-90-3	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	
Naled	300-76-5	1.2E+02	nc	1.8E+03	nc	7.3E+01	nc	5.7E-01
Nickel and compounds	7440-02-0	1.6E+03	nc	4.1E+04	nc	1.0E+02	gws	1.3E+02
Nitrate	14797-55-8	1.3E+05	nc	1.0E+06	max	1.0E+04	gws	

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Nitrite	14797-65-0	7.8E+03	nc	2.0E+05	nc	1.0E+03	gws	
2-Nitroaniline	88-74-4	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	5.6E-01
Nitrobenzene	98-95-3	2.0E+01	nc	1.1E+02	nc	3.4E+00	nc	2.2E-02
Nitrofurantoin	67-20-9	4.3E+03	nc	6.2E+04	nc	2.6E+03	nc	3.7E+01
Nitrofurazone	59-87-0	3.2E-01	c	1.6E+01	c	4.5E-02	c	8.5E-04
Nitroglycerin	55-63-0	6.1E+00	nc	8.8E+01	nc	3.7E+00	nc	3.4E-02
4-Nitrophenol	100-02-7	4.9E+02	nc	7.0E+03	nc	2.9E+02	nc	1.7E+00
2-Nitropropane	79-46-9	7.6E-03	c	1.8E-01	c	1.2E-03	c	5.7E-06
N-Nitrosodi-n-butylamine	924-16-3	2.4E-02	c	6.2E-01	c	2.0E-03	c	2.9E-05
N-Nitrosodiethanolamine	1116-54-7	1.7E-01	c	8.8E+00	c	2.4E-02	c	9.7E-05
N-Nitrosodiethylamine	55-18-5	3.2E-03	c	1.6E-01	c	4.5E-04	c	2.3E-06
N-Nitrosodimethylamine	62-75-9	9.5E-03	c	4.8E-01	c	1.3E-03	c	5.7E-06
N-Nitrosodiphenylamine	86-30-6	9.9E+01	c	5.0E+03	c	1.4E+01	c	7.6E-01
N-Nitroso di-n-propylamine	621-64-7	6.9E-02	c	3.5E+00	c	9.6E-03	c	4.8E-05
N-Nitroso-N-methylethylamine	10595-95-6	2.2E-02	c	1.1E+00	c	3.1E-03	c	2.1E-05
N-Nitrosopyrrolidine	930-55-2	2.3E-01	c	1.2E+01	c	3.2E-02	c	3.3E-04
m-Nitrotoluene	99-08-1	6.9E+02	Csat	6.9E+02	Csat	1.2E+02	nc	8.0E-01
o-Nitrotoluene	88-72-2	2.8E+00	c	2.5E+02	c	2.9E-01	c	1.9E-03
p-Nitrotoluene	99-99-0	4.0E+01	c	1.8E+03	nc	4.2E+00	c	2.8E-02
NuStar	85509-19-9	4.3E+01	nc	6.2E+02	nc	2.6E+01	nc	1.8E+03
Oryzalin	19044-88-3	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	9.6E+01
Oxadiazon	19666-30-9	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	2.6E+01
Oxamyl	23135-22-0	1.5E+03	nc	2.2E+04	nc	2.0E+02	gws	8.4E-01
Oxyfluorfen	42874-03-3	1.8E+02	nc	2.6E+03	nc	1.1E+02	nc	2.1E+02
Paraquat dichloride	1910-42-5	2.7E+02	nc	4.0E+03	nc	1.6E+02	nc	9.9E+00
Parathion	56-38-2	3.7E+02	nc	5.3E+03	nc	2.2E+02	nc	1.0E+01
Pentachlorobenzene	608-93-5	4.9E+01	nc	7.0E+02	nc	2.9E+01	nc	2.0E+01
Pentachloronitrobenzene	82-68-8	1.9E+00	c	9.5E+01	c	2.6E-01	c	8.3E-02
Pentachlorophenol	87-86-5	3.0E+00	c	1.1E+02	c	1.0E+00	gws	2.8E-02
Perchlorate	7790-98-9	5.5E+01	nc	1.4E+03	nc	2.6E+01	nc	
Permethrin	52645-53-1	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	2.4E+03
Phenol	108-95-2	1.8E+04	nc	2.6E+05	nc	1.1E+04	nc	5.6E+01
m-Phenylenediamine	108-45-2	3.7E+02	nc	5.3E+03	nc	2.2E+02	nc	1.5E+00
p-Phenylenediamine	106-50-3	1.2E+04	nc	1.7E+05	nc	6.9E+03	nc	4.8E+01
2-Phenylphenol	90-43-7	2.5E+02	c	1.3E+04	c	3.5E+01	c	1.4E+01
Phosphine	7803-51-2	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	
Phosphorus (white)	7723-14-0	1.6E+00	nc	4.1E+01	nc	7.3E-01	nc	5.4E-02
p-Phthalic acid	100-21-0	6.1E+04	nc	8.8E+05	nc	3.7E+04	nc	2.5E+02
Phthalic anhydride	85-44-9	1.2E+05	nc	1.0E+06	max	7.3E+04	nc	5.2E+02
Polybrominated biphenyls	59536-65-1	5.5E-02	c	2.8E+00	c	7.6E-03	c	
Polychlorinated biphenyls (PCBs)	1336-36-3	2.2E-01	c	1.0E+01	c	5.0E-01	gws	9.0E-01
Aroclor 1016	12674-11-2	3.9E+00	nc	5.0E+01	nc	9.6E-01	c	1.3E+00
Aroclor 1221	11104-28-2	2.2E-01	c	1.0E+01	c	5.6E-03	c	2.3E-03
Aroclor 1232	11141-16-5	2.2E-01	c	1.0E+01	c	5.6E-03	c	2.3E-03

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Aroclor 1242	53469-21-9	2.2E-01	c	1.0E+01	c	3.4E-02	c	4.5E-02
Aroclor 1248	12672-29-6	2.2E-01	c	1.0E+01	c	3.4E-02	c	5.9E-02
Aroclor 1254	11097-69-1	2.2E-01	c	1.0E+01	c	3.4E-02	c	2.7E-01
Aroclor 1260	11096-82-5	2.2E-01	c	1.0E+01	c	3.4E-02	c	3.9E-01
Polycyclic Aromatic Hydrocarbons (PAHs)								
Acenaphthene	83-32-9	3.7E+03	nc	3.8E+04	nc	3.7E+02	nc	7.3E+01
Acenaphthylene	208-96-8	3.8E+03	nc	4.4E+04	nc	3.7E+02	nc	9.1E+01
Anthracene	120-12-7	2.2E+04	nc	3.9E+05	nc	1.8E+03	nc	1.7E+03
Benz[a]anthracene	56-55-3	6.2E-01	c	2.9E+01	c	9.2E-02	c	1.5E+00
Benzo[b]fluoranthene	205-99-2	6.2E-01	c	2.9E+01	c	9.2E-02	c	4.5E+00
Benzo[k]fluoranthene	207-08-9	6.2E+00	c	2.9E+02	c	9.2E-01	c	4.5E+01
Benzo[g,h,i]perylene	191-24-2	1.7E+03	nc	2.3E+04	nc	1.1E+03	nc	1.2E+05
Benzo[a]pyrene	50-32-8	6.2E-02	c	2.9E+00	c	2.0E-01	gws	8.2E+00
Chrysene	218-01-9	6.2E+01	c	2.9E+03	c	9.2E+00	c	1.5E+02
Dibenz[ah]anthracene	53-70-3	6.2E-02	c	2.9E+00	c	9.2E-03	c	1.4E+00
Fluoranthene	206-44-0	2.3E+03	nc	3.0E+04	nc	1.5E+03	nc	6.3E+03
Fluorene	86-73-7	2.6E+03	nc	3.3E+04	nc	2.4E+02	nc	7.8E+01
Indeno[1,2,3-cd]pyrene	193-39-5	6.2E-01	c	2.9E+01	c	9.2E-02	c	1.3E+01
Naphthalene	91-20-3	5.6E+01	nc	1.9E+02	nc	6.2E+00	nc	3.2E-01
Phenanthrene	85-01-8	2.2E+04	nc	4.1E+05	nc	1.8E+03	nc	1.5E+03
Pyrene	129-00-0	2.3E+03	nc	5.4E+04	nc	1.8E+02	nc	5.0E+02
Prometon	1610-18-0	9.2E+02	nc	1.3E+04	nc	5.5E+02	nc	5.6E+00
Prometryn	7287-19-6	2.4E+02	nc	3.5E+03	nc	1.5E+02	nc	4.6E+00
Propachlor	1918-16-7	7.9E+02	nc	1.1E+04	nc	4.7E+02	nc	7.3E+00
Propanil	709-98-8	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	2.2E+00
Propargite	2312-35-8	1.2E+03	nc	1.8E+04	nc	7.3E+02	nc	4.0E+03
iso-Propylbenzene (Cumene)	98-82-8	1.6E+02	nc	2.9E+02	Csat	6.6E+02	nc	6.3E+01
n-Propylbenzene	103-65-1	7.8E+02	nc	2.0E+04	nc	3.7E+02	nc	4.3E+01
Propylene glycol	57-55-6	3.0E+04	nc	4.1E+05	nc	1.8E+04	nc	7.4E+01
Propylene glycol, monoethyl ether	111-35-3	4.3E+04	nc	6.2E+05	nc	2.6E+04	nc	1.0E+02
Propylene glycol, monomethyl ether	107-98-2	4.3E+04	nc	6.2E+05	nc	2.6E+04	nc	1.0E+02
Pursuit	81335-77-5	1.5E+04	nc	2.2E+05	nc	9.1E+03	nc	5.4E+02
Pyridine	110-86-1	6.1E+01	nc	8.8E+02	nc	3.7E+01	nc	1.9E-01
Quinoline	91-22-5	1.6E-01	c	8.2E+00	c	2.2E-02	c	1.7E-03
RDX (Cyclonite)	121-82-4	4.4E+00	c	2.2E+02	c	6.1E-01	c	7.2E-03
Resmethrin	10453-86-8	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	1.9E+04
Ronnel	299-84-3	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	1.5E+02
Rotenone	83-79-4	2.4E+02	nc	3.5E+03	nc	1.5E+02	nc	2.0E+03
Selenious Acid	7783-00-8	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	
Selenium	7782-49-2	3.9E+02	nc	1.0E+04	nc	5.0E+01	gws	5.2E+00
Silver and compounds	7440-22-4	3.9E+02	nc	1.0E+04	nc	1.8E+02	nc	3.1E+01
Simazine	122-34-9	4.0E+00	c	2.1E+02	c	4.0E+00	gws	2.4E-02

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
Sodium azide	26628-22-8	3.1E+02	nc	8.2E+03	nc	1.5E+02	nc	
Sodium diethyldithiocarbamate	148-18-5	1.8E+00	c	9.1E+01	c	2.5E-01	c	1.2E-03
Strontium, stable	7440-24-6	4.7E+04	nc	1.0E+06	max	2.2E+04	nc	1.5E+04
Strychnine	57-24-9	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	1.7E-01
Styrene	100-42-5	6.3E+02	Csat	6.3E+02	Csat	1.0E+02	gws	4.1E+00
2,3,7,8-Tetrachlorodibenzodioxin (TCDD/dioxin)	1746-01-6	3.9E-06	c	2.7E-04	c	5.0E-06	gws	9.6E-05
1,2,4,5-Tetrachlorobenzene	95-94-3	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	6.6E-01
1,1,1,2-Tetrachloroethane	630-20-6	3.0E+00	c	7.1E+01	c	4.3E-01	c	3.1E-03
1,1,2,2-Tetrachloroethane	79-34-5	3.8E-01	c	9.0E+00	c	5.5E-02	c	4.0E-04
Tetrachloroethylene (PCE)	127-18-4	5.6E-01	c	1.9E+01	c	5.0E+00	gws	8.0E-02
2,3,4,6-Tetrachlorophenol	58-90-2	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	9.2E+01
p,a,a,a-Tetrachlorotoluene	5216-25-1	2.4E-02	c	1.2E+00	c	3.4E-03	c	2.7E-04
Tetrahydrofuran	109-99-9	9.3E+00	c	2.2E+02	c	1.6E+00	c	6.7E-03
Thallium and compounds	7440-28-0	6.3E+00	nc	1.6E+02	nc	2.0E+00	gws	2.8E+00
Thiobencarb	28249-77-6	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	4.1E+01
Thiocyanate	463-56-9	1.2E+01	nc	1.8E+02	nc	7.3E+00	nc	3.1E-02
Tin and compounds	7440-31-5	4.7E+04	nc	1.0E+06	max	2.2E+04	nc	1.1E+05
Toluene	108-88-3	2.6E+02	Csat	2.6E+02	Csat	1.0E+03	gws	1.0E+01
Toluene-2,4-diamine	95-80-7	1.5E-01	c	7.7E+00	c	2.1E-02	c	1.8E-04
Toluene-2,5-diamine	95-70-5	3.7E+04	nc	5.3E+05	nc	2.2E+04	nc	1.9E+02
Toluene-2,6-diamine	823-40-5	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	9.7E+00
p-Toluidine	106-49-0	2.6E+00	c	1.3E+02	c	3.5E-01	c	5.9E-03
Toxaphene	8001-35-2	4.4E-01	c	2.2E+01	c	3.0E+00	gws	3.1E+01
1,2,4-Tribromobenzene	615-54-3	3.1E+02	nc	4.4E+03	nc	1.8E+02	nc	6.0E+00
Tributyltin oxide (TBTO)	56-35-9	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	1.6E+04
2,4,6-Trichloroaniline	634-93-5	1.4E+01	c	7.3E+02	c	2.0E+00	c	2.4E-02
1,2,4-Trichlorobenzene	120-82-1	7.8E+02	nc	2.0E+04	nc	7.0E+01	gws	4.9E+00
1,1,1-Trichloroethane	71-55-6	7.1E+02	Csat	7.1E+02	Csat	2.0E+02	gws	2.1E+00
1,1,2-Trichloroethane	79-00-5	8.4E-01	c	1.9E+01	c	5.0E+00	gws	3.5E-02
Trichloroethylene (TCE)	79-01-6	4.3E-02	c	9.2E-01	c	5.0E+00	gws	4.3E-02
Trichlorofluoromethane	75-69-4	3.9E+02	nc	9.5E+02	Csat	1.3E+03	nc	2.2E+01
2,4,5-Trichlorophenol	95-95-4	6.1E+03	nc	8.8E+04	nc	3.7E+03	nc	2.5E+02
2,4,6-Trichlorophenol	88-06-2	4.4E+01	c	2.2E+03	c	6.1E+00	c	1.2E-01
2,4,5-Trichlorophenoxyacetic Acid	93-76-5	6.1E+02	nc	8.8E+03	nc	3.7E+02	nc	2.0E+00
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1	4.9E+02	nc	7.0E+03	nc	5.0E+01	gws	3.6E+00
1,1,2-Trichloropropane	598-77-6	1.5E+01	nc	5.1E+01	nc	3.0E+01	nc	2.5E-01
1,2,3-Trichloropropane	96-18-4	3.2E-01	c	1.1E+01	nc	3.4E-02	c	2.7E-04
1,2,3-Trichloropropene	96-19-5	7.1E-01	nc	2.3E+00	nc	2.2E+00	nc	1.7E-02
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	2.6E+03	Csat	2.6E+03	Csat	5.9E+04	nc	2.8E+03
1,2,4-Trimethylbenzene	95-63-6	5.2E+01	nc	1.7E+02	nc	1.2E+01	nc	1.9E+00
1,3,5-Trimethylbenzene	108-67-8	2.1E+01	nc	7.0E+01	nc	1.2E+01	nc	4.6E-01
Trimethyl phosphate	512-56-1	1.3E+01	c	6.7E+02	c	1.8E+00	c	7.8E-03

CONTAMINANT	CAS No.	Residential Soil[1,4] (mg/kg)	Value Basis[5]	Industrial Soil[1,4] (mg/kg)	Value Basis[5]	Ground Water[2,4] (ug/L)	Value Basis[5]	Migration to Groundwater[3,4] (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	1.8E+03	nc	2.6E+04	nc	1.1E+03	nc	5.2E+01
Trinitrophenylmethylnitramine (Tetryl)	479-45-8	2.4E+02	nc	3.5E+03	nc	1.5E+02	nc	1.3E+01
2,4,6-Trinitrotoluene	118-96-7	1.6E+01	c	4.4E+02	nc	2.2E+00	c	1.7E-01
Uranium (chemical toxicity only)	7440-61-1	1.6E+01	nc	4.1E+02	nc	7.3E+00	nc	
Vanadium and compounds	7440-62-2	7.8E+01	nc	2.0E+03	nc	3.7E+01	nc	7.3E+02
Vinclozolin	50471-44-8	1.5E+03	nc	2.2E+04	nc	9.1E+02	nc	1.4E+01
Vinyl acetate	108-05-4	4.3E+02	nc	1.4E+03	nc	4.1E+02	nc	1.8E+00
Vinyl bromide	593-60-2	1.9E-01	c	4.2E+00	c	1.0E-01	c	9.7E-04
Vinyl chloride (lifetime)	75-01-4	1.5E-01	c			2.0E+00	gws	1.3E-02
Vinyl chloride (adult)	75-01-4			8.8E+00	c	2.0E+00	gws	1.3E-02
Warfarin	81-81-2	1.8E+01	nc	2.6E+02	nc	1.1E+01	nc	4.4E-01
Xylenes	1330-20-7	1.0E+02	Csat	1.0E+02	Csat	1.0E+04	gws	1.2E+02
Zinc	7440-66-6	2.3E+04	nc	6.1E+05	nc	1.1E+04	nc	1.4E+04
Zinc phosphide	1314-84-7	2.3E+01	nc	6.1E+02	nc	1.1E+01	nc	
Zineb	12122-67-7	3.1E+03	nc	4.4E+04	nc	1.8E+03	nc	8.0E+00

Notes:

[1]The residential and industrial soil values consider ingestion and dermal exposure to soil and inhalation exposure to contaminants moving from soil to ambient air.

[2]Groundwater standards promulgated under 46CSR12 are provided, where available. Standards that are unavailable under 46CSR12 are based on a risk-based methodology that considers ingestion and inhalation exposure arising from the domestic use of groundwater.

[3]The migration from soil to groundwater values shall be applied unless it is shown to the satisfaction of the Secretary that migration of soil contaminants to groundwater will not result in an exceedance of the DeMinimis Groundwater Standards.

[4]The concentrations in this table shall be applied where the exposure pathways described in footnotes 1,2, and 3 are the major contributors to risks identified in the site assessment. If other exposure pathways are identified, the acceptable concentrations shall be determined only in consultation with the Secretary, considering all exposure pathways, and all other requirements of the regulations.

[5]Basis of standard: c – cancer effect; nc – noncancer effect; max – calculated risk-based concentration exceeds maximum possible contaminant level of $1x10^6$ mg/kg; Csat - calculated risk-based concentration exceeds residual saturation level; gws – West Virginia Groundwater Quality Standard from 46CSR12.

*Lead - Residential soil based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (July 1994), USEPA OSWER Directive 9355.4-12. Industrial soil based on the USEPA documents Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soils (December 1996) and Frequently Asked Questions (FAQs) on the Adult Lead Model (April 1999).

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Arsenic Cleanup Criteria for Soils in the US and Abroad: Comparing Guidelines and Understanding Inconsistencies

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Chapter 9

ARSENIC CLEANUP CRITERIA FOR SOILS IN THE US AND ABROAD: COMPARING GUIDELINES AND UNDERSTANDING INCONSISTENCIES

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ABSTRACT

Widely divergent cleanup targets, guidelines and standards for arsenic in soils have been established by many regulatory, scientific and advisory organizations in the past 25 years, both in the United States and in other countries. In contrast to many other substances, for which guidelines and standards are similar or identical among agencies, arsenic has provided a powerful study in just how many different ways a single issue can be viewed. This paper provides a detailed survey concerning the breadth of arsenic soil criteria that have been proposed and applied, and explores the basic differences in their derivation, which can be based upon toxicological properties, geological background levels, anthropogenic background contributions, and practical site-specific considerations. A broad comparison of extant values in common use for USEPA, individual states, and non-US entities will be presented, coupled with a discussion regarding common examples of the technical bases for arsenic soil cleanup guideline development. Arsenic target levels in many cases can dominate remedial considerations at sites where the applicable criteria are very stringent. Several case studies will be presented to illustrate the problems that are inherent in such variable criteria for this ubiquitous and extraordinarily common substance.

Keywords: Arsenic, soil, cleanup guidelines, criteria, risk, variability

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1. INTRODUCTION

Over the past few decades, arsenic has been increasingly examined and analyzed due to its toxicological properties, broad aspects of exposure potential, and historically inconsistent cleanup targets and guidelines. Arsenic is a metalloid found naturally at high concentrations in some soils that can not be destroyed by the environment; however, it can change form (e.g., organic to inorganic, altered valence states) or become attached to or separated from particles. Arsenic is a known human carcinogen at sufficient levels in water and air, but credible reports of soil-based health effects are quite limited. There are a variety of soil cleanup guidelines from the U.S. Environmental Protection Agency (USEPA), state agencies, and international agencies. The guidelines vary across about a 1000-fold range (0.039 to 40 mg/kg) in the U.S. alone. In this summary report, we present many of these guidelines, and explore the various foundations and supporting information on which the guidelines are predicated.

2. REVIEW OF ARSENIC SOIL CRITERIA IN THE U.S. AND ABROAD

2.1 United States

The USEPA Regional Screening Level (RSL) for soil arsenic under unrestricted use (e.g., residential) assumptions is 0.39 mg/kg (USEPA, 2009). This level is based on a target cancer risk of 1E-06, toxicological guidance values from the Integrated Risk Information System (IRIS), and standard assumptions for exposure assessment and risk assessment. As shown on Table 1, many of the individual state guidelines for residential soil are taken directly from, or calculated very similarly to, the USEPA RSL. However, some states use an alternative cancer risk level and/or different exposure assumptions, and many states take into consideration the presence of arsenic at significant concentrations in naturally occurring background soils. Section 3 presents details on the various derivations of selected guidelines that are presented in Table 1.

2.2 International

The international guidelines that were reviewed provide considerable grounds for additional in-depth research. As with the US guidelines, the international levels have diverse, and often unexplained, foundations, which result in widely varying concentrations. In general, however, the international guidelines are consistently

higher than the US numbers (5 mg/kg to 150 mg/kg for the selected countries that were reviewed; see Table 2).

3. ARSENIC SOIL CRITERIA: BASES & ASSUMPTIONS

3.1 Health Basis

The USEPA (2009) Regional Screening Levels (RSLs), as well as many state guidelines, are based on typical human exposure assessment assumptions (350 days/yr, 30 yr residence during a 70-yr lifetime, 100% relative bioavailability) and standard toxicological guidance values. The cancer target risk ranges from 1E-07 to 1E-04. At least 14 states (see Table 1) employ the USEPA RSL methodology and a 1E-06 cancer risk level, resulting in default guidelines that fall tightly between 0.38 mg/kg and 0.41 mg/kg. As noted later, that range is less than commonly encountered background soil arsenic levels in much of the country.

Whereas a systemic, or noncarcinogenic effects guideline typically is calculated as part of the process, it almost always is deferred based on using the lower of noncarcinogenic versus carcinogenic values. The exception is Texas, which uses a cancer risk level of 1E-04, resulting in a guideline of 34 mg/kg. The calculated noncancer guideline is 24 mg/kg, which thus becomes the state default Tier 1 Protective Concentration Level for residential exposure circumstances (TCEQ, 2009).

Recent information suggests that ongoing reassessment efforts by USEPA may further restrict the oral Cancer Slope Factor by as much as 15-20x, based on bladder and lung cancer studies. It should be noted that internal and external technical reviewers have rightly questioned such a dramatic reduction, noting that if those assumptions were correct we should be seeing an epidemic of bladder and lung cancer in the U.S., given that current drinking water guidelines are, and have been for decades, well above the new proposals in terms of ingested dose. The same can be said for the many countries outside the U.S. that have arsenic guidelines in drinking water and in soil that permit intakes that are considerably higher than the calculated health-based soil levels.

3.2 Ambient Background Basis

Many states use naturally occurring background soil arsenic levels as their default screening guidance. While these typically rely on geologic conditions, some jurisdictions also consider the possibility of historical anthropogenic contributions. The background concentrations found and reported herein range from 7 to 40 mg/kg. For Rhode Island, 7 mg/kg is the default guideline, based on

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Table 1. Selected state cleanup guidelines for arsenic in soil for residential/unrestricted use.

State	Guideline (*mg/kg*)	Basis
Wisconsin (WDNR, 2009)	0.039	Cancer (10^{-7} risk level), standard risk assessment assumptions and toxicological guidance values
California (CalEPA, 2005)	0.07	Cancer (10^{-6} risk level), 4% dermal absorption assumption, CalOEHHA Slope Factors
AL (ADEM, 2008), CO (CDPH, 2007), DE (DNREC, 2007), ID (IDEQ, 2004), LA (LDEQ, 2003), MD (MDE, 2008), MS (MSDEQ, 2002), NC (NCDENR, 2005), OK (OKDEQ, 2007), OR (ODEQ, 2005), VA (VDEQ, 2009), WV (WVDEP, 2009), WY (WDEQ, 2009)	0.38 to 0.41	Cancer (10^{-6} risk level), either direct cite to EPA, or state-specific calculation with standard risk assessment assumptions and toxicological guidance values
Maine (MDEP, 2009)	1.4	Cancer (10^{-5} risk level), CalOEHHA Slope Factors
Florida (FDEP, 2005)	2.1	Cancer (10^{-6} risk level), 33% oral bioavailability, state-specific exposure assumptions
New Mexico (NMED, 2009)	3.59	Cancer (10^{-5} risk level), standard risk assessment assumptions and toxicological guidance values
Indiana (IDEM, 2009)	3.9	Noncancer soil-plant-human uptake (based on USEPA soil screening guidance)
Ohio (OEPA, 2008)	6.7	Cancer (10^{-5} risk level), 3% dermal absorption assumption
AZ (ADEQ, 2002), IA (IDNR, 2004), KS (KDHE, 2007), KY (KEEC, 2004), MA (CMR, 2003), MN (MDEQ, 2005), MO (MRBCA, 2006), NH (NHDES, 2007), NJ (NJAC, 2008), NY (NYSDEC, 2006), PA (PDEP, 2001), RI (RIDEM, 1996), WA (WAC, 2007)	7 to 40	State-specific Natural Background
Texas (TCEQ, 2009)	24	Noncancer (lower than cancer endpoint at 10^{-4} risk; 34 mg/kg)

Table 2. Selected international cleanup guidelines for arsenic in soil for residential/unrestricted use.

Country	**Guideline** *(mg/kg)*	**Basis**
Finland (FME, 2007)	5	Threshold value based on background and groundwater protection; lower and upper guidance values for ecological endpoints are 50 and 100 mg/kg, respectively; human health-based values were less restrictive
Canada (CCME, 2007)	12	Soil Quality Guideline - lower of the human health SQG or eco SQG
UK (England, Northern Ireland, Wales; UKEA, 2009)	32	Derived from UK oral Index Dose for drinking water, based on oral and dermal exposure of a young child
Netherlands (NEAA, 2008)	76	Soil Intervention Value indicating severe contamination condition – based on 10^{-4} risk level
Australia (ANEPC, 1999)	100	Health-based Investigation Level based on protection of a 2.5 year old child exposed to 100 mg soil/day via oral, dermal and inhalation routes
Japan (JME, 2003)	150	General soil value; 15 mg/kg applies to rice fields

the upper limit of statewide natural background, and any detection above this level is initially assumed to be from a release of arsenic-containing material (RIDEM, 1996). Kentucky's guideline (9.4 mg/kg; KEEC, 2004) represents the 95% upper confidence limit of the mean ambient background, and Illinois (IEPA, 2007) employs the mean concentration of soil samples from non-metro counties (11.3 mg/kg). Additionally, based on ambient background, New Jersey (NJAC, 2008) uses a concentration of 19 mg/kg and Montana uses 40 mg/kg, based on the 95% UCL of 209 native soil samples (MDEQ, 2005). These guidelines are all derived from different aspects of the land including varied backgrounds and soil types, but clearly are independent of considerations regarding potential health effects. Again, given the widespread existence of elevated arsenic concentrations in soil, many of which are naturally occurring, the question has been raised regarding an apparent absence of arsenic-related adverse health effects in those states.

3.3 Alternative Basis

At least one state agency, Indiana (IDEM, 2009), bases their soil arsenic screening guideline on a soil-plant-human exposure pathway uptake estimation. The Residential Closure Level for direct exposure in Indiana is 3.9 mg/kg, and is calculated based on the USEPA (2006) Soil Screening Guidance for vegetable uptake.

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3.4 Bioavailability Considerations

The Florida Department of Environmental Protection (FDEP) commissioned the University of Florida to conduct a primate feeding study to determine the relative oral bioavailability of arsenic in several Florida-specific soils. Based on the results of that study (Roberts et al., 2001), the FDEP soil cleanup target levels for arsenic employ an oral bioavailability adjustment factor of 3x. On that basis, combined with other route-specific considerations, the Florida default direct exposure Soil Cleanup Target Level (SCTL) was adjusted from 0.8 mg/kg to 2.1 mg/kg for the cancer endpoint (FDEP, 2005). No other state agencies were identified which explicitly incorporate bioavailability of less than 100% in calculating state soil arsenic guidelines.

4. REGULATORY APPLICATION AND CHALLENGES

Due to arsenic's prevalence and long history of use, academic study, and regulation, it would seem that more wide-ranging consensus concerning health protective guidelines would exist in the regulatory community. The rather obvious, somewhat rhetorical, questions raised earlier regarding the lack of arsenic-related health effects, when ostensibly health-protective levels are exceeded on a routine basis, demonstrates the challenges that arsenic presents, particularly in soil and other non-drinking water exposures.

4.1 Case Studies

A relatively similar list of site types can be compiled across states, based on known industrial, commercial and recreational land uses. The following are selected examples of the categories of sites commonly identified where arsenic in soils can be a significant consideration.

Golf Courses - frequently have elevated soil levels due to historical arsenical herbicide/pesticide use. Site-specific risk-based protective levels are rarely exceeded when realistic exposures are considered (e.g., reduced frequency of exposure, exposure unit concentrations). Recent increases in reconfiguration and residential development of some golf courses has caused a recent focus on the issue.

Former Agricultural Properties - notable impacts from proper, legal, historical application of fertilizers. Can be financially and technically difficult to convert to residential use with sitewide exceedances of health-based criteria.

Railroad Rights of Way - common to find elevated soil arsenic due to historical arsenical herbicide use. Rails-to-trails conversions and other beneficial

use projects typically must demonstrate that risks are limited based on planned use and engineering controls (e.g., paving, fencing, mulching, ground cover maintenance).

Coastal and Mountain Properties - may show elevated background soil arsenic as a result of marine environments or local geologic formations. Costly characterization often is needed to prove natural occurrence.

4.2 Historical Perception

In addition to the beneficial applications and natural occurrence which result in enhanced presence of soil arsenic relating to the land uses discussed above, arsenic has a historical media presence that often overshadows the apparent limited risk that it may pose from direct soil exposures. Arsenic is a classic, archetypal poison at high levels, yet it also is an historical and ongoing medicinal agent, currently approved for treatment of very specific cancer conditions (relapsed or refractory APL). Furthermore, recent media and regulatory attention pertaining to tanning beds being deemed "equally as deadly as arsenic and mustard gas" produced unfortunate comparisons. This leaves the impression that arsenic, no matter the exposure medium or conditions, is deadly. Even under the exposure condition that is closest to that which forms the basis for the toxicological guidance values, that of drinking water ingestion, the protective level is not health-based. Rather, the present arsenic MCL (10 ug/L) is based on considerations of technical and feasibility limitations of drinking water supply systems, and is promulgated at a level considerably higher than if it were strictly health-based. Further, the immediate former MCL was 50 ug/L for approximately 50 years. Yet, there evidently is no related cancer epidemic to report.

5. DISCUSSION

While an abundance of caution should always be the rule when assessing risk, the evaluation of potential risk from exposure to arsenic in soil suffers greatly from a lack of consensus from the regulating and scientific community. There recently has been proposed a downward change to toxicity guidance that, if implemented, will lower health-based soil guidelines 15-20x. In Florida alone, this will once again result in guidelines that are below 1 ppm, a level that is not significantly different than natural background throughout much of that state, and indeed the nation. In the classic toxicologist's quote from Paracelsus nearly 500 years ago, the dose makes the poison. In the case of arsenic in soil, it is evident that what that dose may be, and its health significance, is open to interpretation, and theoretically ranges from less than 0.05 parts per million to well over 100 parts

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per million. The continued reliance on the jumble of guidelines that are either health-based, but inappropriate for most soil exposures, or that are based on natural background, with no acknowledgement of potential toxicity at all, does not serve the science of risk assessment or toxicology well.

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Federal Register

Friday,
January 5, 2001

Part III

Environmental Protection Agency

40 CFR Part 745
Lead; Identification of Dangerous Levels of Lead; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 745

[OPPTS–62156H; FRL–6763–5]

RIN 2070–AC63

Lead; Identification of Dangerous Levels of Lead

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA is issuing a final regulation under section 403 of the Toxic Substances Control Act (TSCA), as amended by the Residential Lead-Based Paint Hazard Reduction Act of 1992, also known as "Title X (ten)," to establish standards for lead-based paint hazards in most pre-1978 housing and child-occupied facilities. This regulation supports the implementation of regulations already promulgated, and others under development, which deal with worker training and certification, lead hazard disclosure in real estate transactions, requirements for lead cleanup under State authorities, lead hazard evaluation and control in Federally-owned housing prior to sale and housing receiving Federal assistance, and U.S. Department of Housing and Urban Development (HUD) grants to local jurisdictions to perform lead hazard control. In addition, today's action also establishes, under authority of TSCA section 402, residential lead dust cleanup levels and amendments to dust and soil sampling requirements and, under authority of TSCA section 404, amendments to State program authorization requirements. By supporting implementation of the major provisions of Title X and by providing guidance to all owners and occupants of pre-1978 housing and child-occupied facilities, this regulation will help to prevent lead poisoning in children under the age of 6.

DATES: This final rule is effective on March 6, 2001. This rule shall be promulgated for purposes of judicial review at 1 p.m. eastern daylight time on February 5, 2001.

FOR FURTHER INFORMATION CONTACT: *For general information contact*: Barbara Cunningham, Director, Office of Program Management and Evaluation, Office of Pollution Prevention and Toxics (7401), Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, DC 20460; telephone number: 202–554–1404; e-mail address: TSCA-Hotline@epa.gov.

For technical information contact: Dave Topping, National Program Chemicals Division (7404), Office of Pollution Prevention and Toxics, Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460; telephone number: (202) 260–7737; e-mail address: topping.dave@epa.gov.

SUPPLEMENTARY INFORMATION:

I. General Information

A. Does this Action Apply to Me?

You may be affected by this action if you must comply with other Title X regulations that are affected by today's action. The following table identifies potentially affected categories and entities:

Category	Examples of Entities	NAICS or SIC codes	Effect of Regulation
Lead abatement professionals	Workers, supervisors, inspectors, risk assessors, and project designers engaged in lead-based paint activities.	562910	Provides standards that risk assessors would use to identify hazards and evaluate clearance tests; helps determine when certified professionals would need to be employed to perform lead cleanup
Training providers	Firms providing training services in lead-based paint activities	611519	Provides standards that training providers would have to teach in their courses
Federal agencies that own residential property		92511, 92811	Standards identify hazards that Federal agencies or purchasers of Federal property would have to abate in pre 1960 housing prior to sale, under Title X, section 1013.
Property owners that receive assistance through Federal housing programs	State and city public housing authorities, owners of multifamily rental properties that receive project-based assistance, owners of rental properties that lease units under HUD's tenant-based assistance program	53110, 531311	Standards identify hazards that property owners would have to abate or reduce as specified by regulations issued by HUD under authority of Title X, section 1012
Property owners	Owner occupants, rental property owners, public housing authorities, Federal agencies	531110, 531311	Standards identify hazards that, when known, would have to be disclosed under EPA/HUD joint regulations promulgated under Title X, section 1018

This listing is not intended to be exhaustive, but rather provides a guide for entities likely to be affected by this action. Other types of entities not listed in the table in this unit could also be affected. To determine whether you or your business is affected by this action, you should carefully examine the applicability provisions in relevant regulations. If you have any questions regarding the applicability of this action to a particular entity, consult the technical person listed in the **FOR FURTHER INFORMATION CONTACT** section.

B. How Can I Get Additional Information, Including Copies of this Document or Other Related Documents?

1. *Electronically.* You may obtain electronic copies of this document, and certain other related documents that might be available electronically, by

going directly to the Internet Home Page for this regulation at http://www.epa.gov/lead/leadhaz.htm and selecting the desired document. You can also go directly to the **Federal Register** listings at http://www.epa.gov/fedrgstr/ to obtain a copy of this final rule.

2. *In person.* The Agency has established an official record for this action under docket control number OPPTS–62156. The official record consists of the documents specifically referenced in this action, any public comments received during the comment period, and other information related to this action. This official record includes the documents that are physically located in the docket, as well as the documents that are referenced in those documents. The public version of the official docket, which includes printed, paper versions of any electronic comments submitted during the comment period, is available for inspection in the TSCA Nonconfidential Information Center, North East Rm. B–607, Waterside Mall, 401 M St., SW., Washington, DC. The Center is open from noon to 4 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Center is (202) 260–7099.

II. Overview

A. Introduction

The Title X term "lead-based paint hazard" is intended to identify lead-based paint and all residential lead-containing dusts and soils regardless of the source of the lead, which, due to their condition and location, would result in adverse human health effects. One of the underlying principles of Title X is to move the focus of public and private sector decision makers away from the mere presence of lead-based paint, to the presence of lead-based paint hazards, for which more substantive action should be undertaken to control exposures, especially to young children. This regulation establishes hazard standards for residential lead-based paint, and residential dust and soil lead. The hazard standards for these three media, collectively, are statutorily defined as lead-based paint hazards.

B. Summary of Statutory Authority

The Residential Lead-Based Paint Hazard Reduction Act of 1992 was enacted as Title X of the Housing and Community Development Act of 1992. Title X establishes a comprehensive Federal program for reducing the risks from lead-based paint and certain lead hazards. The Title X program primarily gives authority to HUD and EPA, but affects a number of other Federal agencies. Among other things, Title X amended TSCA by adding TSCA Title IV, which specifically gives regulatory authority to EPA to cover, among other things, training of workers who deal with lead-based paint hazard abatement, the appropriate form of State and Tribal lead programs, and the identification of dangerous levels of lead. Title IV includes section 403. EPA is promulgating the standards for lead-based paint hazards under the authority of TSCA section 403, 15 U.S.C. 2683.

Section 403 requires EPA to promulgate regulations that "identify . . . lead-based paint hazards, lead-contaminated dust, and lead-contaminated soil" for purposes of the entire Title X. Lead-based paint hazards, under TSCA section 401 (15 U.S.C. 2681), are defined as conditions of lead-based paint and lead-contaminated dust and soil that "would result" in adverse human health effects (15 U.S.C. 2681(10)). Lead-based paint is defined by statute as paint with lead levels equal to or exceeding 1.0 milligrams per square centimeter (mg/cm^2) or 0.5% by weight (see section 302(c) of the Lead-Poisoning Prevention Act (42 U.S.C. 4822(c)) and TSCA section 401(9) (15 U.S.C. 2681(9)). TSCA section 401 defines lead-contaminated dust as "surface dust in residential dwellings" that contains lead in excess of levels determined "to pose a threat of adverse health effects" (15 U.S. C. 2681(11)). TSCA section 401 defines lead-contaminated soil as "bare soil on residential real property that contains lead at or in excess of levels determined to be hazardous to human health" (15 U.S.C. 2681(12)).

EPA is also promulgating amendments to the regulations for lead-based paint activities under the authority of TSCA section 402 (15 U.S.C. 2682) and to the State and Tribal program authorization requirements under authority of TSCA section 404 (15 U.S.C. 2684). These changes are needed to ensure consistency among the various regulations covering lead risks under TSCA. Section 402 requires EPA to promulgate regulations establishing training and certification requirements for individuals and firms engaged in lead-based paint activities. Lead-based paint activities, in the case of target housing and child-occupied facilities, include risk assessment, inspection and abatement. See TSCA section 402(b)(1); 15 USC 2682(b)(1). To clarify this definition, EPA notes that lead-based paint activities do not include interim controls. These regulations "shall contain standards for performing lead-based paint activities, taking into account reliability, effectiveness, and safety" (15 U.S.C. 2682(a)(1)). Section 404 requires States and Tribes seeking to administer and enforce standards, regulations, or other requirements under section 402, 406, or both to seek authorization from EPA.

C. Guiding Principles

Reducing exposure to lead has been an important issue for EPA for more than 2 decades. Young children are especially vulnerable to the toxic effects of lead because their nervous systems are still developing and they absorb more of the lead to which they are exposed. Many of the health effects associated with lead are thought to be irreversible. Moreover, the effects at lower levels of exposure are often asymptomatic. In light of the impacts on children and the nature of the health effects, EPA's goal is to eliminate exposure to harmful levels of lead. This goal has informed Agency actions such as the decision to remove lead as an additive from gasoline as discussed in the preamble to the proposed rule (63 FR at 30305).

First and foremost, the Agency faces the difficulty of determining the level at which to set the standards given the uncertainties in information on cause and effect--what environmental levels in which specific medium may actually cause particular blood lead levels that are associated with adverse health effects. The Agency has tools, which are only generally consistent, that show that certain increases in environmental lead levels are associated with certain increases in blood lead levels. Given the range of uncertainty shown in its analysis supporting the establishment of a hazard level under this rule, EPA has developed a technical analysis that considers hazard standards for dust and soil at the lowest levels at which the analysis shows that across-the-board abatement on a national level could be justified. EPA recognizes, however that for any levels of lead in dust or soil judgment must be exercised as to how to treat the medium, and interim controls as well as abatement could be effective. In addition, EPA recommends that organizations and individuals consider some form of interim control in certain residential areas even where soil lead levels are below the hazard standard if there is a concern that children under 6 might spend substantial time in such areas, or there is potential for that soil to contribute to hazardous lead levels in play areas or dwellings. While the risks from lead at these lower levels are less than the hazard level, EPA believes that public health will be further protected if

owners and occupants of residential properties are encouraged to take actions to reduce the potential for lead exposure.

In performing its analyses for this rule, the Agency could not quantitatively compare interim control strategies with abatement strategies because there are only limited data available on the effectiveness of interim controls over extended periods of time, and those data which are available are not suitable for quantitative comparisons with abatements. In comparing interim control strategies with abatement strategies, one must make a number of assumptions concerning the costs of administrative management, and frequency of monitoring and renewal over the planning horizon. For the 50–year planning horizon which the Agency used in its dust and soil analyses, one would have to compare the time stream of interim control expenses, for as long as such expenses are necessary, and weigh the possible differences in potential blood-lead reductions, to make a fair comparison of abatement and interim control strategies.

Nevertheless, experience with interim control programs is increasing and certain organizations, particularly public health and housing agencies, believe they have been able to develop effective programs for interim controls which achieve virtually the same degree of risk reduction as do abatement programs, but at much reduced cost. EPA received comments on this issue during the public comment process. EPA wishes to encourage the continuing evaluation of such efforts because resources to deal with hazardous lead levels are often limited, and strategies which achieve comparable risk reduction, but at much reduced cost, have the potential to protect more children by allocating the limited resources more effectively. EPA believes that public and private organizations should evaluate both interim control and abatement strategies in determining the most effective course of action when dealing with dust and soil hazards.

In addition, EPA recommends that organizations and individuals consider some form of interim control response action in certain areas even where soil lead levels are below the hazard standard. This would apply if there is a concern that children under the age of 6 spend substantial time in such areas, or there is potential for that soil to contribute to hazardous lead levels in play areas or dwellings. While the risks from lead at these lower levels are less than at the hazard level, EPA believes that public health will be further protected if owners and occupants of residential properties are aware of such contamination and are encouraged to take actions to reduce the potential for lead exposures.

For determining a paint lead hazard EPA faced a data problem different from that faced with respect to dust and soil hazards. For dust and soil, EPA had substantial raw data on environmental levels and blood lead levels, even though it faced substantial uncertainty in correlating the levels. For lead-based paint, as discussed later in this preamble, the Agency had no data by which it could select a threshold below which the paint would not be a hazard. EPA, therefore, could not apply the same analysis for the paint hazard determination as it did for the dust and soil hazard determinations. Comments indicated that even very tiny amounts of deteriorated lead-based paint are sufficient in certain circumstances to result in adverse health effects. Accordingly, EPA has generally designated any amount of deteriorated paint as a lead-based paint lead hazard. Nevertheless, as with dust and soil hazards, EPA would not recommend full scale abatement be undertaken for all paint lead hazards. Instead, the Agency wishes the public to be aware that any deteriorated lead-based paint presents enough of a risk that it should be stabilized and carefully monitored if it is not abated.

Controlling exposure to lead in the residential environment presents EPA with challenges that, in important respects, are different from and often more complex than those the Agency deals with in other regulatory contexts. Among the challenges of this regulation is that it requires the Agency to address exposure from the past use of products that contained lead rather than current products and/or processes that introduce lead into the environment. Assuming that there are safe and available substitutes, the government can eliminate lead from an existing product if the risk warrants such removal (e.g., gasoline, solder for water pipes and food cans). Removing lead that is already in the environment is far more difficult. It would have been better that lead never found its way into paint that exists today in approximately 64 million homes. However, since it is so pervasive, EPA is faced with a number of dilemmas. First, the number of properties that have some form of lead is enormous. However, the number of buildings with lead paint an dust that present a hazard is, relatively, much lower. The Agency must therefore distinguish which of these lead conditions need to be controlled. Because there is a great deal of variability among properties containing lead paint, our ability to identify which properties present risks is limited. Moreover, the exposure risk to individuals, even if there were not such a large number of affected properties, can be compounded by child-specific factors (e.g., hand-to-mouth behavior, pica, nutrition, hygiene).

In addition, the success of the program will largely rely upon the voluntary participation of States and Tribes, as well as counties and cities, to implement the program and upon property owners to follow the standards and EPA's recommendations. If EPA were to set unreasonable standards (e.g., standards that would recommend removal of all lead from paint, dust, and soil), States and Tribes may choose to opt out of the Title X lead program and property owners may choose to ignore EPA's advice, believing it lacks credibility and practical value. Consequently, EPA needed to develop standards that would protect children without wasting resources by chasing risks of negligible importance and that would be accepted as reasonable by States, Tribes, local governments, and property owners.

Three other considerations also merit the public's attention. First, as noted, the standards are designed to focus resources on the worst problems. If property owners are able to address less pressing problems (e.g., deteriorated paint below the minimum area threshold), EPA encourages them to take action. EPA also encourages States, Tribes, and local governments to adopt more stringent standards if local circumstances warrant such action.

Second, the standards alone cannot solve the lead problem. They are part of a broader program designed to educate the public and raise public awareness, empower and protect consumers, and provide helpful technical information that professionals can use to identify and control lead hazards. EPA has developed and implemented an active public education and outreach program consisting of a toll-free hotline (1–800–424–LEAD) co-sponsored with HUD and U.S. Centers for Disease Control and Prevention (CDCP), public service announcements, poster campaigns, distribution of a parent's guide through grocery stores, slides in movie theaters, and an outreach campaign with the National Parent Teachers Association, the National Association of Child Care Providers, and public libraries.

Consumer empowerment and protection efforts include the hazard disclosure regulations jointly issued with HUD training and certification

standards for individuals and firms engaged in lead-based paint activities, and the pre-renovation education rule that requires renovation and remodeling contractors to provide the EPA pamphlet "Protect Your Family from Lead in Your Home" to occupants prior to the start of renovation and remodeling projects. In addition, under section 402 of TSCA, EPA is currently developing training and certification requirements for renovation and remodeling contractors whose activities may create lead hazards.

EPA and other Federal agencies continue to conduct field studies to identify and evaluate lower cost products and technologies for evaluating and controlling lead-based paint hazards. The findings of these studies are distributed to professionals through our lead hotline, EPA's website (www.epa.gov/lead) and at other agencies' websites, and through on-going contact with trade and professional associations. The standards, combined with these other efforts, provide a comprehensive program designed to reduce and eventually help eliminate lead in residential paint, dust, and soil as a cause of childhood lead poisoning.

Third, these standards are based on the best science available to the Agency. EPA recognizes, however, that the science is constantly developing and with it our understanding of the relationship between lead in the environment and human exposure and the relationship between exposure and health impacts. If new data become available (e.g., empirical data showing that very small amounts of deteriorated paint pose a serious health risk or data showing that hazard control activities are more effective at reducing long-term dust-lead levels than assumed by EPA), the Agency will consider changing the standards to reflect these data. If the data indicate that the standards should be changed and they meet EPA's quality criteria, the Agency will consider publishing the data for public review and comment and amending today's regulation.

D. Regulatory Approach

1. *Uniform national standards.* EPA is issuing uniform national standards in this rule. The rationale for adopting uniform national standards is found on pages 63 FR 30307 to 30308 of the preamble to the proposed rule. EPA summarizes this reasoning in the following paragraphs.

EPA stated that the relationship between environmental lead levels (from paint, dust, and soil) and their effects on the health of exposed children, which forms the basis for this rule, is complex, and is dependent upon numerous site-specific and child-specific factors. Where more site-specific factors can be considered on a smaller (residence or community) scale, estimates of the effects of environmental levels on blood lead can be more accurate. The data needed, however, are not available for communities nationwide. In contrast, national data on lead in paint, dust, and soil are currently available. Even if data were available, the residence or community scale standards would still not account for variability in exposure influenced by child-specific factors (e.g., hand-to-mouth behavior, hygiene, and nutrition). Detailed evaluations that considered the specifics of individual communities would generally require information for each residence to evaluate the impact of environmental lead on children.

In addition, uniform national standards provide a fixed basis of comparison for all homes. National standards can be used to compare properties and establish priorities. This would be extremely difficult to accomplish if there were the numerous standards specific to individual communities.

EPA also took into account that certain segments of the population have a higher incidence of elevated blood-lead levels (e.g., minority and low-income children). Because estimates of the relationship between environmental lead levels and children's health effects are not sufficiently refined to distinguish relationships for particular subsets of the general population of children, EPA is choosing to emphasize program implementation (e.g., training, education, and environmental justice grants), which the Agency considers a more effective and simpler approach to address vulnerable communities rather than setting community-specific standards. EPA preferred to establish a simple, set of standards that could easily be adopted by States, allowing them to tailor the standards, should they so choose. This allows States greater flexibility to establish and implement their programs while a national, baseline level of protection to children is maintained.

2. *Media-specific standards.* A second basic issue that shaped EPA's standard-setting approach involves the fact that a child's total lead exposure is the sum of contributions from numerous sources, including paint, dust, soil, and others. Specifically, EPA had to decide whether to set separate, independent standards for paint, dust, and soil or to integrate the standards.

Under the first option, EPA would establish a fixed standard for each medium without considering the varying conditions in the other media. For example, the soil standard would remain constant, regardless of whether dust lead levels were high or low. The chief advantage of this option is that the standards are simple to understand and use.

A potential disadvantage of this approach is that a standard could be established for a particular medium that does not consider the total exposure of a child (i.e., exposures from all other media). To address this potential shortcoming, the Agency considered candidate sets of standards for dust, lead, and paint together so that its comparisons of candidate standards reflected exposures to all media. Consequently, the standards, although they are medium-specific numbers will effectively identify hazards as long as all media are evaluated and compared to the standards.

Under the second option, EPA would set standards to account for total lead exposure from all media. Under a joint standard, the standard for each medium would vary, depending on the conditions in the other media. For a graphical [illustration of this option, see page 30308 of the preamble to the proposed rule. The major advantage of the joint standards is that they avoid anomalous situations. For example, it stands to reason that if both dust and soil measurements are just below the hazard levels--35 $\mu g/ft^2$ on the floor and 1,175 parts per million (ppm) in the non-play area--the situation is more dangerous than if one measurement is above the hazard level--e.g. 1,225 ppm for soil--and floor dust is at zero. Yet the first set of measurements would not constitute a hazard and the second set would. In these circumstances, joint standards may better reflect the total exposure and risk. Furthermore, for this option to be truly effective, EPA would need to know the levels from all sources of lead exposure and how they relate to blood lead levels individually and in various combinations. EPA, currently, lacks the analytical tools to support selection of joint standards. In addition, EPA is endeavoring to set the media specific hazard standards low enough that hazardous situations will not occur if both soil and dust are just below the standards. In such a case, the media specific standards could be overinclusive. The Agency, however, believes that this approach is appropriate to protect public health. Accordingly, in this rule EPA is establishing media-specific standards. Additional explanation for this decision

can be found on pages 30308 and 30309 of the preamble to the proposed rule.

E. Applicability and Uses of the Standards

The standards established in this rule apply to target housing (i.e., most pre-1978 housing) and child-occupied facilities (pre-1978 non-residential properties where children under the age of 6 spend a significant amount of time such as daycare centers and kindergartens). The standards are intended to be used prospectively. That is, they should be used to identify properties that present risks to children before children are harmed. This, of course, would not prevent them from being used retrospectively in the case of environmental intervention blood lead investigations and clearance of resulting lead hazard control activities.

These standards are not appropriate as the sole source of information to use when identifying the source of exposure for a lead-poisoned child. When a property is being evaluated in response to an identification of a lead-poisoned child, the risk assessor in cooperation with local public health officials should identify and consider all sources of lead exposure. For example, a risk assessor should consider lead in drinking water as well as the presence of any amount of deteriorated lead-based paint.

Within the scope of Title X, these regulatory standards will help support and implement major provisions of the statute. They will be incorporated into the risk assessment work practice standards, providing the basis for risk assessors to determine whether lead-based paint hazards are present. By helping to determine when a hazard is present, the standards will help determine when a hazard control activity must be performed by certified personnel. EPA further notes that only abatement of lead-based paint hazards specifically hazardous lead-based paint, dust-lead hazards or soil-lead hazards identified in 40 CFR 745.65 requires certified personnel. This is because "abatement" is defined in 40 CFR 745.223 as "measures designed to permanently eliminate lead-based paint hazards." Thus, permanent elimination of lead-based paint, and dust or soil lead would not require the use of certified personnel unless lead-based paint hazards are present in those media.

States and Tribes wishing to obtain or retain authorization to administer and enforce training and certification programs must incorporate hazard standards as protective as the standards in this rule. Provisions for State and Tribal authorization are described at 40 CFR part 745, subpart Q. These standards will also help property owners comply with section 1018 by establishing what conditions must be disclosed to prospective purchasers and renters as *lead-based paint hazards* prior to the sale or rental of target housing. HUD, the Department of Defense (DoD), and other Federal agencies will use these standards in implementing or overseeing the evaluation and control of hazards in Federally-assisted housing and Federally-owned housing prior to disposition. (24 CFR part 35)

Under section 1018 of Title X (42 U.S.C. 4852d), EPA and HUD have jointly developed regulations requiring a seller or lessor of most pre-1978 housing to disclose the presence of any known lead-based paint and lead-based paint hazards to the purchaser or lessee (24 CFR part 35, subpart A; 40 CFR part 745, subpart F). When these section 403 rules become effective, lead-based paint hazards in lead paint, dust or soil will need to be disclosed. EPA further notes, however, that under the section 1018 rules, the seller or lessor also must provide the purchaser or lessee any available records or reports "pertaining to" lead-based paint, lead-based paint hazards and/or any lead hazard evaluative reports available to the sellor or lessor (section 1018(a)(1)(B). See 40 CFR 745.107(a)(4). Accordingly, if a seller or lessor has a report showing lead is present in levels that would not constitute a hazard, that report must also be disclosed. Thus, disclosure is required under section 1018 even if dust and soil levels are less than the hazards. EPA notes, however, that with respect only to leases of target housing, disclosure is not required in the limited circumstance where the housing has been found to be lead-based paint free by a certified inspector (24 CFR 35.82; 40 CFR 745.101), although voluntary disclosure of such certifications is encouraged.

Beyond the scope of Title X, these standards will guide the control of lead-based paint hazards in the nation's housing stock.

Although other regulations (e.g., hazard evaluation and control in housing receiving Federal assistance and Federally-owned housing prior to sale) may require property owners to evaluate properties for the presence and/or control of lead hazards, today's action does not contain such requirements. Specific requirements are determined by the particular State, Federal, and local government regulations which mandate actions when health hazards are found in target housing or child-occupied facilities. EPA, however, strongly recommends that property owners or other decision makers take appropriate actions to reduce or eliminate hazards. Finally, the standards provide property owners and other decision makers with the Federal government's best judgement concerning lead dangers in residential paint, dust, and soil.

The standards were established assuming that property owners and other decision makers would identify and control hazards in all three media (i.e., paint, dust, and soil). Failure to take a multimedia approach may not provide adequate protection to children. First, the protectiveness of the standards assumes that all media will be appropriately addressed. Second, failure to address one or more medium leaves children at risk from exposure to lead in media that are not addressed. Third, failure to address one or more media reduces the effectiveness of hazard control actions that are taken due to recontamination of one media from lead in another. Fourth, the Agency believes that soil can be a source of exposure whenever it is accessible for either incidental ingestion or tracking into a home, and that while grass and other coverings may be effective in significantly reducing potential exposures, such coverings must be maintained in order to provide continuing protection.

F. Summary of the Final Rule

1. *Hazardous lead-based paint (§ 745.65(a)).* The hazard standard for lead-based paint, called the "paint lead hazard," is any of the following:

a. Any lead-based paint on a friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction surface are equal to or greater than the dust hazard levels.

b. Any damaged or otherwise deteriorated lead-based paint on an impact surface that is caused by impact from a related building component.

c. Any chewable lead-based paint surface on which there is evidence of teeth marks.

d. Any other deteriorated lead-based paint in residential buildings or child-occupied facility or on the exterior of any residential building or child-occupied facility.

The purpose of identifying almost all deteriorated lead-based paint as a paint lead hazard is to alert the public to the fact that all deteriorated lead-based paint should be addressed--through use of paint stabilization or interim controls. Something less than abatement and certified personnel, however, would be needed to undertake interim controls or to abate lower levels of deterioration.

Two existing HUD and EPA rules provide the applicable standards: HUD rules under sections 1012 and 1013 of Title X published on September 15, 1999 (61 FR 50140), and EPA work practice rules under section 402 of TSCA published on August 29, 1996 (61 FR 45778) (FRL–5389–9). In general, these rules provide that occupant protection procedures, clearance testing, use of certified personnel or other similar specialized lead hazard control practices and procedures are not required if one or more of the following conditions exist:

a. Two square feet or less of deteriorated lead-based paint in a room.

b. Twenty square feet or less of deteriorated exterior lead-based paint;

c. Ten percent of the total surface area on an interior or exterior type of component with a small surface area consist of deteriorated lead-based paint.

2. *Dust standards.* Today's regulation includes two standardsfor dust: hazard levels for floors (including carpeted floors) and interior window sills (§ 745.65(b)) and clearance standards for floors (including carpeted floors), interior window sills, and window troughs (§ 745.227(e)(8)(viii)). The dust-lead hazard standards are 40 μg/ft² for floors based on a weighted average of all wipe samples and 250 μg/ft² for interior window sills based on a weighted average of all wipe samples. The weighted average, or weighted arithmetic mean, means the arithmetic mean of sample results weighted by the number of subsamples in each sample. Its purpose is to give influence to a sample relative to the surface area it represents.

The clearance standards for dust following an abatement are 40 μg/ft² for floors, 250 μg/ft² for interior window sills, and 400 μg/ft² for window troughs. The dust-lead level must be less than the applicable standard for the surface to pass clearance. Clearance standards are used to evaluate the effectiveness of cleaning following an abatement, and EPA may also use these standards in future rulemakings to evaluate the effectiveness of cleaning following a renovation and remodeling project. Properties that undergo abatement must pass clearance according to the work practice standards for abatement found at 40 CFR 745.227. If a property fails clearance, it must be recleaned until it passes, although it is not automatically necessary to reclean the entire property when clearance fails, such as when some of the visual and dust-testing clearance results have indicated that portions of the property are already cleared.

3. *Soil standards.* Today's regulation establishes the following standards for bare residential soil: a hazard standard of 400 ppm by weight in play areas based on the play area bare soil sample and an average of 1,200 ppm in bare soil in the remainder of the yard.based on an average of all other samples collected. See § 745.65(c). The final rule also identifies lead-contaminated soil as soil with levels equal to or greater than these soil-lead hazard standards.

Property owners and other decision makers should implement effective measures to reduce or prevent childrens' exposure to lead in soil that exceeds these levels. These measures may incorporate, but are not limited to, interim controls that include covering bare soil and placement of washable doormats in entryways. The need for more permanent controls should be determined with consideration of local conditions and usage patterns, the relative risks from different lead sources, and the potential for exposures to change over time.

4. *Summary of other actions.* Today's rule also amends existing regulations for lead-based paint activities including:

a. Requirements for interpreting the results of a lead-based paint risk assessment sampling for purposes of determining if lead-based paint hazards are present.

b. Changes to the risk assessment work practice standards at 40 CFR 745.227 to require testing of all deteriorated paint on surfaces with a distinct painting history to determine if the paint is lead-based.

c. Changes to the dust and soil sampling locations in the risk assessment work practice standards at 40 CFR 745.227.

d. Work practice standards for the management of soil removed during an abatement.

e. Amendments to the State and Tribal program authorization requirements under 40 CFR part 745, subpart Q; and

f. Amendment to the definition of "abatement" at 40 CFR 745.223 to make it clear that abatement does not include removal of paint, dust, and soil unless lead-based paint hazards are present in those media.

G. Limitations of the Hazard Standards

As stated in the proposed rule (63 FR at 30304), there is significant confusion about the requirements and purpose of the TSCA section 403 regulations. Consequently, EPA felt it necessary in the preamble to the proposed rule to highlight major limitations and other issues related to the scope and use of the regulation. These statements continue to apply. To summarize, the regulation does not establish a new definition for lead-based paint. The hazard standards apply to conditions observed when the risk assessment was performed. The standards do not address the potential for a hazard to develop. The standards apply to target housing, but may be used as guidance for other residential property. Finally, the standards are intended to identify dangerous levels of lead, not housing that is free from risks associated with exposure to lead.

As stated in Unit II.F.3., today's rule establishes two hazard standards for bare residential soil; 400 ppm for play areas and an average of 1,200 ppm for the rest of the yard. EPA recommends that organizations and individuals consider some action in certain areas even where levels in bare soils are below the hazard standard, particularly, if there is a concern that children 6 years and under might spend substantial time in such areas, or if there is concern that the bare soil in such areas may contribute to lead levels in the dwelling, or in the play areas. However, this rule does not mandate that any action be implemented when levels are found to be below the lead hazard standard. Moreover, the kind of response that organizations and individuals might consider could include modest actions such as planting grass (or other ground cover) to more extensive actions such as covering the bare soil with several inches of clean fill.

As indicated in Unit II.E., it is also important to emphasize that this rule only applies to pre-1978 target housing and certain child-occupied facilities, and that these standards were not intended to identify potential hazards in other settings. If one chooses to apply the hazard level to situations beyond the scope of Title X, care must be taken to ensure that the action taken in such settings is appropriate to the circumstances presented in that situation, and that the action is adequate to provide any necessary protection for children exposed. See also Unit IV.D. for a discussion regarding the relationship of the soil hazard standard to Superfund soil cleanup standards.

H. Preamble Overview

The remainder of this preamble consists of four units. Unit III. presents an explanation of the Agency's decisions. It includes a summary of the proposal, identifies the major changes between the proposed and final rules, and explains the changes. Unit IV. presents a discussion of some of the more significant issues raised by the public comments. Unit V. contains the

references for sources used in this preamble. Unit VI. is the regulatory assessment unit, which deals with the Federal requirements for agency rulemaking that are imposed by various statutes and executive orders. Unit VII. discusses the Congressional Review Act requirements.

III. Explanation of the Agency's Decisions

A. Summary of the Proposed Regulation

EPA published the proposed regulations on June 3, 1998 (63 FR 30302) (FRL–5791–9). The proposed standard for hazardous lead-based paint was lead-based paint in poor condition, defined as more than 10 ft^2 of deteriorated lead-based paint on exterior components with large surface areas, more than 2 ft^2 of deteriorated lead-based paint on interior components with large surface areas, or deteriorated lead based paint on more than 10% of the total surface area of interior or exterior components with small surface areas. Lesser amounts of deteriorated paint were considered *de minimis* levels and were not considered hazards. The proposed standard for a dust lead hazard was the average level of lead in dust that equals or exceeds 50 $\mu g/ft^2$ on uncarpeted floors and 250 $\mu g/ft^2$ on interior windows sills. The proposed standard for soil-lead hazard was lead that equals or exceeds 2,000 ppm based on a yard-wide average soil-lead concentration. A soil-lead level of concern, proposed to be 400 ppm, was included in draft guidance but not in the proposed regulation. The statutory basis for the level of concern was the section 403 requirement that EPA identify "lead-contaminated soil," which the Agency interpreted to be a level less than the soil-lead hazard. EPA used the term "level of concern" instead of "lead-contaminated soil. EPA proposed that lead-based paint hazards be identified by certified risk assessors performing risk assessments according to the work practice standards at 40 CFR 745.227.

The June 3, 1998 document also proposed amendments to existing regulations for lead-based paint activities including:

1. Clearance standards for dust following an abatement of 50 $\mu g/ft^2$ for uncarpeted floors, 250 $\mu g/ft^2$ for interior window sills, and 800 $\mu g/ft^2$ for window troughs.

2. Requirements for interpreting the results of a lead-based paint risk assessment sampling for purposes of determining if lead-based paint hazards are present.

3. Changes to the dust and soil sampling locations in the risk assessment work practice standards at 40 CFR 745.227.

4. Work practice standards for the management of soil removed during an abatement; and

5. Amendments to the State and Tribal program authorization requirements under 40 CFR part 745, subpart Q.

B. Summary of Significant Changes from the Proposed Regulation and Other Major Decisions

This section of the preamble briefly presents the major changes between the proposal and final rule. EPA also identifies major provisions of the proposed regulation that remain unchanged in the final rule. Unit II.D. of the preamble presents the Agency's explanation for these decisions.

1. *Dust standards.* The final rule changes the lead-based paint hazard standard for dust, known as the dust-lead hazard, and the standard for dust clearance for floors to 40 $\mu g/ft^2$. In addition, the dust-lead hazard will apply to all floors, including carpeted floors. It will not be limited to bare floors. The final rule does not change the dust-lead hazard for interior window sills. Today's action lowers the clearance level for window troughs from the proposed 800 $\mu g/ft^2$ to 400 $\mu g/ft^2$. In addition, the final rule modifies the method for interpreting composite dust clearance samples. Under the proposed rule, the result of the composite sample would have been compared to the clearance level divided by the number of subsamples in the composite. The final rule requires the result of the composite sample to be compared to the clearance level divided by half the number of subsamples in the composite.

2. *Soil standards.* With respect to the soil standards, there are several changes from the proposed rule. First, EPA is not establishing any distinction between lead-contaminated soil (soil lead "level of concern") and soil-lead hazards. Instead, EPA is, in the preamble, simply identifying lead-contaminated soil as soil with levels equal to or greater than the soil-lead hazard standards. For purposes of this rule "lead-contaminated soil" is the same as a "lead-based paint hazard" based on soil lead."

Second, in the final rule EPA is establishing the lead-based paint hazard standard for bare soil, known as the soil-lead hazard standard, to have one hazard level for play areas and another for the remainder of the yard. The proposed rule did not give special attention to play areas and made the hazard determination based on the whole yard only. From the proposed 2,000 ppm for bare soil in the entire yard, EPA is setting a final soil-lead hazard of 400 ppm for bare soil in play areas and an average of 1,200 ppm for bare soil in the non-play area portion of the yard.

3. *Paint standards.* The paint component of the lead-based paint hazard standards is known as the paint-lead hazard. The paint-lead hazard consists of three standards: Deteriorated lead-based paint; lead-based paint on friction and impact surfaces; and lead-based paint on accessible (chewable) surfaces.

a. *Deteriorated paint.* EPA considers that, in general, any deteriorated lead-based paint needs to be addressed and should be considered a paint-lead hazard. Accordingly, in the final rule the Agency does not have a *de minimis* level of deteriorated paint for the paint-lead hazard. Instead, the final rule simply refers to work practice and certification regulations issued by HUD and EPA that apply to dealing with paint-lead hazards. These regulations provide that occupant protection procedures, clearance testing, use of certified personnel or other similar specialized lead hazard control practices and procedures are not required at lesser levels of paint deterioration. These specific levels of deterioration are (i) Two square feet or less of deteriorated lead-based paint per room; (ii) twenty square feet or less of deteriorated exterior lead-based paint; (iii) ten percent of the total surface area on an interior or exterior type of component with a small surface area.

b. *Friction and impact surfaces.* The standard in the final rule for the paint-lead hazard on friction surfaces is lead-based paint that is subject to abrasion where the lead dust levels on the nearest horizontal surface underneath the friction surface are equal to or greater than the lead-dust hazard levels. The paint-lead hazard for impact surfaces is any damaged or otherwise deteriorated paint on an impact surface that is cause by impact from a related building component. No minimum area threshold of paint deterioration applies to friction or impact surfaces. In the proposed rule, EPA did not include a preferred option for these surfaces. The Agency, instead, solicited public comment on a range of options including: Lead-based paint regardless of condition on a friction/impact surface; abraded lead-based paint on a friction/impact surface; and no separate standard.

c. *Surfaces accessible for chewing or mouthing.* The standard for the paint-

lead hazard on accessible surfaces, referred to as "chewable" surfaces in the final rule, is any chewable lead-based paint surface on which there is evidence of teeth marks. No minimum area threshold applies to deteriorated lead-based paint on accessible surfaces. In the proposed rule, EPA did not include a preferred option for these surfaces. The Agency, instead, solicited public comment on a range of options including: Lead-based paint regardless of condition on interior window sills up to 5 feet off the floor; and no separate standard for accessible surfaces. EPA has eliminated the 5–foot requirement.

4. *Requiring certified risk assessors to determine the existence of lead-based paint hazards.* The final rule does not include a requirement that the presence of lead-based paint hazards must be determined by certified risk assessors following the risk assessment work practice standards at 40 CFR 745.227.

C. Explanation of the Agency's Decisions

In this section of the preamble, EPA provides its reasons for choosing the final TSCA section 403 standards for lead-based paint hazards (which includes paint-lead, dust-lead, and soil-lead hazards) and its final determination for what constitutes lead-contaminated dust and residential soil. In addition, EPA provides its reasons for establishing the clearance levels for household dust--measures of dust in lead that will show that hazards have been appropriately cleaned.

The choice of the particular methodologies used to develop each of these standards constitutes another important set of decisions. Hazard levels for dust and soil were developed using an analysis of risk, the potential for risk reduction (considering uncertainties in the data and scientific evidence describing the risks), and the cost of reducing risk. In determining the paint-lead hazard, EPA has decided that any deteriorated lead-based paint would result in adverse health effects, based on information submitted in public comments and other information in the rulemaking record. The Agency has been unable to determine any level of deteriorated lead-based paint that should not be considered a paint-lead hazard.

The general outline of these methodologies is referred to in later sections of this Unit and, where applicable, incorporates into the final rule those decisions made in the preamble to the proposed rule.

1. *Basis for dust and soil standards.* As a preliminary matter, EPA has found, after considering all significant public comments and all other information in the rulemaking record, that the legal interpretations and policy decisions in the preamble to the proposed rule form the basis for the final decisions discussed in this preamble, except as indicated below. EPA hereby incorporates, for purposes of this final rule, the relevant reasoning and analyses from the proposed preamble, as indicated below. Any modifications to the analyses or reasoning from the preamble to the proposed rule will be specifically explained in this preamble, the Reponse to Comment (RTC) document, or other documents in the record, and are supported by the record for the final rule.

a. *Legal basis.* Details of the basic legal structure of Title X and the legal effect of the issuance of regulations under TSCA section 403, including the responsibilities of EPA and HUD, are set forth in the preamble to the proposed rule (63 FR 30306) and need not be repeated here. There EPA provided a detailed discussion of its views at the time of the statutory mandate and the statutory criteria, including the Agency's interpretation of relevant terms and the statutory basis for the Agency's decision to use particular criteria to develop the determination for what constitutes lead-contaminated dust and lead-contaminated soil and the hazard standards for dust, soil and paint at (63 FR at 30311–30315). EPA has modified some of these interpretations and retains others, as discussed below.

EPA needs to define three terms under TSCA section 403, "lead-based paint hazards," "lead-contaminated dust" and "lead-contaminated soil." Lead-based paint hazards consist of lead-contaminated paint, lead-contaminated dust and lead-contaminated soil that "would result" in adverse health effects.

Section 401(9) of TSCA provides a definition of lead-based paint, which EPA interprets to be lead-contaminated paint for purposes of this rule. EPA noted that lead-based paint is not, under the statute, a risk-based term, but only a benchmark that identifies material subject to jurisdiction of the authorities of TSCA and Title X. Not all lead-based paint is a hazard, only that paint which EPA determines "would result" in adverse health effects. EPA has determined, as discussed below, that the dust and soil levels designated as lead-based paint hazards are also identified as "lead-contaminated dust" and "lead-contaminated soil." This equating of dust and soil contamination with "lead-based paint hazards" caused by dust and soil lead represents a change from the reasoning in the preamble to the proposed rule. EPA's reasons for this change are discussed below.

EPA generally refers to the hazards in each of the media as "paint-lead hazards," "dust-lead hazards" and "soil-lead hazards."

i. *Decision on contaminated dust and soil.* While section 403 obligates the Agency to identify lead-based paint hazards, lead contaminated dust, and lead-contaminated soil, the legislative history and statutory text are themselves silent on how Congress intended the Agency to differentiate between the standard for soil contamination (the level of lead in soil determined to be hazardous to human health), dust contamination (the level of lead in dust that poses a threat of adverse health effects in pregnant women or young children), and the levels of contaminated dust or soil that constitute a lead-based paint hazard (a condition that would result in adverse human health effects). Further, the terms "lead-contaminated dust" and "lead-contaminated soil" have no significance under either TSCA or Title X except insofar as the level of contaminated dust or soil constitutes a "lead-based paint hazard".

In the proposed rule EPA considered that, because the statute required the identification of "lead contaminated" dust and soil, the Agency needed to establish separate levels for these terms than for "lead-based paint hazards" resulting from contaminated dust or soil. Furthermore, EPA proposed, based on the statutory language and the structure of the statute, that the determination of whether dust or soil were contaminated required less certainty than whether such dust or soil constituted a hazard. See 63 FR 30311-12. In the preamble to the proposed rule EPA set the "contamination" levels, then called "levels of concern," at those levels the Agency determined could result in a 1 to 5% probability of an individual child's exceeding a blood lead level of 10 µg/dL. See 63 FR 30316-30317.

EPA noted, however, that the terms, "lead-contaminated" dust and soil have no direct effect on any activities subject to regulation under Title X. For example, no certification requirements are imposed for persons who remove lead-contaminated soil, only for those who remove soil associated with soil-lead hazards. Because the contamination levels do not affect other activities under Title X or TSCA Title IV, EPA proposed not to include them in the regulatory language. EPA only proposed to adopt in guidance to accompany the final rule a separate level for lead-contaminated soil of 400

ppm for the entire yard. EPA did not propose to adopt a separate standard for contaminated dust, since it found substantial overlap in its analysis and could not distinguish between dust-lead contamination and dust-lead hazards.

EPA received a significant number of comments criticizing the establishment of these "contamination" levels, particularly for soil, primarily because setting two levels for "contamination" and "hazard" would confuse the public. Other comments claimed EPA had no authority to establish separate contamination levels, as opposed to hazard levels.

While the Agency clearly has authority to establish separate levels for contaminated dust and soil, given the comments, the lack of clear statutory direction, and the lack of significance of the terms in the statutory structure, the Agency has determined not to establish any separate levels for contaminated dust or soil beyond those levels that constitute a lead-based paint hazard. The Agency believes it sufficient for purposes of TSCA and Title X to conclude that, at a minimum, the quantity of lead in dust or soil found to result in conditions that cause exposure to lead that would result in adverse human health effects (i.e., constitutes a lead-based paint hazard) is "lead-contaminated dust" and "lead-contaminated soil," respectively. Accordingly, for purposes of this regulation, the dust and soil levels designated as lead-based paint hazards are also identified as "lead-contaminated dust" and "lead-contaminated soil".

ii. *Weight of evidence for dust and soil hazard standards.* EPA's dilemma in determining what constitutes dust-lead and soil-lead hazards is based on the Agency's recognition that any determination of hazard requires a great deal of judgment in the case of lead health risks where, "as a practical matter, all the scientific evidence is uncertain to some degree . . ." (See preamble to the proposed rule at 63 FR 30313.) Making judgments on the science varies to a large extent with respect to three issues: How to determine which blood lead levels are truly hazardous; how to interpret the statutory language "result in adverse human health effects," when uncertainties exist; and how best to account for uncertainties in the risk analyses that relate environmental lead levels to blood lead levels and the prevalence data that is used in this analysis.

The resolution of these issues, at best, produces a continuum where, at one end, blood and environmental levels exist that everyone would agree constitute a hazard. At the other end, approaching blood lead levels in the general population (averaging lower than 5 µg/dL) or typical environmental levels (generally, less than the hazard levels found in this regulation), greater uncertainty exists on how to model the likelihood of health effects. This is compounded by having to factor in uncertainties of the effects of both blood lead levels and the associated environmental levels. This is because, even if EPA has confidence in the blood lead levels of concern, the Agency still faces the uncertainty of associating blood lead with environmental levels in each medium, as well as possible effects from other sources--for example, water and air emissions.

In addressing the first issue, the Agency has chosen 10 µg/dL as the blood-lead level of concern. This value is equal to the level of concern recommended by the CDCP and the Agency's reasons for choosing this value are explained in the next section of this preamble.

As to the second issue, the challenge to the Agency is how to deal with the statutory criterion, "would result in adverse human health effects." This is especially problematic because the statutory mandated activity that requires EPA to choose a cutoff for when this risk exists does not lend itself to a straightforward empirical analysis that provides bright lines for decision makers. Even if the science and environmental-lead prevalence data were perfect, there would likely be no agreement on the level, or certainty, of risk that is envisioned in the phrase "would result in adverse human health effects." Thus, it would not be appropriate to base a lead-based paint hazard standard on any specific probability of exceeding any specific blood-lead level.

The Agency therefore elected to take a pragmatic approach to setting the hazard standards namely, evaluating the amount of risk reduction that the hazard standards could provide. That is, rather than trying to select standards based solely on model-based probability distributions (which is even further complicated by the fact that different models produce different results), the Agency looked at the consequences of the standards based on the assumption that, if EPA calls something a "lead-based paint hazard," all persons would act rationally in their own best interests and would permanently eliminate (abate) these hazards before a child is about to become exposed to them. This is the so-called "normative" analysis referred to in the preambles to the proposed and final rule and discussed in detail in the economic analyses and preambles for the proposed and final rules. (EPA's analysis for using this method for determining what constitutes dust and soil hazards is discussed in detail in the preamble to the proposed rule at 30312-15. That analysis is incorporated as the final interpretation of the Agency on this matter and will not be repeated in great detail here. Later in this preamble, EPA responds to the various public comments on its analysis of the appropriate method for determining dust and soil lead-hazards under TSCA section 403.)

Also, identification of lead-based paint hazards under this regulation is sure to have impacts that could be expensive even though the range of expenses is, itself, difficult to resolve because of the uncertainty of individual behavior and the willingness of individuals to accept risks that EPA may identify. Thus, if EPA were to choose standards that are too low, the public could be unable to distinguish between trivial risks at the low levels of lead from the more serious risks at higher levels. This could result in clean up for little to no health benefit, or conversely, it could result in almost no clean up because persons would question the credibility of the "hazard" determination. Thus, they may ignore even those high risk situations that need to be controlled. On the other hand, if the Agency chooses standards that are too high, actual adverse effects could occur at levels below that. EPA's dilemma is to draw this line.

Based on the language of section 403, the purposes of Title X and its legislative history, and basic policy decisions, EPA determined that it was a reasonable exercise of its discretion to draw this line based on consideration of the potential for risk reduction of any action taken (considering uncertainties in the data and the scientific evidence describing the risks) and whether such risk reductions are commensurate with the costs of those actions. This is commonly referred to as cost-benefit balancing. In this rule, EPA used cost-benefit balancing to assist in identifying the hazard standards. This method was useful because available data run through various models showed a range of environmental levels that could be associated with a particular blood-lead level (the surrogate used to approximate risk) and the potential reduction in blood-lead concentration/risk that could result from eliminating or controlling the environmental level. Given this range, EPA used cost-benefit balancing to assist in selecting the specific

standards for this rule from within the range bounded by the results of the models.

Using this approach, the Agency is better able to deal with the third issue identified above how to best consider and account for the strengths and weaknesses of its risk assessment tools and data. For example, in estimating the number of homes that would be identified as hazards at various environmental lead levels, the Agency relied upon data from the HUD National Survey. Obviously, when assessing the impacts of standards at lower environmental lead levels, estimates are more likely to be inaccurate due to the presence of outliers in the data than would be the case in the middle range of the data. Additionally, the Agency must consider the range of exposures over which its models relating environmental lead to blood lead can be expected to perform well and the sensitivity of those models to the data inputs. By considering at which points in its analyses the data and models are strongest and weakest, the Agency can identify where in its analyses the greatest levels of certainty exist. Consideration of these factors is described in section 3.b., which discusses the selection of the dust and soil hazard levels.

b. *Choosing the lowest candidate hazard standards.* While EPA is no longer considering the determination of what constitutes lead-contaminated dust or soil to be governed by different standards from those used in the determination of what constitutes dust or soil-lead hazards, the analysis used in the proposal to determine the contamination standards is still relevant to the consideration of options for the hazard standards. This is because the effect of choosing the proposed dust and soil lead contamination standards based on a 1 to 5% probability of an individual child's having blood lead levels exceeding 10 µg/dL was to establish the lowest candidate hazard standards. In the proposal, this was for dust 50 µg/ft^2 on uncarpeted floors and 250 µg/ft^2 for sills and for soil 400 ppm in the entire residential yard. Additional analysis, as noted below in discussion of the dust and soil hazard level determination, was applied to actually develop the hazard standards.

Furthermore, as noted above, the determination of which blood lead levels are truly hazardous (the blood lead level of concern) was the first scientific issue EPA had to decide in selecting dust and soil lead hazards.

Accordingly, EPA adopts as the basis determining the lowest candidate standards for the final dust and soil lead hazards the same policy basis used in the proposal for choosing dust and soil lead contamination levels--a 1 to 5% probability of a child's developing a blood lead level of 10 µg/dL.

The choice of 10 µg/dL is based on a significant body of scientific evidence, extensively cited in the preamble to the proposed rule, that shows that a number of significant health effects manifest themselves in the 10-15 µg/dL range. EPA hereby incorporates as the basis for its final decision on the blood lead concentration of concern all relevant discussions in the preamble to the proposed rule, particularly the discussion at 63 FR 30316-17. The Agency's decision is supported by past statements made by the Clean Air Science Advisory Committee and is consistent with Federal policy established by the CDCP and the recommendations of the National Academy of Sciences (NAS). The Agency wishes to emphasize, as it stated in the proposed rule, that this choice does not imply that 10 µg/dL is a threshold level. On the contrary, EPA maintains its position that there is no known threshold for lead. EPA decided not to use a level lower than 10 µg/dL because the evidence indicates that health effects at lower levels of exposure are less well substantiated, based on a limited number of children, and observation of subtle molecular changes that are not currently thought to be sufficiently significant to warrant national concern.

The choice of probability is based on the Agency's interpretation of the statute and the limits of EPA's analytical tools. The Agency rejected the lowest possible probability, which is zero. Even without lead-based paint and lead-contaminated soil and dust, there could be some small mathematical probability that a child could still have a blood-lead level equaling or exceeding 10 µg/dL. This is because other sources of exposure (e.g., air, water, diet, and background levels of lead) remain. Because under the statute EPA may only account for risks associated with paint, dust and soil, a zero exceedence probability would not make sense for this rule.

In addition, EPA's assessment for this rule indicates that, as a practical matter, in the context of establishing on a national level the initial candidate for the hazard level, the probabilities that given environmental levels of lead "would result" in blood lead levels of concern, 1% is not distinguishable from 5% in estimating risks from soil lead. This is because, within the context of the analyses for this rule, there was substantial overlap in estimates of risk from soil lead within the 1 to 5% risk range. This overlap is due to the uncertainty and variability related to EPA's analyses to associate low levels of lead in a specific environmental medium to blood-lead concentrations and limited data. For example, results from models used to relate environmental levels to blood lead levels vary depending upon what is assumed about the interrelationship between dust and soil. Also, in the performance characteristics analysis (explained below), the number of children was small, yielding similar results for a 1% exceedence as for a 5% exceedence. In effect, EPA is setting the exceedence probability as close to zero as it is able (within analytical limits of its analyses) for the effects of lead paint and lead in dust and soil.

In addition, given the data and analytical tools available to support this rulemaking, the Agency determined that, as a practical matter, 1% is not distinguishable from 5%. This overlap is due to the uncertainty and variability related to any effort to associate low levels of lead in a specific environmental medium to blood-lead concentrations and limited data. For example, in the performance characteristics analysis, the number of children was small, yielding similar results for a 1% exceedence as for a 5% exceedence. In effect, EPA is setting the exceedence probability as close to zero as it is able (within analytical limits of its analyses) for the effects of lead paint and lead in dust and soil.

At the other end of the range considered by EPA was an exceedence probability of 10%. With this distribution of risk, a child would have approximately a 2% chance of having a blood-lead concentration exceeding 15 µg/dL and a less than 1% chance of having a blood-lead concentration exceeding 20 µg/dL, the level at which CDC recommends medical intervention. In the proposal's discussion of the contamination standard, the Agency rejected this probability as presenting exceedingly high risks. For determination of a hazard level, they would also be excessively high. EPA believes it is inconsistent with the statute to establish a hazard standard at which significant numbers of children would need medical treatment.

c. *Basis for the dust and soil hazard standards.* As explained in the preamble to the proposal, EPA used cost-benefit balancing to establish a range of options for hazard standards. EPA then selected its preferred options based on consideration of relevant factors, including the assumptions and tools underlying EPA's analysis, health

protectiveness, cost, and the effect on the overall lead risk reduction program (63 FR at 30314–30315). The Agency refers the public to the proposal for the detailed discussion of its reasoning for choosing the approach to develop the hazard standards. EPA's approach for using cost benefit analysis is described in the proposed rule and is used for the final rule.

In this document, EPA wishes to highlight several points that merit special attention. First, the various modeling techniques used by EPA only established a range of possible answers upon which the Agency exercised its administrative judgement. EPA used its quantitative modeling as a tool to establish the boundaries of the Agency's inquiry, not as the sole basis for decisions. Because precise values cannot be assigned to risks (or costs), any cost-benefit balancing is appropriately used to help select an option within a range for the hazard standards. The Agency then selected its preferred options, from within the range bounded by the modeling results, based on consideration of relevant factors, including the weight of the evidence of harm, assumptions and tools that underlie EPA's analysis, as well as other factors, including health protectiveness and total costs.

To support the establishment of a range of options, EPA used a normative analysis which assumes that all hazards to young children will be identified and controlled. EPA adopted this approach not only in view of the obvious imprecision in its ability to estimate how the public will actually respond in terms of the number and scope of hazard control interventions that will be implemented in response to the standards, but also with the objective of allowing Agency decision-makers to compare costs and benefits. Thus, while the Agency can only estimate the theoretically possible costs and benefits associated with each option, not the actual costs and benefits, EPA is confident that the relative balance of costs and benefits estimated is unlikely to be very different from the relative balance of actual costs and benefits.

Finally, EPA wishes to emphasize that there is no set way to apply the balancing of costs and risk reduction. Where standards would require the high expenditure of resources, the level of risk reduction (considering both the toxicity of lead and the probabilities of exposure) and the strength of evidence should be correspondingly high. On the other hand, if the costs of standards are relatively low, the level of risk reduction and the strength of the evidence could be less compelling. As stated in the preamble to the proposed rule and as adopted in today's final rule, the determination on soil standards considers the fact that relatively high costs may be incurred to abate residential soils. Consequently, under a cost-benefit balancing concept, before selecting an option associated with high costs, EPA would want a greater measure of confidence that the standard would result in a higher level of risk reduction.

EPA recognizes that resources for abatement to address lead risks to children are often limited and that societies often have to set priorities. Therefore, establishing numerically low national standards could serve to dilute resources across more properties and communities instead of steering resources to address situations that present clearer, more certain risk. Along the same line of reasoning, the Agency believes that it is sound public policy for the hazard standard to embody a "worst first" approach that will aid in setting priorities to address the greatest lead risks promptly.

With respect to the paint component, data limitations prevented EPA from quantifying the costs and benefits of the options considered in the proposal (as well as for the final rule). Consequently, EPA's decisions with respect to the options for the paint component involved a more qualitative judgment on the part of the Agency in the proposal, as well as in the final rule. Later in this unit, EPA explains its decision for identifying what constitutes hazardous lead based paint.

2. *Technical analyses.* To support the development of the dust and soil hazard standards in this rule, EPA required tools to relate lead in the environment to blood-lead concentration. As described in the proposal to the proposed rule, EPA used several methods for this purpose: a mechanistic model that has been calibrated and validated with various empirical dataset and which simulates the body's response to lead exposure, and both modeling and non-modeling analyses of empirical data from the Rochester Lead in Dust Study. The mechanistic model is the Agency's Integrated Environmental Uptake and Biokinetic (IEUBK) model. The empirical data used in the modeling and non-modeling analysis to support this rule was obtained from a study of lead in Rochester, New York entitled "Rochester Lead-in-Dust Study." The preamble to the proposed rule (63 FR 30315) contains a general overview of these tools. Given the uncertainties and limitations associated with any single approach, EPA decided that it would be helpful to obtain several perspectives (with different associated strengths and weaknesses) on the relationship between environmental lead and blood lead levels.

EPA thoroughly evaluated its choice of methods in response to public comments and all other information available to the Agency. EPA has concluded that it is appropriate to use the same methodology for its final decision. Based upon public comments and all other information in the rulemaking record, the Agency also recalculated the numerical results obtained for the proposed rule. These recalculations did result in some changes to the standards from those proposed, as is explained below.

a. *Initial candidate hazard levels—i. Dust.* For development of the proposed dust-lead contamination level (referred to as the level of concern) EPA used: A multimedia model based on the data from the Rochester Lead-in-Dust study and a performance characteristics analysis of the Rochester data. The reasons for using these models and their implementation is explained in the preamble to the proposed rule (63 FR at 30317–30319) in the Units titled "c. Characterizing individual risk." and "d. Dust analysis." For purposes of this analysis for determining the initial candidate levels for the final hazard standards, however, EPA judges it is appropriate to continue to use the same model, based on the same reasoning.

The multimedia model yielded the following results. The levels of lead in dust on floors associated with an individual child having from a 1 to 5% chance of having a blood-lead concentration equal to or exceeding 10 µg/dL range from near zero to 6.7 µg/ft^2. The range for dust loadings on window sills is from near zero to 74 µg/ft^2.

The performance characteristics analysis yielded the following results. For floors, dust-lead loadings ranged from 50 µg/ft^2 to 400 µg/ft^2. For interior window sills, dust-lead loadings ranged from 100 µg/ft^2 to 800 µg/ft^2. These ranges were significantly higher than the ranges yielded by the multimedia approach.

The performance characteristics analysis to support the determination that 1 to 5% of children would develop blood lead levels above 10 µg/dL remains unchanged for the analysis in this final rule. The results yielded by the multimedia model would put the environmental dust-lead levels at which 1-5% of children would develop blood lead levels above 10 µg/dL at near or below background levels and well below the residual levels that remain after homes have been well cleaned (i.e.,

the clearance levels). These results do not seem to make sense to the Agency since they imply that background levels in well cleaned homes would still be of concern from a risk perspective. Therefore, based upon public comments, the Agency reevaluated its analyses.

Based upon this reassessment, EPA decided to make some revisions to the way it applied the multimedia model so that its results would be more comparable to the performance characteristics analysis. This was accomplished by using the same set of parameters (average soil concentration, dust on floors and sills, and paint conditions) and the same subset of data from the Rochester Lead-in-Dust Study. Following these changes, the order of magnitude difference in results between the original multimedia model and the performance characteristics model virtually disappears. At 50 μg/ft², the performance characteristics shows a 7.5% risk of equaling or exceeding 10 μg/dL and the multimedia model shows a 5.34% risk. At 40 μg/ft², the performance characteristics shows a 5.1% risk of equaling or exceeding 10 μg/dL and the multimedia model shows a 5.30% risk. That is, under these analyses, floor dust levels at 40 μg/ft² correspond to 5% and less probability of blood lead levels exceeding 10 μg/dL. Thus, using the revised model, 40 μg/ft² is the standard that better meets the criteria spelled out in the Agency's proposal (less than 5% probability of exceeding 10 μg/dL). EPA provides a detailed description of this revised analysis in the "Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil: Supplemental Report." EPA accordingly has chosen 40 μg/ft² as the initial candidate level for the dust-lead hazard level in today's final rule.

ii. *Soil.* In the proposed rule, EPA set a "level of concern" based on the Agency's IEUBK model and a performance characteristics analysis of the Rochester data. The reasons for using these models and their implementation is explained in the preamble to the proposed rule (63 FR 30317, 30319) in the Units titled "c. Characterizing individual risk" and "e. Soil Analysis." Under the IEUBK analysis soil-lead concentrations generally at or below 500 parts per million (ppm) would result in a 1 to 5% probability that a child will have a blood-lead concentration that equals or exceeds 10 μg/dL. The performance characteristics analysis for soil ranged from 200 ppm to 1,500 ppm correlated with 1 to 5% of children with elevated blood lead levels exceeding 10--μg/dL. EPA chose 400 ppm as the proposed soil lead contamination level. EPA adopts that same level as the initial candidate soil hazard standard for the same reasons as provided in the preamble to the proposed rule for choosing 400 ppm as the soil contamination level.

3. *Dust and soil hazard levels.* The analyses to support selection of the dust and soil hazard levels included evaluation of the nation-wide reduction in risk that could potentially result from a set of hazard standards. EPA measured the change in risk reduction in terms of an estimated change in the national blood-lead distribution, equated this change to reductions in several adverse public health outcomes (e.g., IQ point loss), assigned a value to these reductions, and compared these public health benefits to the costs of hazard intervention.

a. *Methodology.* EPA finds no reason to change its methodology of using a normative cost-benefit analysis for developing dust-lead and soil-lead hazards. The Agency, accordingly, adopts the reasoning set forth in the preamble to the proposed rule for conducting this analysis. The general overview of the cost-benefit analysis and its use in decisionmaking is provided in the preamble to the proposal (63 FR at 30319–30320) in the introductory paragraphs to the section entitled "2. Dust-lead and soil-lead hazard standards".

The methodology for estimating risk reduction is found in the section entitled, "a. Estimating risk reduction." (63 FR 30320) and, partially, in the section entitled "b. Estimating costs and benefits." (63 FR 30321). Methodology for estimating the monetary value to be assigned to the value of risk reduction that may be achieved by actions taken in response to the hazard standards is found in the section entitled "b. Estimating costs and benefits." (63 FR at 30320–30321). Determination of the costs of actions that may be taken to reduce risk is in the same section at 30321-22 and in two paragraphs at 63 FR 30325 in the section entitled "c. Results." The limitations, qualifications and uncertainties that affect both the estimates of benefits and costs are found at 63 FR 30322–30323 in the section entitled "b. Estimating costs and benefits."

The Risk Assessment was designed to estimate the declines in children's blood lead levels that would result if abatement and other response actions were taken in housing units that exceeded candidate standards for paint, dust, and soil. While certain details of the analysis are complex, the basic approach is straightforward. First, a baseline of environmental lead and blood lead levels was established. These represent the "pre-403" conditions.

For the pre-403 environmental lead levels, the Agency used the Department of Housing and Urban Development's National Survey of Lead-Based Paint in Housing (the HUD Survey). Conducted in 1989-1990, the HUD Survey measured the extent and condition of lead-based paint in housing, the amount of lead in dust within the housing, and the amount of lead in soil surrounding the housing. For the pre-403 blood lead levels, the Agency used Phase 2 of the third National Health and Nutrition Examination Survey (NHANES III). Conducted by the Centers for Disease Control and Prevention in 1991-1994, NHANES III included measurements of children's blood-lead levels.

Next, the Agency estimated the reduction in environmental lead levels that would result if abatements or other responses were performed in housing units that failed candidate standards for paint, dust, and soil. These levels represent the "post-403" environmental lead levels and rely upon estimates of the effectiveness and duration of the response actions.

The Agency then modeled the blood lead levels that would correspond to the pre- and post-403 environmental lead levels. This allowed an estimation the blood-lead reduction that would result from the standards (i.e., the difference in the blood lead levels from the pre-403 environmental levels to the post-403 environmental levels). Here, the Agency used two different models the Integrated Exposure Uptake Biokinetic (IEUBK) Model and an empirical model that was based upon the results of the Rochester Lead in Dust Study. Consequently, there are two different estimates of the blood-lead changes that would result from the 403 standards, one based upon each model. Finally, the two estimates of blood-lead changes were re-scaled by applying the pre-403 blood-lead levels in NHANES III. EPA repeated this process for each set of standards under consideration.

The two models of risk assessment were incorporated into the economic benefit-cost framework to generate net benefit estimates for the various candidate hazard standards. EPA wishes to emphasize that it is more important to consider the net benefit estimates relative to each other rather than their actual numerical value for the various candidate hazard standards. In order to apply these models in this national analysis, the models relating environmental lead to blood lead could not reflect the consideration of site-specific data to the extent that would be sought when they are applied locally.

Also, the Agency recognizes that the costs and benefits associated with the normative analysis are likely to overstate the actual costs and benefits associated with the standards since it is likely that not everyone will follow the rule recommendations and, to the extent they do not, benefits and costs would both be lower. This is not of great concern because the objective of this analysis is to provide EPA with a tool to compare options in terms of relative costs and benefits of each option, not to develop precise absolute estimates of costs and benefits.

Despite the limitations and uncertainties of the analysis, the results for options within each model can be compared. The limitations may affect the estimates of absolute costs and benefits, but these limitations should have similar effects on the estimates for each option. Additional discussion of how to interpret the results of the normative cost-benefit analysis is provided in the preamble to the proposed rule (63 FR 30323) at the beginning of the Unit entitled "c. Results."

b. *Results.* The results of the analysis, under each model, to determine dust-lead and soil-lead hazards for the proposed rule are found in the preamble to the proposed rule (63 FR at 30323–30325). The results of the analysis after the reevaluation for the final rule are presented in this section. The analysis' computation of net benefits is the difference between the total benefits estimate and the total costs estimate. Net benefits are an indicator of the societal gains from hazard controls. While the rule, in and of itself, does not impose a requirement to abate the hazards, for purposes of its risk analysis for this rule, EPA has assumed that abatement will be undertaken in all homes that exceed the levels when a child is born. This analysis does not account for the costs and benefits associated with child-occupied facilities because of the lack of available data and resources.

While the Agency has assumed that the remediation response to the presence of a paint, dust or soil lead hazard is abatement (e.g., removal or permanent covering for soil) for purposes of its analyses, it should not be concluded that the Agency has identified abatement as the only viable response to paint, soil or dust hazards. The Agency believes that well-designed and well-managed programs of interim controls can achieve significant reductions in hazards and, particularly for soil hazards, could be less expensive than removal.

As noted previously in this preamble, in performing its analyses for this rule, the Agency could not quantitatively compare interim control strategies with abatement strategies because there are only limited data available on the effectiveness of interim controls over extended periods of time, and those data which are available are not suitable for quantitative comparisons with abatements. Nevertheless, experience with interim control programs is increasing and certain organizations, particularly public health and housing agencies, believe they have been able to develop effective programs for interim controls which achieve virtually the same degree of risk reduction as do abatement programs, but at much reduced cost. EPA believes that public and private organizations should evaluate both interim control and abatement strategies in determining the most effective course of action.

Therefore, while EPA does not have the authority under this statute to mandate any particular remediation action for lead-based paint hazards, it recommends strongly that some action be initiated--interim controls or abatement--if lead levels exceed the hazard standards. Morever, if bare soil-lead levels are below the hazard standard in non-play areas, the Agency recommends that organizations and individuals at least consider some action in bare soil in those areas if there is a concern that children under the age of 6 might spend substantial time in such areas, or there is concern that the bare soils in such areas may contribute to hazardous lead levels in the dwelling, or in the play area.

The IEUBK-based analysis and the Empirical-model-based analysis are only used to calculate the benefits of the various options. Costs are calculated in the same manner for both models. Total costs increase as options become increasingly stringent and are mainly a function of unit costs (costs for a single abatement) and the number of homes affected. Unit costs for dust are the same whenever a dust lead hazard is present. For soil, unit costs vary depending on the part of the yard being addressed by the abatement (e.g., dripline, mid-yard, play-area) and on whether the removed soil has to be managed as hazardous waste under regulations under the Resource Conservation and Recovery Act (RCRA). The unit cost is lower for lower soil-lead levels (below 2,000 ppm) because it is expected that the removed soil would not have to be managed as hazardous waste.

In the analysis for the proposed rule, unit costs for dust abatement were $ 391 for single-family homes and $ 262 for multi-family units (63 FR 30324). The preamble to the proposed rule (63 FR 30322) included the following complete range of unit costs for soil removal and other control actions as follows:

TABLE 1.—HAZARD EVALUATION AND CONTROL COSTS (PER ACTIVITY IN 1995 DOLLARS)

Activity	Single Family	Multi-family (per unit)
Risk assessment	456	235
Interior paint repair	437	437
Interior paint abatement	6,587	4,687
Exterior paint repair	807	182
Exterior paint abatement	5,706	2,275
Dust cleaning	391	262
Soil removal (dripline; nonhazardous waste)	2,046	399
Soil removal (mid-yard; nonhazardous waste)	7,878	777
Soil removal (both areas; nonhazardous waste)	9,008	901

TABLE 1.—HAZARD EVALUATION AND CONTROL COSTS (PER ACTIVITY IN 1995 DOLLARS)—Continued

Activity	Single Family	Multi-family (per unit)
Soil removal (dripline; hazardous waste)	3,443	541
Soil removal (mid-yard; hazardous waste)	16,486	1,351
Soil removal (both areas; hazardous waste)	19,013	1,617
Soil removal (play area, non-hazardous waste)	1,460	314
Soil removal (play area, hazardous waste)	2,129	359

It is important to note that, as printed in the proposal, this table contained a typographical error with respect to the cost of exterior paint abatement in single-family housing. This error was identified and corrected in a **Federal Register** document published on December 18, 1998 (63 FR 70087) (FRL–6048–3).

Total costs for the various options considered are found in Tables 4, 5, 6, and 7 of the proposal (63 FR at 30324–30325). Similar tables, although slightly revised as is described later in this section, are presented as Tables 7–A1 through 7–A4 in Appendix 7 of the Economic Analysis of the TSCA section 403 Lead-based Paint Hazard Standards Final Rule (December 2000) (Economic Analysis) (Ref. 14). As in the proposal, however, these tables do not include estimated costs or benefits of paint interventions, or any testing or risk assessment costs. Since only a single standard was considered for paint interventions, associated costs and benefits are omitted from the tables to permit a clearer presentation of the incremental changes in costs and benefits that are associated with changes in standards for the option considered. The Agency also omits testing and risk assessment costs in the tables below for a similar reason. Finally, in order to observe the effects of intervention in each medium separately, EPA held lead levels in all other media constant at baseline levels, which are based on the HUD National Survey data. In tables 7A-3 and 7A-4 for the estimated costs and benefits for soil-lead hazard standard, independent dust and paint interventions are assumed not to occur. Some dust interventions that are triggered by soil abatements are incorporated in these two tables.

The units of benefit and the value being assigned to them are presented in Table 2 below.

TABLE 2.—SUMMARY OF BENEFITS ANALYSIS ESTIMATE

Type of Effect	Description	Estimate	Source
Effect of a Single Point Reduction in IQ	Sum of the direct and indirect effects on the percent of earnings lost (2.379%) and express the effect in terms of the present value of average lifetime earnings	$9,360 in 1995 dollars	Product of the estimate of the present value of average lifetime earnings based on U.S. Department of Commerce ($366,021 (1992 $)) and the assumed percentage loss of earnings from a single point reduction in IQ of 2.379% (Salkever 1995)
Cost of Additional Education	Sum of the direct costs ($316) and opportunity costs ($627) of additional education	$1,014 in 1995 dollars	Sum of the estimate of the direct and opportunity costs of additional education based on U.S. Department of Education (1993) data
Total Effect of a Single Point Reduction in IQ	Subtract the costs of additional education from the effects on earnings lost	$8,346 in 1995 dollars	Accounting for the cost of additional education was based on Salkever (1995)
Special Education (IQ less than 70 points)	Cost of special education beginning at age 7 and ending at age 18	$53,836 in 1995 dollars	Kakalik et al. (1981) estimate annual incremental regular classroom costs of $6,458 in 1995 dollars for special education. This estimate is the discounted value of such costs for age 7 through 18.
Compensatory Education (Blood lead greater than 20)	Cost of compensatory education beginning at age 7 and ending at age 9	$15,298 in 1995 dollars	Kakalik et al. (1981) estimate annual incremental regular classroom costs of $6,458 in 1995 dollars for compensatory education. This estimate is the discounted value of such costs for age 7 through 9.
Medical Intervention (for several blood lead ranges)	Cost of blood lead screening and medical intervention for children less than six years old (by blood lead Risk Group)	Risk Group[1] I:$58; R.G. IIA: $70; R.G. IIA: $227; R.G. IIA: $417; R.G. IIA: $678; R.G. IIA: $9843; R.G. IIA: $9843	Recommendations and actual practice based on information from CDC (1991), AAP (1995), and medical practitioners. These estimates are the discounted costs per newborn associated with each blood lead Risk Group.

[1](All in $1995)

Calculations for the IEUBK-based analysis for a range of dust hazard options for floor dust and the soil hazard standard options are presented in the economic analysis (Ref 14). Discussion of the calculations is found at 63 FR 30323-25. The dust values for 40 μg/ft² will be discussed later in this preamble. Finally, the units of benefit and the value being assigned to them in these analyses are presented in Table 2.

In summary, total benefits increase as options become increasingly stringent, ranging from $ 50 billion to $ 88 billion for dust and from $ 16 billion to $ 145 billion for soil. As discussed in the Economic Analysis, the results presented for soil account for the fact that soil interventions (excluding those in play areas only) include dust interventions following the removal and replacement of soil, and thus incorporate the costs and benefits associated with dust interventions in addition to the costs and benefits associated with the soil abatement itself. Benefits increase at an increasing rate because, as dust and soil-lead levels decline, the number of homes at given environmental lead levels increases more quickly. For example, moving from a soil standard of 5,000 ppm to 4,500 ppm increases the number of homes exceeding the standard from about 600,000 to about 700,000 (an increase of about 100,000 housing units), while moving from 1,000 ppm to 500 ppm increases the number of homes exceeding the standard from about 6 million to 12 million (an increase of about 6 million housing units).

Because total benefits increase at a faster rate than total costs, net benefits also increase as options become increasingly stringent, ranging from $ 42 billion to $ 69 billion for dust and $ 13 billion to $ 103 billion for soil. The increase in net benefits is relatively constant as the dust standards become more stringent. For soil, net benefits increase slowly from 5,000 ppm to 3,000 ppm and increase more quickly from 3,000 ppm to 2,000 ppm and from 1,200 to 500 ppm. Net benefits increase because total benefits are increasing at a faster rate than total costs.

It is important to note that the above analyses do not take into account lead levels in other media. Controlling for other contributors to blood lead presents a different picture of the net benefits that result from moving to a more stringent standard.

Under the Empirical-model for floor dust, total benefits increase as options become increasingly stringent, ranging from $ 27 billion to $ 36 billion. For sill dust over the range of candidate standards that were considered, net benefits are in the maximum range at 250 μg/ft² and are slightly higher with floor dust standards of 50 μg/ft² as compared to 100 μg/ft². As is the case in the IEUBK model-based analysis, the rate at which benefits increase rises as the stringency of the options increase, because more homes are affected (and more children are protected). The rate at which benefits increase, however, is tempered somewhat because the relationship between dust and soil-lead and blood lead remains relatively constant across the range of options considered. The increasing number of children protected by more stringent standards is counter balanced by decreasing risk reduction predicted for children living in homes with low dust and soil-lead levels. That is, there are smaller changes in blood lead because there are smaller changes in environmental-lead between baseline dust-lead levels and post-intervention levels.

Of the combinations of dust standard options evaluated in the proposal, net benefits were relatively constant for all the combinations except the most and least stringent (floor = 50 μg/ft² with sill = 100 μg/ft² and floor = 100 μg/ft² with sill = 1,000 μg/ft², respectively). For the other options considered, benefits and costs increase at approximately the same rate, resulting in little change in net benefits. Specifically, the combinations resulted in net benefits of around $ 20 billion, which is also the case when a floor standard of 40 μg/ft² is considered.

Net benefits for soil range from $ -7 billion to $ 2 billion, approaching maximum levels near 5,000 ppm and 2,000 ppm. Below 2,000 ppm, net benefits decrease because total benefits increase at a slower rate than total costs. The increased number of children protected at more stringent standards is offset by a smaller predicted reduction in risk at lower environmental levels.

4. *Selection of the standards and other Agency decisions.* This section of the preamble presents the explanation of EPA's decisions regarding the standards for dust and soil lead hazard and paint-lead hazard standards.As part of the discussion of the Agency's decisions for each media, EPA is also presenting its decisions on related issues including sampling location and interpretation. The dust section will also include a discussion of the dust clearance standards, and the soil section will include EPA's decision regarding management of soils removed during abatement.

The clearance standards for dust, interpretation of composite clearance samples, soil management practices, and sampling location requirements are not being issued under authority of section 403 of TSCA, but under the work practice standards of section 402. Therefore, the legal reasoning, policy decisions, and technical analyses explained above do not have direct applicability to their promulgation. EPA is presenting these issues in this unit for public convenience, in order to keep all its decisions regarding each medium in one place in this preamble.

a. *Dust*—i. *Dust-lead hazard standards.* EPA has decided to adopt a dust-lead hazard standard 40 μg/ft² for floors and 250 μg/ft² for interior window sills) in the final rule. The floor standard is changed somewhat from the proposal but the window sill standard remains the same as for the proposal.

According to the Empirical model-based analysis for the proposal, the results of which are summarized in Table 6 of the proposed rule, four of six combinations of options for floor and window sill standards have net benefits in the maximum range (i.e., $ 21 to $ 22 billion). One combination (100 μg/ft² for floors, 1,000 μg/ft² for sills) provides significantly less risk reduction relative to cost; and one combination (50 μg/ft² for floors, 100 μg/ft² for sills) provides little additional benefit but costs increase significantly. Incremental benefits are less than one third the incremental costs and an additional 11 million homes would fall under the standard. EPA, therefore, considers that this lower standard for sills is associated with increased costs without commensurate attendant benefits.

Of the four combinations considered in the proposed rule, the 50/250 μg/ft² standard was found to be the most protective in terms of the amount of risk reduction yielded. The other three options, though less costly, also provided less risk reduction. The decrease in both costs and benefits as the combination of floor and sill options become less stringent were roughly the same (between $5 billion and $6 billion), resulting in little change in net benefits.

EPA's decision on the proposed floor standard was further supported by the results of the IEUBK model-based normative analysis, summarized in Table 4 of the preamble to the proposed rule, which showed that the net benefits for the proposed floor standard were greater than those for a less stringent standard; net benefits estimated by this analysis increased from $ 48 billion for 100 μg/ft² to $ 61 billion for the proposed 50 μg/ft² standard.

EPA reiterates that this normative cost-benefit analysis has been undertaken for comparative purposes

only to evaluate the hazard standards on a relative basis. However it does not mean to imply that billions of dollars will be spent on lead dust cleanup because the responses projected in the cost estimates may not necessarily reflect the behavior of residents and building owners over 50 years. These costs also reflect some extremely conservative assumptions, such assuming that all yards are potentially affected even if they actually contain no bare soil. These costs are put into better perspective when it is understood that the cost per residence of dust cleaning is less than $600 per affected residence over a 50–year period in 1995 dollars. In making this decision, EPA recognizes that the proposed standard could result in dust hazard interventions in perhaps as many as 20 million homes. Although this is a very large number of homes, the cost of intensive dust cleaning is relatively low for individual residences.

EPA decided to propose the 50 μg/ft² and 250 μg/ft² standards respectively for floors and sills because the Agency preferred to select the most protective of the four combinations.

In the proposal, the Agency did not consider a floor standard option less than 50 μg/ft² because, in its risk analysis, EPA's best estimate was that the post-intervention dust-lead loading would be the lower of the pre-intervention dust-loading or 40 μg/ft². This was the Agency's best estimate of dust levels that would remain after controlling sources of lead and thoroughly cleaning the residence. It was based on an analysis of data from several abatement studies which is more fully discussed in Chapter 6 of the Agency's risk analysis (Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil, EPA 747–R–97–3006, June 1998) (Ref. 12). in the record for the proposed rule. In light of this estimate, EPA found it would be impractical to set the standard for floors lower than 40 μg/ft² because little or no risk reduction would likely to be achieved for homes that had dust-lead loadings at or below 40 μg/ft².

In the preamble to the proposed rule, EPA stated that, if new data were to become available before promulgation of the final rule that show that even lower post-intervention dust-lead loadings could be achieved, EPA would consider establishing a more stringent dust-lead hazard standard. A number of comments were submitted claiming that cleanup could be achieved below 40 μg/ft². Of particular relevance were comments from HUD stating that, in its experience, cleaning to levels below 40 μg/ft² was typically achieved as evidenced by its Grantees program. In fact, since the proposal of this rule, HUD has promulgated a 40 μg/ft² standard for floors in its 1012/1013 regulations. Since EPA's basis for not considering a standard less than 50 μg/ft² was based upon its understanding of the effectiveness of cleaning and, based upon the data provided by HUD in its comments, it is now clear that a 40 μg/ft² standard is achievable, the Agency is establishing 40 μg/ft² as the dust-lead hazard standard for floors. The Agency believes that this is consistent with the approach taken in its proposal namely, that the floor-dust hazard standard should be at the lower end of the range where risk reduction is possible. Further, when considered in terms of its cost-benefit analysis, EPA found that indeed positive net benefits resulted for the 40 μg/ft² hazard standard. In fact, as compared to the proposed standard of 50 μg/ft² with a sill dust standard of 250 μg/ft² (see Tables 2 and 4), net benefits are somewhat higher under the IEUBK model-based analysis and approximately the same under the Empirical model-based analysis.

EPA does not believe it is appropriate to set a dust-lead hazard below this level for the additional reason that such a level would significantly increase the number of homes identified as lead hazards and would not likely identify more truly hazardous environments. This is based on the fact that these lower levels would identify significantly more than the approximately 22 million homes that are identified as having dust-lead hazards under the 40 μg/ft² standard. In view of the fact that there are far less children in the population with elevated blood lead levels, EPA has to question modeling results that would suggest such lower levels.

ii. *Carpeted floors.* In contrast to the proposed standards that only applied to uncarpeted floors, EPA has decided to include carpeted floors in the dust-lead hazard standard, and the clearance standards. EPA's reasoning is explained herein.

The Agency received substantial comment on the issue of the floor dust standard, and its proposed limitation to uncarpeted floors. As discussed in the preamble for the proposed rule (63 FR 30336), EPA did not include dust standards for carpeted floors because the Agency was unaware of adequate data that could be used to establish a statistical relationship between dust lead on carpeted floors and children's blood-lead concentrations. In the absence of such relationship, EPA felt it could not estimate the level of risk and risk reduction that would be associated with various levels of dust-lead in carpeted floors. Furthermore, EPA did not believe it had adequate data on the effectiveness of carpet cleaning that would be needed to establish a dust clearance level for carpeted floors. EPA did state that it planned to analyze expeditiously any newly available data to establish dust standards on carpeted floors and to amend the regulations to add standards for carpeted floors.

EPA, however, acknowledged that the lack of standards for carpeted floors was a significant limitation of the proposal. Accordingly, the Agency requested comment on the impact of not including standards for carpeted floors and indicated it would be interested in any information or data that would help it establish such standards.

Almost all comments on this issue disagreed with EPA's decision not to set carpet standards, even though many recognized that the lack of data on hazardous levels of lead in carpets makes it difficult for EPA to establish a dust-lead standard for carpeted floors. However, by excluding carpet dust from the dust hazard standard EPA will cause excessive amounts of lead to be ignored during dust-lead control activities. Many children who live in homes with wall-to-wall carpeting will remain unprotected from floor dust-lead hazards. Using data from the 1997 American Housing Survey, EPA estimates that approximately 54 million housing units built prior to 1978 contain some wall-to-wall carpeting. Of these units, wall-to-wall carpeting is found in a living room in approximately 47 million units and in a bedroom in approximately 46 million units (i.e., rooms in which children reside and play most frequently.

A number of comments pointed out the unintended consequences of not having a dust-lead standard for carpets. Contractors complained that, because abatement requires quality control standards in order to be properly executed, many contractors will refuse to work in rooms where there is no standard on which they can fall back to show they have done their work correctly. This could raise liability issues because there would be no standard to determine whether it is safe for a family to return to a home after a lead cleanup. Not having a carpet standard could create the notion that, if carpet remains, there is no hazard on the floors and the carpeted floor can be ignored. Further, a property owner could avoid having to meet clearance levels for lead dust on floors simply by laying carpet.

In view of the substantial loophole that could be created in the absence of a standard for carpeted floors, many comments recommended that EPA

should maintain one standard for all floors until research can be done that supports a different standard for carpeted floors. The Agency is persuaded by the comments that the absence of any standard at this time would potentially lead to significant exposures for children, and that some standard is necessary at this time.

In response to these concerns, the Agency has reviewed the information submitted by commenters and other information in its rulemaking record, including the data base supporting the floor dust-lead standard. EPA agrees with the comments that the huge potential loophole created by not having a carpet standard could affect large numbers of children and would be inappropriate. It is known that carpeting can be a dust reservoir with significant amounts of lead. In addition, the Agency believes that its rulemaking record supports setting a carpet standard that is the same as the standard for bare floors.

Specifically, EPA finds that the following information supports setting a carpet standard that is the same as the bare floor standard. First, EPA agrees with the comments, particularly with respect to the fact that substantial amounts of children would remain unprotected by not having a carpet standard and that the consequences are harmful to public health.

With respect to data, EPA has examined its analysis that supported the dust-lead hazard standard. That analysis not only supports the standard for bare floors, but also the same one for carpeted floors. This is because the data that was used as input to its models did not distinguish between bare floors and carpeted floors. That is, the Agency's risk analysis, its analysis of risk reduction that could be achieved through cleanup, and the cost-benefit analysis for floors evaluated both carpeted and uncarpeted floors. EPA cannot definitively state that, in fact, all factors will be the same for both carpeted and uncarpeted floors, but sufficient evidence exists to establish a carpet standard. This is based upon considering the potential loophole that could exist in the absence of a carpet standard and the fact that some correlation exists between carpeted and non-carpeted floors.

The correlation between carpeted and non-carpeted floors is supported by data in the rulemaking record, as well as data submitted by HUD in comment. These data include the Rochester (NY) Lead-in-Dust study and the pre-intervention, evaluation phase of the HUD Lead-Based Paint Hazard Control Grant ("HUD Grantees") Program (data collected through September 1997), both of which appear in the record for this rulemaking and are described in the Risk Analysis for the proposed rule. The Rochester Study shows a significant correlation between dust lead in carpets and children's blood lead. Further, the study showed that the percentage of children with blood-lead levels above 10 µg/dL were nearly the same with carpeted and uncarpeted floors (19.8 and 18%, respectively). This correlation supports setting at least the same standard for carpeted and non-carpeted floors. In addition, data from the HUD Grantees indicate that grantees were able to reduce dust-lead loadings in carpets, although the data are limited by the fact that grantees were working with higher clearance standards (80 - 200 µg/ft^2 instead of 40 µg/ft^2). Nevertheless, the fact is that the identical cleaning techniques were used, regardless of the clearance standard. Finally, there are no scientific data available demonstrating that carpeted floors pose different risks to children than any other type of flooring.

Accordingly, EPA's dust-lead, hazard and clearance standards apply to all floors. This will ensure that children are protected from dust hazards on all types of floors until future rulemakings can more definitively evaluate the need for different carpet standards.

iii. *Sampling requirements related to assessing dust-lead hazards.* EPA is adopting the sampling location (63 FR 30342) and interpretation (63 FR 30339—30340) requirements based on the rationale in the proposed rule. This regulation amends the work practice standards for risk assessments at 40 CFR 745.227 to require risk assessors, for purposes of hazard assessment, to take samples from floors and interior window sills. This regulation also amends the work practice standards to require risk assessors to make the dust-lead hazard determination by comparing the average of wipe sample results, weighted by the number of subsamples in each sample to the hazard standard for the appropriate surface (i.e., floors, sills) For multifamily properties, the risk assessor will determine that unsampled units of particular type of surface (i.e., floors, sills) constitute a hazard if at least one sampled unit is determined to be a hazard. Unsampled common areas are presumed to contain a lead-based hazard if at least one sampled common area of a similar type contains a lead-based hazard.

iv. *Dust clearance standards.* EPA is explaining in this section its reasoning for establishing clearance standards for cleanup of lead dust hazards and work practice standards for interpreting composite samples for clearance purposes.

Clearance standards are used by certified individuals to evaluate the adequacy of the cleanup performed in residences at the completion of abatement. According to the practices prescribed at 40 CFR 745.227, a certified risk assessor or inspector must collect dust samples and have them analyzed by an EPA-recognized laboratory following the cleanup to assure that the cleanup reduces dust-lead levels to prescribed "clearance" levels. If the clearance levels are not met, the cleanup and testing process must be repeated until the clearance standards are met. Although clearance testing is not required following implementation of interim controls (e.g., paint repair), the Agency strongly recommends such testing to ensure that the residence has been adequately cleaned.

With respect to composite sampling, the work practice standards at 40 CFR 745.227 do not differentiate between single surface samples and composite samples for determining compliance with clearance standards. EPA recognizes that because composite samples provide an average level of lead, low values on some surfaces may mask the presence of lead levels that exceed clearance standards on other surfaces. EPA continues to believe, however, that composite sampling is a useful tool for risk assessment and clearance and wishes to preserve its use under the regulations, the Agency proposed a method to remedy this problem and discussed various related issues in the preamble to the proposal (63 FR 30342).

A. Clearance standards for floors and sills. The final regulation contains clearance standards for floors and interior window sills of 40 µg/ft^2 and 250 µg/ft^2 respectively. This change from 50 µg/ft^2 to 40 µg/ft^2 accounts for the Agency's decisions to include standards for carpets as well as bare floors and to lower the dust lead hazard standard, as discussed earlier in this preamble.

The preamble to the proposed rule (63 FR 30341) discusses the statutory requirements applicable to clearance standards in TSCA section 402. On the same page, EPA provides the reasoning supporting the Agency's decision to use the same level to define clearance standards for dust as is used to define dust hazard standards for floors and interior window sills. This section of the proposal also explains how the Agency considered available field data documenting experience with the HUD cleaning protocol and decided to propose clearance standards that are the

same as the dust-lead hazard standard. These portions of the preamble to the proposed rule are adopted as support for the final clearance standards in this rule.

B. Clearance standard for window troughs. For window troughs, where EPA is not issuing a hazard standard, the Agency has decided to issue a clearance standard of 400 µg/ft². This is a change from the proposal, where EPA proposed to adopt the then-existing clearance standard of 800 µg/ft² from HUD's guidance.

The decision is based on EPA's consideration of public comments, and other information available to the Agency, which suggested that 400 µg/ft² is an appropriate clearance standard for window troughs. In the proposal, EPA used the current HUD clearance level for troughs (800 µg/ft²). As a result of the public comments, EPA revisited the data from the Agency's clearance evaluation, which clearly demonstrates that the 400 µg/ft² level is achievable without a major increase in burden. In six of the eight studies the pass rate for 400 µg/ft² after one trough clearance test ranged from 80.3% to 93.6%. The corresponding range for 800 µg/ft² is 88.4% to 96.6%. Two of the studies had significantly lower pass rates at 400 µg/ft² (30.6% and 53%). These studies, however, also had lower significantly lower pass rates at 800 µg/ft² (43.5% and 62.9%).

C. Sampling location and interpretation of composite dust samples. EPA is adopting the amendments to the sampling location requirements in the abatement work practice standards at 40 CFR 745.227 discussed in the proposed rule. This amendment changes sampling locations from uncarpeted floors and windows to all floors, interior window sills, and window troughs. This change is needed because the EPA is establishing clearance standards for all floors, including carpeted floors, and specific window surfaces.

To remedy the problem that composite samples may mask the presence of lead levels that exceed clearance standards, EPA proposed to require a risk assessor to divide the clearance standard by the number of subsamples in the composite. For example, if a composite floor sample of 50 µg/ft² contained four subsamples, the risk assessor would compare the loading from the composite sample to 12.5 µg/ft² (i.e., the proposed floor clearance standard divided by four). Using this approach, it was mathematically impossible for the composite to pass when any single subsample exceeds the 50 µg/ft² proposed clearance standard for floors. It would have, however, introduced the possibility of a composite sample failing clearance even if all the subsamples would have passed clearance individually (i.e., false failure), leading to additional clean up activities that would not have been necessary. At the time of the proposal EPA decided that this method would provide the best balance of safety, effectiveness, and reliability (63 FR 30342). EPA specifically asked for comment on this approach.

Commenters objected to this approach for several reasons. The most persuasive is that this approach would create a significant disincentive for risk assessors to use composite testing. HUD specifically referred to a study by Scott Clark and Paul Succop which showed that a better approach would be to compare the composite sample to the clearance levels divided by half the number of subsamples. Clark's and Succop's data shows that this approach produces an equivalent rate of passing clearance as single surface sampling.

Upon review of this study, EPA has decided to adopt this approach and is amending the work practice standards at 40 CFR 745.227 accordingly. Although the Agency prefers single surface sampling, it does not want to create a disincentive to conduct composite testing since in some circumstances it can save time and money. By selecting an approach that judges composite samples and single surface samples in an equivalent manner, EPA is removing the disincentive that the proposed approach would have created.

b. *Soil.* This section of the preamble presents EPA's decisions regarding the soil lead hazard standards. It addresses the soil-lead hazard standards for children's play areas and the remainder of the yard, and management controls for soil removed during an abatement:

i. *Soil hazard standard.* For the final regulation, EPA has selected 400 ppm in bare soil as the hazard standard for children's play areas and is an average of 1,200 ppm as the soil-lead hazard standard for the remainder of the yard. EPA's decision is a change from the proposed standard of 2,000 ppm as a yard-wide standard.

EPA's reasoning in support of the 2,000 ppm yard-wide standard is explained in the preamble to the proposed rule (63 FR at 30328–30330). To determine the final soil hazard, EPA uses the same underlying legal and policy rationale in the proposal. The Agency, however, now believes it is more protective of children and still consistent with the legal and policy bases to establish a lower level that focuses on children's play areas, as well as a lower level for the remainder of the yard.

EPA did not identify new information that has a significant bearing on the decisions needed for this rule and indeed is using the same references cited in support of the proposed soil hazard standard, to support this final decision. Comments on the proposal that questioned whether the proposed standard would be adequately protective of children, however, did cause the Agency to rethink its approach in reviewing the results of the analysis and the assessment of the available options. During this reevaluation of the options, EPA considered all options from 400 ppm to 5,000 ppm and selected the most protective option that could be supported by the analysis. This section presents EPA's rationale for selecting 400 ppm for children's play areas and 1,200 ppm for the remainder of the yard as the hazard standards and for not choosing the other options. Detailed responses to comments on all the options are found in the RTC document.

In order for the public to understand EPA's reasoning for the final soil hazard levels, the Agency believes it is necessary to review its reasons for not selecting the lowest and highest levels under consideration (400 and 5,000 ppm yard-wide averages, respectively), the reasons for proposing 2, 000 ppm instead of 1,200 ppm as yard-wide standards, and the reasons for choosing 1,200 ppm in the nonplay areas as the final soil hazard standard. This discussion will also show where the final analysis is consistent with the proposal and where divergence from the proposed reasoning is appropriate.

The proposal explained that, to arrive at a soil-lead hazard level, EPA sought to determine, with consideration of the uncertainty of the scientific evidence regarding environmental lead levels at which health effects would result, those conditions for which the Agency had sufficient confidence in the likelihood of harm that abatement seemed warranted to achieve the associated level of risk reduction. This is the method EPA has used to arrive at standards for both dust and soil. The Agency has determined that this is an appropriate way under the statute to determine whether a dust or soil lead "would result" in adverse human health effects. EPA has followed a similar approach in examining the final decision, although it has reached a different conclusion with respect to choosing the levels.

In the proposal, EPA rejected options for both higher and lower soil lead levels for a number of reasons. While, at

the time the Agency was only considering a yard-wide standard, those reasons are still relevant to today's final decision. However, the Agency's reasons for not selecting the extremes of either 400 ppm and 5,000 ppm, as a yard-wide standard, were of a more serious nature than its reasons for not choosing of 1,200 ppm. For this final rule, EPA reaffirms the reasoning in the proposal for not selecting the 400 ppm and 5,000 ppm standards, as yard-wide standards, with additional explanations noted below.

With respect to not choosing the 400 ppm level as a yard-wide standard, EPA acknowledged in the preamble to the proposed rule that the results of the IEUBK model-based analysis at relatively low soil-lead concentrations are dependent upon modeling assumptions that are sensitive to local conditions, for example the transport of outdoor soil into a residence. Although the IEUBK model predicts substantial benefits resulting from abatement at higher soil-lead levels, the absence of site-specific information at lower soil-lead levels increases the uncertainty in the public health protection that should be expected. Consequently, EPA does not believe that, as a uniform national soil-lead standard, a value as low as 400 ppm yard-wide represents a reasonable public policy choice. Also, much of the benefit that the IEUBK model-based cost-benefit analysis predicts is very sensitive to certain of the data and assumptions used therein. For example, a significant proportion of these benefits are associated with changes in dust concentration, which are affected by both the HUD National Survey data and EPA's assumptions about post-intervention dust concentrations.

Second, EPA's Empirical-based model cost-benefit analysis has an even greater difference with the IEUBK cost-benefit results with respect to the risk reduction achievable at soil-lead concentrations as low as 400 ppm yard wide. Had the Empirical-based analysis yielded results more similar to the results of the IEUBK model-based approach, EPA would have greater confidence that significant risk reduction is achievable at soil-lead concentrations between 400 ppm and 1,200 ppm as yard-wide standards for most properties.

In addition, EPA considered that, at lower levels, interim controls would be of greater help in reducing risks than at higher levels. While EPA lacks published studies to estimate the effectiveness of these controls, it seems reasonable that interim controls can interfere with exposure pathways and reduce risk. Flexibility to use these measures may aid in taking cost-effective measures where appropriate. EPA, however, was not able at the time of the proposal, and still is not able, to quantify the benefits of interim controls.

The Agency notes that HUD, provided data on interior dust lead measurements at homes where soil interim controls had been instituted. These data included average costs of some interim control strategies and dust measurements approximately 2 years after the controls were implemented. While these data were not used in the risk analyses that support this rule, they were examined in sensitivity analyses that are contained in the Economic Analysis for today's rule (Ref. 14).

An additional reason that supports not using 400 ppm as the yard-wide soil-lead hazard standard is provided by a number of commenters arguing that 400 ppm should be the hazard standard, but that abatement should not occur until 5,000 and interim controls are more appropriate at 400 ppm. These comments come from a number of advocacy groups and State and local governments who are experienced in dealing with abatement issues. EPA disagrees with these comments, for reasons discussed in more detail later in this preamble, because the Agency has decided to base the hazard standards on the lowest levels at which its technical analysis shows that across-the-board abatement on a national level could be justified. Nevertheless, these comments by persons experienced in dealing with control of lead problems, in effect, provide additional support for the Agency's determination that 400 ppm should not be a yard-wide hazard under EPA's methodology for choosing the hazard standards (i.e., that 400 ppm should not be an across-the-board abatement level).

EPA also fears that by calling 400 ppm yard-wide a hazard, property owners and other decision makers would undertake abatements as the automatic response. A value of 400 ppm is below the level at which EPA believes that across-the-board yard-wide abatement and its associated expenditure of resources are justified and at that level could divert resources from potentially riskier sources of lead exposure--namely deteriorated lead-based paint and dust-lead hazards.

EPA also was concerned that more stringent standards would not meet the priority-setting goals the Agency believes are appropriate for the Title X program. Of particular concern was the fact that the Agency estimates that over 12 million homes would exceed a 400 ppm yard-wide standard. Scarce resources potentially would have to be allocated across more communities and would be diverted away from interventions needed to respond to both deteriorated interior and exterior lead-based paint.

With respect to the not choosing a level of 5,000 ppm as the hazard standard, EPA found that while costs may be lower at that level, the IEUBK model-based approach shows that net benefits also decrease by $ 32 billion when increasing the standard from 2,000 ppm to 5,000 ppm. While the empirical model-based approach shows that net benefits are about the same for both options, the benefits decline by $9 billion when the standard increases from 2,000 ppm to 5,000 ppm. Thus, the absolute benefits at 2,000 ppm are substantially higher.

As discussed in the preamble to the proposed rule, however, the difference between 1,200 ppm and 2,000 ppm as the yard-wide standard was a closer call. While 2,000 ppm was justified by both the IEUBK and the Empirical model based analysis, there still was concern for substantial risk at 1,200 ppm. At 1,200 ppm in soil, the IEUBK model estimates a mean blood lead level in the range of 8 to 11 µg/dL. This range of mean blood-lead concentrations corresponds to a range of approximately 30 to 60% exceeding 10 µg/dL and 2 to 10% exceeding 20 µg/dL. In addition, there is a much smaller difference in homes affected when comparing the 2,000 ppm and 1,200 ppm standards as opposed to comparing 2,000 ppm with 400 ppm. At 1,200 ppm, 4.7 million homes would exceed the standard.

EPA decided to propose 2,000 ppm for several reasons. Readers are referred to the preamble to the proposed rule for details. First, the results of the empirical model-based normative analysis showed that net benefits are positive and near the maximum level at 2,000 ppm. The IEUBK normative model-based analysis showed positive and significantly higher net benefits at concentrations up to 2,000 ppm than for soil-lead concentrations above 2,000 ppm. Because both analyses showed positive net benefits at 2,000 ppm, EPA was confident that this level represented a reasonable public health policy choice.

The second reason EPA gave in the proposal for choosing 2,000 ppm was that, outside of its use in the economics model, the IEUBK model predicts significant risk to children at that soil-lead concentration under virtually all exposure scenarios. At 2,000 ppm in soil, the model estimates a mean blood lead level in the range of 11–16 µg/dL, depending upon the assumed concentration of lead in house dust (100–1,400 ppm in this case). This range corresponds to approximately 55 to 80%

equal to or exceeding 10 µg/dL and 9 to 30% exceeding 20 µg/dL. Although this is greater than empirical data, the Agency believes that this application of the IEUBK model supports the conclusion that a level of 2,000 ppm would result in adverse effects.

The third reason given in the proposed preamble to support the 2,000 ppm soil hazard level was that data from a number of epidemiological studies show that between 40 and 50% of the children living in certain communities with soil-lead concentrations at the 2,000 ppm level have blood-lead concentrations equal to or exceeding 10 µg/dL and that 10% of children have blood-lead concentrations equal to or exceeding 20 µg/dL.

However, there are several limitations associated with the above analysis. First, the results are based on a single media analysis, i.e., the estimated percent of children with elevated blood-lead concentration considered only the level of lead in soil and did not control for the contribution of lead from other media to blood lead level. Second, studies were conducted over a period of time between 1979 and 1996 and the study duration varied from a couple of months to several years. Third, the studies were conducted in different geographical regions. Some of the studies were performed in the vicinity of smelters (active or inactive) or in ore processing communities. Fourth, the target populations were different among the studies (i.e., targeting children with 5-20 µg/dL blood-lead concentration, high-risks neighborhoods, homes with a lead-poisoned child, children in a certain age group).

In the proposal, EPA decided not to use as its preferred option the more stringent soil-lead hazard standard. While EPA interpreted the balancing of costs and benefits under IEUBK model-based analysis as showing costs would be at least commensurate with risks at 1,200 ppm, the results of the empirical model-based approach suggested they might not be. In addition, some epidemiological data indicated substantial risks even at 1,200 ppm. Because the Agency's analysis, thus, showed that at the national level costs may not be commensurate with risk reduction at the lower level. EPA decided to propose the higher level because it "was mindful of the impacts that the costs of soil abatement could have on individual properties and communities." (63 FR 30330) This was notwithstanding the fact that some epidemiological data indicated substantial risks even at 1,200 ppm. Ultimately, therefore, the consideration of costs and their impacts was the primary reason why EPA proposed 2,000 ppm as opposed to 1,200 ppm.

At the time of the proposal, the Agency also expected that measures undertaken in response to the proposed soil-lead level of concern in guidance and dust hazard standards would help protect children exposed to soil-lead concentrations at all levels below 2,000 ppm.

EPA received numerous comments on the proposed standard which provided a broad range of perspectives but no clear consensus. Comments that questioned whether the proposed standard would be adequately protective of children did cause the Agency to rethink its approach in reviewing the results of the analysis and the assessment of the available options. While EPA did not choose the options at the extremes, the Agency's principal dilemma as it considered comments on the proposed rule was to consider whether it should retain 2,000 ppm as the soil hazard standard or move to 1,200 ppm. EPA also received many comments that it should establish a separate play area standard. The Agency has resolved these problems, for the final rule, by establishing a 400 ppm standard for children's play areas and an average of 1,200 ppm standard in the remainder of the yard. The following discussion presents EPA's rationale for selecting 400 ppm as a children's play area standard and for selecting 1,200 ppm as the hazard standard for the remainder of the yard and for not choosing 2,000 ppm.

A. Play area hazard standard. As explained above, EPA's proposal was to establish a single hazard standard that would be used for the entire yard. Many comments were received on this approach that were highly critical of the Agency for not treating the play area separately from the rest of the yard. These commenters reasoned that the play area is where children receive a significant proportion of their exposure to soil and that, therefore, the Agency should establish a more stringent standard for play areas. The Agency is persuaded by these comments and has reconsidered its treatment of play areas.

The Agency's initial reluctance to considering a separate standard for play areas was the concern that play areas could not be readily distinguished from the remainder of the yard. Among the comments that urged the Agency to consider a separate standard were comments from local public health agencies stating that risk assessors can readily identify play areas, thus making EPA's primary objection to this approach (feasibility), moot. Given that, in responding to these comments, the Agency, consistent with the interpretation that was stated in its proposal, focused upon the condition and location of lead in soil that would result in adverse health effects. As opposed to assuming equivalent exposure from all areas of the yard, the Agency agrees that it is also appropriate to consider that the extent of exposure and the potential for risk reduction is much greater in play areas. Consequently, because of the high levels of exposure that almost by definition correspond to a "play area," the Agency believes it appropriate to consider 400 ppm to be a soil-lead hazard when that soil is situated in a child's play area.

The Agency's next step was to attempt to estimate how a separate play area standard would affect the risk reduction that would result from various other standards (e.g., 1,200 ppm and 2,000 ppm) in the rest of the yard. The Agency tried various options to partition children's expected exposures from soil in play areas and soil in the rest of the yard. This posed numerous problems, which will be described later in this section, but it did indicate that an approach which focuses primarily upon a child's play area would likely be preferable in terms of protectiveness, risk reduction, and cost-effectiveness.

In its analysis, the Agency considered two options for the degree of exposure: (1) That 50% of exposure is from play area soil and 50% is from soil in the rest of the yard; and (2) that 2/3 of the exposure is from play area soil and 1/3 is from soil in the rest of the yard. The Agency coupled these exposure assumptions with two assumptions regarding the relative size of the play area: (1) That 10% of the yard is the play area ("small yard"); and (2) that 50% of the yard is the play area. These analyses indicated that, in situations where the play area is small, an approach which establishes a more stringent standard for the play area can be more optimal in terms of cost effectiveness (and obviously more protective) than a less stringent standard applied to the yard as a whole.

For example, in the "small yard" case where exposure is assumed to be 50% from the play area and 50% from the rest of the yard, the consequences of moving from a yard-wide average standard of 1,200 ppm to standards of 400 ppm for the play area and 1,200 ppm for the rest of the yard are as follows: total costs are increased slightly from $68.9 to $70.4 million while total benefits increase from $159.3 to $174.2 million, using the IEUBK model. This results in an increase in net benefits from $90.4 to $103.8 million. Using the Empirical model, this analysis produces

the same trend, although the results are less dramatic, indicating an increase in net benefits of $1.4 million. The results of these analyses confirm that the establishment of a separate, more stringent standard for play areas can constitute a more targeted, more protective, and more cost-effective approach, especially where play areas are not large.

As noted above, while the Agency believes that these analyses are indicative of the benefits of separate standards for the play area and the rest of the yard, there are a number of technical problems associated with such analyses. First, the amount of direct exposure to soil that children experience in their play areas versus the rest of their yard has not been studied to any significant degree. A further complication is the fact that there is little or no data on the actual, or even relative, sizes of play areas. Additionally, the soil in the rest of the yard can re-contaminate play areas where interventions have previously occurred. For these reasons, the Agency was unable to develop definitive estimates of risk and available risk reduction for separate standards for the play area and the rest of a yard.

The Agency believes that these analyses serve to demonstrate that, to the extent to which children's exposure to soil is greater in a play area and the size of the play area is smaller compared to the rest of a yard, greater risk reduction (and at a lower cost) would be achieved with a separate standard for a play area and a different standard for the rest of the yard (as opposed to applying a single standard to the entire yard). Consequently, the Agency believes that establishment of a more stringent standard for the play area will be more cost-effective as well as more protective of children.

B. Remainder of yard hazard standard. EPA believes that, based on the technical analysis, either an average of 1,200 ppm or 2,000 ppm level could be chosen under the applicable statutory criteria that the conditions of lead-contaminated soil would result in adverse health effects. EPA chose 1,200 ppm for the final rule because it is the most protective level at which EPA has confidence that the risks warrant abatement.

EPA's most basic reason for choosing 1,200 ppm over 2,000 ppm is that the IEUBK model estimates that an individual child would have a 30 to 60% risk of having a blood lead level equaling or exceeding 10 µg/dL, and that some epidemiological data indicated substantial risk at 1,200 ppm. EPA recognizes that this is an overestimate because it was derived without consideration of a play area. EPA recognizes that with separate consideration of a play area, the overall individual risks will likely be lower. It is also important to note that the epidemiological data referred to as indicating substantial risk at 1,200 ppm is the same data, and subject to these same caveats as are discussed in the soil hazard standard section. Also, the Agency notes that abatement at levels above 1,200 ppm have been shown to result in declines in childrens' blood-lead levels. For example, in evaluating the Boston portion of the Urban Soil Lead Abatement Demonstration Project (Ref. 17), the Agency found that:

> ... the abatement of soil in the Boston study resulted in a measurable, statistically significant decline in blood lead concentrations in children, and this decline continued for at least two years. It appears that the following conditions were present, and perhaps necessary for this effect: (a) a notably elevated starting soil lead concentration (e.g., in excess of 1,000 to 2,000 ug/g (ppm)); (a marked reduction of more than 1,100 ug/g in soil lead consequent to soil abatement accompanied by (c) a parallel marked and persisting decrease in house dust lead.

None of these factors, alone, would lead to choosing 1,200 ppm. When combined with the range of uncertainty in either of the cost-benefit analyses, however, the support of the IEUBK cost-benefit analysis, and the nearness to the empirical-based model analysis that would support the 2,000 ppm standard, these factors tip the balance towards the lower of the two levels.

EPA finds national data are not inconsistent with the IEUBK individual risk analysis. EPA estimates, based on the HUD National Survey Data that 4.7 million homes have soil-lead levels that exceed 1,200 ppm. Of these 4.7 million homes, an estimated 830,000 would be occupied by children under the age of 6 (based on the estimate from the 1993 American Housing Survey that 17.6% of homes are occupied by children under the age of 6). According to the IEUBK prediction, elevated blood lead levels due to lead in soil exceeding 1,200 ppm could be found in 30% of these children (based on the lower end of the IEUBK predicted individual range, without consideration of the play area standard), about 250,000 children. Since over 900,000 children, nationwide, have elevated blood-lead levels EPA finds it credible that soil-lead could be a factor in these childrens's blood levels.

EPA decided not to select its proposed choice for the soil-lead hazard standard, 2,000 ppm, for several reasons. First, the Agency's analysis shows that there is substantial and credible risk at soil-lead concentrations below this level. Second, significant risk reduction is possible below this level.

In making its decision, EPA was mindful of the concerns associated with lowering the soil standard from 2,000 ppm to 1,200 ppm. By picking a more stringent hazard standard, EPA increases the estimated number of homes that are potentially affected by 2.2 million. Abatement costs may also divert resources from efforts to control exposure from deteriorated paint and dust which are possibly more significant sources of exposure.

Nevertheless, experience with interim control programs is increasing and certain organizations, particularly public health and housing agencies, believe they have been able to develop effective programs for interim controls which achieve virtually the same degree of risk reduction as do abatement programs, but at much reduced cost. EPA received comments on this issue during the public comment process. EPA wishes to encourage the continuing evaluation of such efforts because resources to deal with hazardous lead levels may be very limited, and strategies which achieve comparable risk reduction, but at much reduced cost, have the potential to protect more children by allocating the limited resources more effectively. Recognizing that a site-specific evaluation may identify unacceptable risks to children, it may be necessary to take a more rigorous approach to mitigate those risks as the lead-levels increase. EPA believes that public and private organizations should evaluate both interim control and abatement strategies in determining the most effective course of action when dealing with dust and soil hazards.

C. De minimis area of bare soil. In the proposal, EPA considered whether the rule should include a minimum (i.e., *de minimis*) area of bare soil as part of the lead hazard criteria. 63 FR 30337-8. The Agency rejected inclusion of a *de minimis* area of bare soil for the hazard standard, but did request comment on two other options. Under one of the other options, EPA would adopt the *de minimis* area from the HUD Guidelines, which instruct risk assessors to sample yards that have at least 9 square feet of bare soil, with no *de minimis* in the play area. HUD's final rule under section 1012/1013 of Title X incorporates this into its interim soil lead hazard standard. That is, a hazard does not exist where there are less than 9 square feet of bare soil outside the play area.

EPA still rejects including a *de minimis* area of bare soil for the hazard standard for the same reasons stated in

the proposal. EPA's reasoning is that the disadvantages of establishing a *de minimis* outweighed the advantages. EPA has no analysis or data that relate the amount of bare soil to risk. EPA also believes that a *de minimis* area of bare soil provides little benefit. First, information provided by an experienced risk assessor suggests that very few properties would be excluded using the *de minimis* in the HUD Guidelines. Second, the incremental cost of including soil testing in a risk assessment is small. Moreover, the *de minimis* used in the HUD Guidelines does not account for differences in yard size. Outside of the play area, 9 square feet may be insignificant in a suburban yard but large for the back yard of an urban row house.

However, EPA highly recommends using the HUD Guidelines for risk assessment (Ref. 5). This would avoid declaring very small amounts of soil to be a hazard in the non-play areas of the yard. This would also help target resources by eliminating the need to evaluate soil or respond to contamination or hazards for properties where there is only a small amount of bare soil.

D. Management of removed soil. EPA is adopting the proposed requirement for management of soil removed during an abatement (63 FR 30343). This requirement prohibits the use of soil removed during abatement as topsoil in another residential property or child-occupied facility. In response to comment, EPA would like to clarify that applicable Federal and State requirements apply to removed soil including testing pursuant to RCRA under the Toxicity Characteristic Leaching Procedure and disposal of soil identified as hazardous waste (Ref. ?). The Agency also advises that care should always be taken to ensure that removed soil does not pose immediate or future risks to human health. For example, it should not be disposed of at an undeveloped site that may later be developed as residential or converted into a playground.

c. *Paint.* This section of the preamble presents EPA's decisions regarding the standards for hazardous lead-based paint. It addresses the deteriorated paint, paint on friction and impact surfaces, and surfaces accessible for chewing or mouthing by young children. This section also discusses relevant amendments to sampling requirements.

i. *Deteriorated paint.* The final regulation adopts the Agency's underlying rationale in the preamble to the proposed rule for setting the hazard standard for deteriorated paint. Specifically, EPA reaffirms its argument in the preamble to the proposed rule (63 FR at 30330–30331) that the available evidence demonstrates a relationship between deteriorated lead-based paint and blood-lead. Due to the continuing lack of data, however, EPA is still unable to definitively select an area threshold below which the lead-based paint would not be a hazard. Further, EPA has received substantial public comments that even very tiny amounts of deteriorated paint can cause harm and should be addressed. As a result, the Agency has reevaluated its rulemaking record and no longer believes it is appropriate to have a threshold level of deteriorated lead-based paint below which a paint-lead hazard does not exist.

Accordingly, EPA has decided to identify as the paint-lead hazard any deteriorated lead-based paint, except in the case of friction surfaces. For friction surfaces, as noted below, a paint-lead hazard may exist if the surface is subject to abrasion and dust lead levels on the nearest horizontal surface underneath the friction surface are equal to or greater than the dust hazard levels.

Furthermore, EPA has decided that it was not appropriate to refer to any area threshold for deteriorated lead-based paint as a *de minimis* threshold. Using this terminology gives the public the perception that the Agency believes risks at lower levels of deterioration are inconsequential and that no action should be taken.

While establishing this paint-lead hazard standard would alert the public to the fact that all deteriorated paint needs to be addressed, EPA acknowledges that paint stabilization or interim controls (activities less than abatement) would often be appropriate to address paint, particularly at lower levels of deterioration or where the deterioration is minor, such as less than: Two square feet of deteriorated lead-based paint per room; 20 square feet of deteriorated exterior lead-based paint; or 10% or less of deteriorated paint on the total surface area of an interior or exterior type of component with small surface area. EPA, further, emphasizes that applicable HUD and EPA regulations do have area threshold exemptions for various work practice standards, clearance, and certification requirements.

A. Comparison of proposed and final rules. EPA proposed to adopt as the paint hazard threshold levels those levels identified in the 1995 HUD Guidelines that defined paint in poor condition. These levels were "component based." That is, there were more than 2 square feet of deteriorated lead-based paint on any large interior architectural component (e.g., floors, walls, ceilings, doors, etc.), more than ten square feet of deteriorated lead-based paint on any large exterior architectural component (e.g., siding), or deteriorated lead-based paint on more than 10% of the surface area of any small architectural component (such as window sills and baseboards). Under HUD's Guidelines no action was required for paint with lesser amounts of deterioration.

The Agency proposed using the criteria in the HUD Guidelines because they were becoming the de facto industry standard that was being considered for incorporation into model housing and building codes and by State officials for adoption as State standards. In addition, EPA decided that relatively small thresholds are needed to be protective, because the area of deterioration has the potential to increase over time and because the presence of even small amounts of deterioration can present a significant risk to children who exhibit pica for paint. EPA also noted that with an area threshold level in place, millions of homes would not be identified as having hazardous paint and that this would reduce the number of paint abatements while still providing protection to the populations of concern. Nevertheless, the preamble to the proposal emphasized that while areas of deteriorated paint that fall below the threshold would not be considered a hazard, property owners should try to keep paint intact, especially paint known to be lead-based, because of the risk to some children.

EPA received numerous comments on the issue of the area threshold. Comments varied from those that argued that all lead-based paint, regardless of condition, should be a hazard to those that argued the Agency should have no separate paint standard but should rely on the dust and soil standards. Comments in between recommended such standards as all deteriorated paint should be a hazard, or that the area thresholds should be lower or more clearly explained. As a result of considering the comments and all other information available in the rulemaking record, EPA is issuing a final rule that generally provides that any deteriorated lead-based paint would be identified as a hazard. Below, EPA explains its final decision. Detailed responses to all significant comments are found in the RTC document.

While there were no comments that could directly quantify the relationship between deteriorated paint and blood lead levels, two comments attempted a

very rough quantification that EPA can use for limited support for its determination that any deteriorated lead-based paint is a paint-lead hazard. One comment cited an analysis by the Consumer Product Safety Commission (CPSC) suggesting that very small areas of deteriorated lead-based paint could present hazard to young children. According to this analysis, chronic ingestion of lead from paint and other consumer products should not exceed 15 ug/day to prevent a young child from having a blood lead levels that exceeds 10 µg/dL. Assuming a 30% absorption rate and and paint with 0.5% lead by weight, this analysis estimates that a child would have to ingest as little as 6 square inches of paint over a month to have an elevated blood lead level. Another comment submitted a theoretical calculation that the proposed standard for the dust lead hazard of 50 µg/ft^2 would be exceeded if only one square centimeter of lead-based paint with a concentration of 4 mg/cm^2 were ground into dust and evenly distributed in an eight by ten foot room. Other commenters presented anecdotal evidence that children have been lead-poisoned as a result of exposure to very small quantities of lead-based paint.

In addition, EPA has also considered the fact that HUD's standards, upon which EPA relied as a consensus standard, have changed with the issuance of HUD's final regulations under sections 1012/1013 of Title X. EPA believes it is appropriate to conform its final paint-lead hazard definition to HUD's regulations. It is EPA's determination that HUD is the government agency with the most experience in dealing with residential paint and the Agency has chosen to rely on HUD's judgment in these matters as to amounts of deteriorated paint that would result in adverse health effects. Industry standards tend to follow the leadership of HUD guidelines and regulations. EPA's consideration of the issues involving the uncertainty of choosing a paint hazard area threshold under the statutory standard for determining what constitutes a hazard, as well as a discussion of the history of the HUD standard for hazardous paint and EPA's evaluation of HUD's regulations follow.

B. Uncertainty analysis. Any deteriorated paint could conceivably cause adverse health effects, as noted by several comments. Furthermore, EPA would want people to know that any deteriorated paint needs to be dealt with. Very small amounts of lead-contaminated paint could be a cause for concern. Even a few paint chips could provide a very concentrated dose to a child that may ingest them. They may prove to be an attractive nuisance (particularly if they are brightly colored) that might encourage a child to ingest them. Any deteriorated surface could rapidly expand, particularly if a child should decide to pick at it. Because of this concern any deteriorated paint should be carefully monitored and stabilized.

The Agency cautions, however, that it does not believe full scale abatement, with all attendant regulations, would be appropriate for all deteriorated lead-based paint, particularly at the lesser areas of deterioration (i.e., less than: 2 square feet of deteriorated lead-based paint per room; 20 square feet of deteriorated exterior lead-based paint; or 10% or less of deteriorated paint on the total surface area of an interior or exterior type of component with small surface area).

Abatement in cases where there are very small amounts of deteriorated paint would make no sense in view of the fact that approximately 60 million residences have some lead-based paint and approximately 13.5 million have some deterioration. The National Survey of Lead and Allergens results will be released in the near future with a different estimate from that on which these numbers were based (Ref. ?). Recommending abatement for all hazards when relatively few children seem to be affected when compared to the total amount of homes with deteriorated paint could result in the cleanup of millions of homes that would result in little to no reduction in risk. Therefore, EPA believes that minimal degradation does not warrant abatement.

Nevertheless, the Agency leans towards being more protective in the face of uncertainties and has decided to have a standard at which any amounts of deteriorated paint would be considered a lead-based paint hazard. The more cracked or deteriorated paint that exists in a residence, the more likely it would be that amount of degraded paint would increase. The greater the deterioration, the more likely the increase in lead in dust. The paint-lead hazard levels would enable people to take protective action before excessive exposure to dust would occur. Since people are not likely to constantly monitor for dust levels, providing a standard that would focus on paint deterioration is an added level of protection. In addition, the more cracking and deteriorated paint that exists, the more likely the lead would be available for potential exposures through ingestion via dust or direct ingestion of paint chips.

In addition, EPA has decided to use the HUD interim standard for the paint-lead hazard (Ref. 5). This is because, in addition to the reasons stated above for having no threshold area, , the HUD standard is a level that people responsible for addressing the paint-lead hazards are either familiar with now or will have to become familiar with and, in the absence of any other definitive level, to choose, it makes sense to use the same standard as a sister agency for ease of identification and compliance. Of course, EPA will reconsider its decision should any information become available to allow choosing a more definitive level.

C. HUD's standard. EPA concurs with HUD's reasoning for setting its interim paint-lead hazards, as discussed in this section. HUD's reasoning for eliminating a level below which no action is required is explained in the preamble to HUD's final 1012/1013 rule. HUD stated that it was convinced by various comments from the public that there should not be an area threshold of deteriorated paint below which no action is required. These comments were: (1) That the *de minimis* exception (as it was referred to at the time) is arbitrary and not supported by science; (2) that the levels are too large, potentially allowing a total of over ten square feet of defective paint per room (counting four walls plus a ceiling plus small components); (3) that some owners or inspectors may use the area threshold as an excuse for overlooking hazardous conditions; and (4) that it is likely to shift the attention of workers from the importance of practicing lead hazard control and maintaining painted surfaces in a lead-safe manner to measuring the size of defective paint surfaces in order to document that surfaces fall above or below the *de minimis* level. (See 64 FR 50156.) In addition, HUD received comments that persons dealing with the threshold levels found it difficult to understand and put in practice. These comments indicated that people would spend too much time measuring the exact areas of deteriorated paint instead of focusing on making housing lead safe. (See 64 FR 50198.)

Based on these comments, HUD's final rule eliminates any provision that provides no action is needed with regard to deteriorated paint. HUD concluded this based on experience in its tenant-based assistance programs (where the area threshold provision was made effective in 1995) that indicated that the area threshold was a cause of confusion. (See 64 FR 50198.) As a result, HUD's final rule provides that all deteriorated lead-based paint (either

known or presumed to be lead-based paint) must be addressed. According to HUD, this would simplify the rule's implementation considerably.

Even though, under HUD's regulation all deteriorated paint must be addressed--through use of paint stabilization or interim controls, HUD nevertheless acknowledges that something less than abatement and, consequently, fully certified personnel, would be needed to address paint at lower levels of deterioration. HUD, thus, retained an area threshold exemption for required work practice and clearance standards. The levels of deterioration in this standard are the same as provided in EPA's TSCA section 402 work practice regulations--2 square feet of deteriorated lead-based paint per room, 20 square feet of paint on the exterior building, or 10% of the total surface area on an interior or exterior type of component with a small surface area. EPA's work practice standards were promulgated on August 26, 1996, 61 FR 45778. These standards have become the industry standard, having been in place since then and having been acknowledged as enforceable standards followed by the public. Thus, under HUD's regulations, activities that disturb painted surfaces of lesser deterioration do not have to use certified workers, work practices required under regulation, or work site clearance. (See 64 FR at 50149, 50156, 50166, 50184, 50185, and 50198.)

HUD had also submitted comments on this proposed 403 rule approximately 1 year before its 1012/1013 rule was issued. These comments were consistent with HUD's eventual final 1012/1013 rule in the sense that they explained that HUD has found it is more practical to require deteriorated lead-based paint of any size surface area to be addressed. HUD commented that use of an area threshold criterion for determining whether any control is necessary has the effect of having inspectors or risk assessors making efforts to measure surface areas instead of focusing on control of deteriorated paint. Further, it had been HUD's experience that some lead-based paint hazards have not been repaired because of confusion on whether or not enough of the paint had deteriorated to warrant attention.

HUD recommended that EPA should eliminate the area threshold for eliminating any need to control deteriorated paint. However, HUD then stated, "All deteriorated paint of any size should be considered a hazard and should be repaired; however, containment, clearance, and safe work practices need not be required for hazards" below the area threshold.

D. EPA's decision. For the reasons discussed above, EPA identifies as a paint-lead hazard any deteriorated lead-based paint, for surfaces other than friction surfaces, as noted below. However, EPA notes a caution that there is a level above which serious restrictions should be placed on worker certification and work practice standards and below which such restrictions are not needed. HUD and EPA also agree that any deteriorated paint needs to be dealt with.

Additionally, to attain consistency with the requirements of the 1012/1013 rule in the sense that action less than abatement should be taken with respect to levels below the hazard threshold, EPA is modifying the work practice standards found at 40 CFR 745.227 to require risk assessors to test all deteriorated paint on surfaces with a distinct painting history. This requirement would provide owners and other decision makers with information that would help these individuals take appropriate action (e.g., stabilize small amounts of deteriorated paint, increase monitoring of the property and resident children). Currently, the work practice standards require risk assessors to test paint only where deterioration exceeds the area thresholds. This sampling requirement, as amended, also applies to accessible surfaces. The existing sampling requirements do not separately address paint testing on these surfaces. The sampling requirements for friction and impact surfaces are discussed below.

ii. *Friction and impact surfaces.* In the final rule, a paint-lead hazard exists on a friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction surface are equal to or greater than the dust hazard standard for that surface. A paint-lead hazard exists on an impact surface when there is any damaged or otherwise deteriorated paint that is cause by impact from a related building component such as a door knob that knocks into a wall or a door than knocks against its door frame.

EPA did not include a preferred option for friction/impact surfaces in the proposed regulation, but instead asked for comment on several options (63 FR at 30332–30333). These options included: Any lead-based paint on a friction/impact surface, abraded paint on a friction/impact surface, or no separate standard. In the latter case, the deterioration of paint on friction/impact surfaces would be counted along with the deterioration of all paint to determine hazardous paint, or the dust-lead hazard standard could be relied upon.

The final paint-lead hazards for friction and impact surfaces are within the range of options discussed for the proposal. EPA decided to include a reference to abrasion as a condition of hazard on the friction surfaces because abrasion indicates that the rubbing or impact of the surfaces is likely to generate lead-containing dust. To this condition the Agency added the presence of dust at the dust-lead hazard level because the combination of deterioration with rubbing or impact is likely to generate lead-contaminated dust. In light of the limited data available to EPA, the Agency issued a standard based on a reasoned and common sense approach that identifies conditions likely to contribute lead to dust and the existence of dust at the hazard level. Even with the condition of deterioration added, this option falls within the bounds of the alternatives presented in the proposal. It is more stringent than the alternative based on abrasion alone but less stringent than the option that would identify any lead-based paint on a friction and impact surface as a hazard.

In promulgating the friction surface paint-lead hazard standard, EPA has considered those comments that urged the Agency not to establish a separate standard for friction and impact surfaces, but instead to focus on dust. On friction surfaces, the absence of either a component that is not subject to abrasion or dust-lead at the hazard level would eliminate the component as a paint-lead hazard. This is because a positive dust test (i.e., presence of a hazard) suggests that a friction surface is a source of lead contamination.

EPA also determined that identifying as a hazard lead-based paint on friction and impact surfaces regardless of the paint's condition is inappropriate. The Agency does not believe that intact paint can generate significant amounts of lead-containing dust. Commenters who favored Option 1 failed to provide evidence supporting the contention that these surfaces contribute to lead-containing dust regardless of the paint's condition. The strongest argument presented by a proponent of Option 1 stated that the hazard designation would lead to the testing of these surfaces for the presence of lead-based paint. Property owners and occupants would then, at a minimum, be encouraged to monitor the condition of the paint and keep it intact. Monitoring of paint condition, however, does not require knowledge that the paint is lead-based. EPA believes that owners/

managers/occupants of target housing should monitor the condition of any paint on friction and impact surfaces. If the paint deteriorates or becomes abraded at any point and young children occupy the residence, the paint should be tested to determine if the paint is lead-based and if a hazard exists. Furthermore, if the component has any abraded or deteriorated paint, it would have to be tested as part of a risk assessment.

The final regulatory decision has also led EPA to amend the sampling requirements for lead-based paint under the work practice standards for risk assessments at 40 CFR 745.227. This amendment will require risk assessors to sample any visibly abraded or deteriorated paint on friction and impact surfaces as part of a risk assessment.

iii. *Accessible (chewable) surfaces.* The final rule at § 745.65(a) uses the term "chewable" surface to refer to the statutory term "accessible" surface. A paint-lead hazard exists on any chewable lead-based paint surface on which there is evidence of teeth marks. EPA did not include a preferred option for accessible/chewable surfaces in the proposed regulation, but instead asked for comment on several options (63 FR 30333). These options included: Any lead-based paint on a interior window sill up to 5 feet off the floor; and no separate standard.

EPA decided to include a standard for chewable surfaces in the final rule, which is more stringent than no separate option and less stringent than any lead-based paint on interior window sills, for the following reasons. EPA has added evidence of chewing as a factor for determining whether a paint-lead hazard exists and has eliminated any requirement that the chewable surface must be up to 5 feet from the floor. The data available to the Agency indicate that chewing on protruding components is extremely rare, it nevertheless presents a cause for concern. Accordingly, evidence that chewing occurs would enable the public to focus attention on those areas where the risk is real. Further, by adding this evidence of chewing requirement, there would be no reason to retain any height requirement for the chewable surface. If there is evidence of chewing on a lead-based paint surface, there need be no other factor to consider.

The option that would identify lead-based paint on interior window sills regardless of paint condition as a hazard is not likely to protect any significantly larger amount of children than would be protected by the requirement to have evidence of chewing. On the other hand, such a stringent requirement could lead to action in millions of other properties where children do not exhibit this behavior, diverting resources from more significant sources of exposure such as deteriorated paint and lead-containing dust.

Most proponents of this option or options to include a broader range of surfaces failed to provide a compelling basis to EPA for selecting this or broader options because they did not provide supporting data (and most did not provide analysis). One State health department suggested that this option would lead to paint testing of these surfaces. Property owners and occupants would then, at a minimum, be encouraged to monitor conditions. EPA recognizes that it would be useful to know if chewable surfaces are covered with lead-based paint so that these surfaces and the chewing behavior of resident children can be monitored by owners and occupants. Chewing behavior by young children, however, can and should be monitored in the absence of this knowledge. This approach would avoid widespread testing of intact paint, which is costly and may require damaging the paint in situations where an x-ray flourescence (XRF) instrument cannot be used.

Several other commenters noted the data that EPA presented relates to chewing, not mouthing of surfaces. Although mouthing may be more frequent than chewing, exposure is less likely to result from mouthing of intact surfaces. If the paint on interior window sills is intact, it would likely have been repainted since lead-based paint was banned for residential use over 20 years ago. Consequently, a child who mouths intact paint would likely come in direct contact only with paint that is not lead-based and meets the Consumer Product Safety Commission standard for new residential paint (i.e., 0.06% by weight). It is important to emphasize that EPA does not intend to imply that mouthing of intact painted surfaces is risk-free behavior. Mouthing of intact paint may result in exposure to low levels of lead and other chemicals and, therefore, should be avoided.

The Agency wishes to note that it is very concerned about the potential exposure for the relatively few children who do chew on intact lead-based paint on such surfaces. The Agency has concluded that the best way to protect these children who do chew on such surfaces is through guidance that strongly recommends immediate action when such behavior is observed. A range of responses is available to property owners and other decision makers, such as plastic or metal coverings.

iv. *Requirements for interpreting paint sampling.* EPA is adopting the proposed requirements for interpreting paint sampling results (63 FR 30339) except for one clarification that is being made in response to a comment from HUD. The Department stated that language regarding the assumption risk assessors should make about paint on surfaces that have not been tested was unclear. The proposed requirement stated that the risk assessor is to "assume all like surfaces that have a similar painting history contain lead-based paint if the tested component has lead-based paint." HUD asserts that the term "like surface" is ambiguous as to whether it refers to building components in the same room equivalent or anywhere in the building. Chapter 7 of the HUD Guidelines indicates that this extrapolation can be made only to components in the same room equivalent, with extrapolation to untested room equivalents appropriate only in restricted circumstances. HUD, therefore, recommends that the method be amended to read "assume all like surfaces in the same room equivalent that have a similar painting history . . ." EPA agrees with HUD that the term "like surfaces" is ambiguous and has changed the language to read "like surfaces in the same room equivalent."

The requirements for interpreting the results of paint testing apply to friction and impact surfaces, chewable surfaces, and other surfaces with deteriorated paint. EPA is also adopting the provision that allows risk assessors to use composite paint sampling. The Agency wishes to restate the point made in the proposal (63 FR 30339), however, that composite sampling for paint can be used to rule out the presence of lead based paint but cannot be used to identify the specific sample (and therefore component) that is lead-based. Therefore, a risk assessor should only use composite testing if he or she is reasonably confident that lead-based paint is not present on the surfaces sampled.

4. *Certified risk assessor requirement.* In the proposed rule, EPA included a requirement that lead-based paint hazards be identified by certified risk assessors following the risk assessment work practice standards and that ex situ sample analysis be performed by recognized laboratories. The Agency argued that this approach would ensure the reliability of sampling results and provide flexibility for future changes in hazard evaluation technology.

This issue received substantial public comment and raised concerns which

have led the Agency to reconsider promulgation of this requirement. Many commenters believed that such a requirement would inhibit the ability of communities and individuals to identify lead-based hazards, and to deliver services or pursue response actions to protect children when an obvious hazard is present, due to the cost of full risk assessments and the lack of availability of risk assessors. Other commenters questioned the Agency's authority to mandate such a restriction. Some commenters believed that certification was appropriate and necessary to ensure the quality and reliability of hazard determinations, but questioned the need for full risk assessments or for such lead-based paint activities to be restricted to risk assessors. Some commenters also suggested that a screening procedure be allowed in lieu of a full risk assessment.

In reconsidering its proposed requirement, the agency agrees with the comments that current shortages and surpluses both in availability of risk assessors, and potentially high costs for full risk assessments could, in certain localities, impede response actions for at-risk children. It also recognizes that for certain hazard determinations, such as the visual determination of deteriorated paint, or analysis of dust levels, a full risk assessment may not be appropriate and may waste scarce resources available for hazard control or abatement.

The Agency also recognizes that a certified risk assessor may not be necessary for the simple visual determination of deteriorated paint, and that such more elementary evaluations of hazards at a property could potentially be performed by individuals with less training and experience than a certified risk assessor, and that such limited activities may not in themselves require certification, but may be performed effectively and reliably when the person performing those activities does so under the supervision of a certified risk assessor or other certified lead professional. In addition, the Agency did not intend to require that certified risk assessors be required to perform clearance sampling following abatements. For these reasons, the Agency believes it prudent to deal with these general issues in subsequent rulemakings and regulatory interpretations which will further address work practices and /certification requirements for both.

While the Agency believes that these issues are best addressed in the overall framework of the section 402 work practices and certification standards, it is nevertheless concerned that those uncertified individuals who may seek to determine hazards may not always produce results of the same quality and reliability as those obtained by a certified risk assessor, and that the use of uncertified personnel to determine the presence or absence of lead-based paint hazards should be considered with caution.

Sampling of dust and soil to determine lead-based paint hazards is not a trivial procedure. The procedures which must be followed by risk assessors in determining the nature and extent of lead-based paint hazards at a property are stated at 40 CFR 745.227. If uncertified individuals are used to determine hazards, it is critical that they have the appropriate training, and follow appropriate procedures for sampling, custody of samples, and analysis of samples to obtain defensible results. If uncertified persons lack the training and experience to determine lead-based paint hazards properly, their findings may result in detrimental consequences to the health of children and create false liabilities for property owners. A false negative result--the failure to determine the presence of a hazard when one actually exists, will fail to protect children from real hazards. A false positive result--the determination of a hazard when none is present--may cause an owner to spend additional resources to hire a certified risk assessor.

IV. Overview of Significant Public Comments and EPA's Responses

In response to the proposed rule, EPA received over 500 comments representing the general public, national and local environmental groups, national and local lead-poisoning prevention advocacy groups, the lead mining and manufacturing industry, State and local governments, other Federal Agencies, community-based organizations, and Federal Advisory Committees, among others. These comments address numerous issues, including EPA's interpretation of the statutory requirements, the policy basis for the standards, the Agency's technical analysis, and the Agency's decisions regarding the standards and other regulatory requirements. As noted previously, the RTC document contains EPA's detailed characterizations and responses to all significant public comments.

This section of the preamble presents in summary form, the characterizations and responses to the comments on the issues that EPA believes are of greatest interest to the public. These comments, specifically, are as follows: (1) It is not appropriate under the statutory requirements of Title X, or from a policy perspective, to consider costs in the development of the hazard standards; (2) standards would fail to protect children in inner-city neighborhoods who are at greatest risk; (3) the dust hazard standard should be significantly lower; and (4) EPA should provide a better explanation of the differences between the TSCA section 403 hazard standards for soil and the Superfund approach for addressing lead in soil.

A. Consideration of Costs in Developing Dust and Soil Hazard Standards

As discussed extensively in the preamble to the proposed rule, this preamble and the RTC document, EPA chose to base its dust and soil hazard standards on consideration of the potential for risk reduction of actions that may be taken (considering uncertainties in the data and scientific evidence describing the risks) and whether such risk reductions are commensurate with the costs of those actions. This is commonly referred to as cost-benefit balancing. Further, the Agency has decided to base the hazard standards on the levels at which, on a national level, risks justify abatement in order to comply with the statutory standard that the hazard levels are those that "would result" in adverse health effects. EPA has noted, however, in various places throughout this preamble, that temporary measures and interim controls can be appropriate in many situations. The analysis of abatement, as noted further below, is EPA's analytical model. The Agency may not require any particular action to be taken.

A number of comments from some advocacy groups and some government organizations expressed general disagreement with this approach from both a legal and policy standpoint. Other comments provided detailed arguments both for and against this approach. EPA responds in the RTC document to the more detailed arguments raised by these comments. However, the Agency believes it is appropriate to discuss the issue more generally in this preamble to clear up important issues and to allay apparent fears of some members of the public.

Comments criticizing EPA's use of cost-benefit balancing generally argued that it is inappropriate to make decisions regarding the selection of hazard standards based on cost or other risk management considerations. Serious concern was expressed that EPA modified health-based protective standards by cost, or feasibility, considerations and that scientific decisions about a health based standard

cannot be modified by such considerations. These comments argued that EPA should have made decisions by tying hazard standards to a target blood lead level. Costs and other risk management factors should only be considered by persons implementing the standards.

EPA believes it is necessary to explain how cost-benefit balancing was used in this rulemaking. First, the decision to use a cost-benefit balancing approach is within the Agency's statutory authority. Title X and TSCA Title IV neither require nor preclude the consideration of costs in setting the standards. EPA's interpretation of the statute, however, shows that an approach that uses cost-benefit balancing is consistent with the statutory language and legislative history, as described more fully in the proposal (63 FR at 30312-30314), earlier in this preamble and the RTC document.

A cost-benefit balancing framework provides EPA with an approach to factor uncertainty in scientific data into the decisionmaking and to set standards where there are no distinct boundaries. For this action, EPA's dilemma is to choose as a hazard that level of lead above which the Agency is reasonably confident that adverse effects would result. Below that level there may still be adverse effects, but the weight of scientific evidence indicating adverse effects is not as great. This formulation, of course, is an over simplification by necessity. The Agency is tasked with line drawing by Congress in a circumstance where there are no clear lines. At the simplest level, no one can say that 1,201 ppm of lead in soil is worthy of abatement and 1,199 ppm is not. As a result, consistent with the applicable statute, EPA used a balancing approach to pick the cutoff level above which a regulatory hazard exists.

EPA's approach first, and foremost, considers the weight of evidence as to whether dust or soil lead will actually result in adverse effects. The surrogate for adverse effects is a consideration of blood lead levels and the potential effects elevated blood-lead levels can have on intelligence and lifetime earnings. Reduction in blood lead levels and, presumably, increased lifetime earnings are then related to reduction in environmental levels. No one would dispute that the higher the environmental lead levels are in any particular medium (e.g., soil or dust), the greater the likelihood of increased blood-lead due to exposure from that medium. At low environmental lead levels, there is less confidence that any specific medium is responsible for blood-lead level increases. EPA's problem is drawing the line at which concern for exposure to lead from paint, dust, and soil diminishes that is, those levels below which EPA will decide a regulatory hazard does not exist.

EPA, using the best scientific evidence it had, did the line drawing by assigning a monetary value to the health effects that will be prevented ("benefits") and evaluating whether elimination (abatement) of the lead hazard that causes these effects is commensurate with the societal resources (determined by the costs of abatement) that would be expended by doing the abatement. This gives EPA a way to evaluate the certainty of the scientific evidence and develop the confidence it needs to determine that the levels it has chosen would result in adverse effects. Essentially, in this area of scientific uncertainty about risk, EPA is more willing to say that a regulatory hazard exists if it can find that costs of abatement are expected to be reasonable. Costs, of course, are given far less weight (or maybe no weight at all) in circumstances in which adverse effects are a certainty. Certainty simply does not exist at the lower lead levels with which the Agency is dealing in this rule.

Two salient points need to be reiterated here on how a cost-balancing analysis was used in this rulemaking. In the first place, for this rule, cost-benefit balancing is a useful method for decision making within the range of uncertainty in the Agency's analyses. In any event, use of the analysis only helps define the boundaries of the inquiry and is not a sole basis for any decision. Once EPA decided the range of options, the Agency chose the levels within those ranges. Second, EPA used the normative cost-benefit analysis only to compare options with the understanding that the relative balance of costs and benefits estimated should be reflective of the relative balance of actual costs and benefits. Thus, decision makers still needed to exercise judgement. There is no "black box" into which numbers are entered and a decision comes out.

The comments that object to EPA's approach for hazard determination for dust and soil offer as an alternative determination of hazards by reference only to environmental levels that are associated, through modeling, with a percentage of children exceeding various blood lead levels. For example, a hazard standard could be that level at which models show no more than 5% of children would exceed 10 µg/dL of blood lead. This type of standard would be based solely on the toxicity of lead (at a particular blood level) and the potential exposure. While EPA did use this method for picking the initial candidate hazard levels, the Agency declined to use this method for choosing hazards.

The reasonableness of EPA's approach is supported to a large extent by the fact that the Agency received several comments recommending particular blood levels and percentages but no comment provided EPA with any kind of rational basis for choosing the standard based on those levels and percentages. Most of these comments argued for having no more than 5% of children above 10 µg/dL. However, they provided no rationale for saying why this would meet the "would result" standard for determining lead-based paint hazards (i.e., why shouldn't we have zero children above 10 µg/dL, or why 10 µg/dL is the proper number for the hazard determination and not a higher or lower number).

EPA's view of the cost-benefit approach points out another misconception in the comments about cost-benefit analysis. This misconception is that EPA's approach is not health-based, but instead modifies a protective standard based on cost considerations. Commenters also seem to believe that the Agency is using cost considerations to leave children unprotected. This is not the case. Instead, as discussed above, EPA evaluated different options within the range of scientific uncertainty provided by the two models used in the Agency's analyses. While it is true that as levels get higher, the certainty regarding the probability of harm increases, this does not mean that lower levels should be discounted or never addressed. It may mean, however, that as you go lower, the levels are less likely to meet the goal of this rule to set levels at which all abatements are specified to be conducted in a specific way. For purposes of setting such a national standard, EPA believes that it is reasonable to choose a level within the range at which there is greater certainty regarding the probability of harm, being always mindful of the need to advise the public that lower levels are not risk-free and may in individual cases present significant risks.

Given the range of uncertainty shown in its analyses for this rule, EPA is choosing an option that the Agency believes provides protection, and at which there is a higher level of certainty that in all cases abatement is likely to reduce risks significantly. EPA has set its dust and soil hazard standards at the lowest levels at which it believes across-the-board abatement and its associated expenditure of resources is justified. Evaluation of resource allocation, of which costs are a measure, is a method

that was used in this rule as a tool to make decisions within a set range of uncertainty.

Finally, EPA's hazard standards should not be considered in isolation, but must be considered along with the Agency's tiered approach for paint and soil. Under this approach, the Agency recognizes that risks could exist below the hazard standard and recommends that organizations and individuals may want to consider taking some action, informed by knowledge of local circumstances, at levels below the hazard levels.

B. Standards Do Not Protect Children at Greatest Risk

Groups representing environmental justice and children's health protection interests argued that the standards do not protect children at greatest risk. Some argued that the 1 to 5% probability level for exceeding 10 µg/dL (EPA's basis for choosing the initial candidate hazard levels in the final rule and the Agency's basis for evaluating lead-contaminated dust and soil in the proposed rule) would result in no improvement because the percentage of children with elevated blood lead levels is already below 5%. Therefore, the populations with the highest blood lead levels would not benefit from the standards.

EPA strongly disagrees with this assertion and, in fact, has concluded that the exact opposite is true. The argument that the 1 to 5% probability criteria would result in no improvement for children at risk reflects confusion with respect to the national blood-lead data and risk to individual children. The national blood-lead data is composed of millions of children exposed to a broad variety of environmental-lead conditions. As such, it actually consists of a broad range of individual risks ranging from near zero to levels above 50% for children exposed to the very worst conditions. The average population risk is just below 5%. Children in at-risk communities tend to have the higher individual risk, as borne out by the higher prevalence of elevated blood lead levels in these communities (e.g., > 20% for African American children living in pre-1950 housing).

In fact, the hazard standards identify a higher percentage of African-American children than any other group. Moreover, instead of offering more protection to children in at-risk communities, more stringent standards may actually afford less protection to these children by diluting the resources available to address hazards in these communities.

C. Dust-Lead Hazard Standard Should be Significantly Lower

Several comments argued that the dust-lead hazard should be significantly lower, in the 5 to 10 µg/ft² range. They claimed that a hazard should be found because more than 5% of children would have blood lead levels above 10 µg/dL. This recommendation is based on several analyses including an independent analysis of the Rochester Lead-in-Dust Study and the so-called HUD pooled analysis. According to these commenters, these analyses show that significant risk exists where floor dust-lead levels are below 10 µg/ft².

EPA agrees that significant risks should be addressed but disagrees with the approach of these commenters. First, as noted above, these comments provided no rational basis for deciding that a regulatory hazard exists based solely on environmental levels associated with particular blood lead levels. Nevertheless, EPA concludes after review of these comments and analyses that the results showing more than 5% of children exceed 10 µg/dL at the low environmental levels were achieved by focusing almost exclusively on the contribution of dust-lead to exposure and not adequately accounting for the contribution of soil and deteriorated lead-based paint to exposure. When exposure to these other sources is adequately accounted for, as EPA believes was done in its analysis, significant risk attributable to dust-lead is not found until dust-lead levels on floors reach 40 µg/ft².

The data also indicate that to make predictions of risk based exclusively on dust-lead measurements would be an inefficient and imprudent approach. An examination of the Rochester data reveals that in practically every case where there was a child with an elevated blood lead level and floor dust lower than 40 µg/ft², soil-lead levels were elevated and/or deteriorated lead-based paint was present. Moreover, in most houses with dust-lead levels below 40 µg/ft², children did not have elevated blood lead levels because other significant sources of exposure were not present.

EPA believes that the above-mentioned empirical data supports its view that it is more technically correct to assess and control exposure in all three media, as opposed to taking an approach that focuses exclusively on dust. Given the uncertainty that exists with respect to the contribution to exposure presented by each medium individually, the Agency believes that it is prudent to control exposure from the combination of paint, dust, and soil together rather than individually. Also, control of all three media also prevents recontamination of one medium by another, making control efforts more effective.

D. Relationship of Soil Hazard Standard to Superfund Soil Cleanup Standards

Several commenters expressed concern about the difference between the TSCA approach for addressing lead in soil in pre-1978 residential property and the approach under programs administered by the Office of Solid Waste and Emergency Response (OSWER) specifically, Superfund sites and RCRA Corrective Action Facilities. Responses to comments on the details of the differences in the programs are addressed in the RTC document. In this section, however, EPA responds generally to issues raised on the relationship between the programs administered by OSWER and TSCA. In general, comments identified concerns that differences in the two programs could cause confusion and that persons responsible for cleanup under the OSWER programs could use the TSCA standard to avoid taking response actions to achieve protection.

As a preliminary matter, EPA emphasizes that at lead-contaminated residential sites both TSCA and the OSWER programs seek to protect the health of the most susceptible population (children under 6 years of age) and to promote a program that assesses and addresses risk. The approaches taken by the various programs share many important aspects, but also differ in some respects because of their purposes. The TSCA program is guided by this section 403 rule, which identifies lead-base paint hazards, which consist of lead paint and lead-containing residential dusts and soils that the Agency considers to be hazards under applicable statutory criteria. Guidance for the OSWER programs is provided by the 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive # 9355.4-12, 1994) and Clarification to the 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive # 9200.4-27P, August 27, 1998) (Refs. 15 and 16).

The EPA programs that implement the RCRA and CERCLA statutes rely on the IEUBK model for relating environmental levels to blood lead levels in children. The OSWER soil lead guidance recommends that the IEUBK Model be applied to utilize site-specific information that can be very important in evaluating the risks at hazardous

waste sites with residential exposure scenarios. This section 403 rule also employs analyses that have relied on the IEUBK Model and the empirical model which employs analyses based on empirical data.

In the absence of site-specific information at hazardous waste sites, EPA believes that soil lead levels above 400 ppm may pose a health risk to children through elevated blood lead levels. The 400 ppm screening level identified in the OSWER soil lead guidance is consistent with both the children's play area hazard determination identified in this rule and the initial candidate hazard level discussed in this preamble. Site-specific information at hazardous waste sites would provide a basis to identify a different soil lead level that would be protective of health. The TSCA soil hazard levels of 400 ppm (play areas) and an average 1,200 ppm (rest of yard) should not be understood as a minimum cleanup level for lead in soils at hazardous waste sites and levels greater than these could be consistent with CERCLA requirements, depending on site-specific factors. Soil lead levels less than these still may pose serious health risks and may warrant timely response actions including abatement. The hazard standard in this TSCA rule was intended as a "worst first" level that will aid in setting priorities to address the greatest lead risks promptly at residential and child-occupied facilities affected by lead-based paint.

In contrast with the section 403 rule, which establishes minimum national standards that are designed to be used at millions of residential properties and child-occupied facilities across the nation, the studies that take place at CERCLA or RCRA involve multiple hazardous substances with potentially numerous sources of contamination and multiple pathways of exposure that require that response levels be developed with site-specific information. Other statutory and regulatory criteria that would typically be considered in determining a final clean-up number include: long-term effectiveness and permanence; and reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; State acceptance; and community acceptance.

V. References

The official record for this rulemaking has been established under docket control number OPPTS–62156, and the public version of the official record is available for inspection as specified in Unit I.B.2. The following is a listing of some of the documents that have been placed in the official record for this rulemaking, including those specifically referenced in this rulemaking.

1. Brody, D.J., J.L. Pirkle, R.A. Kramer, K.M. Flegal, T.D. Matte, E.W. Gutiter, and D.C. Paschal. 1994. "Blood Lead Levels in the U.S. Population: Phase I of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991)." Journal of the American Medical Association. 272(4):277-283.

2. Pirkle, J.L., D.J. Brody, E.W. Gunter, R.A. Kramer, D.C. Paschal, K.M. Flegal, and T.D. Matte. (1994) "The Decline in Blood Lead Levels in the United States: The National Health and Nutrition Examination Surveys (NHANES)." Journal of the American Medical Association. 272(4):284-291.

3. CDCP. (1991, October) Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control.

4. CDCP. (1997, February 21) "Update: Blood Lead Levels-U.S., 1991-1994." Morbidity and Mortality Weekly Report. 46(7):141-145.

5. HUD. (1995, June) HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing.

6. HUD. (1995) The Relation of Lead-Contaminated House Dust and Blood Lead Levels Among Urban Children. Volumes I and II. Final report to U.S. HUD from the University of Rochester School of Medicine, Rochester, NY and The National Center for Lead Safe Housing, Columbia, MD.

7. USEPA. (1990, January) "Report of the Clean Air Scientific Advisory Committee on its Review of the OAQPS Lead Staff Paper and the ECAO Air Quality Criteria Document Supplement." EPA-SAB-CASAC-90-002. January.

8. USEPA. (1994) Reducing Lead Hazards When Remodeling Your Home. EPA 747-R-94-002.

9. USEPA, OPPT. (1995, April) Report on the National Survey of Lead Based Paint in Housing - Base Report. EPA 747-R-95-003.

10. USEPA, OPPT. (1995, April). Report on the National Survey of Lead Based Paint in Housing - Appendix II: Analysis. EPA 747-R-95-005.

11. USEPA. (1995, April) Report on the National Survey of Lead-Based Paint in Housing. Appendix I: Design and Methodology. EPA 747-R95-004.

12. USEPA. (1997, December) Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil. Volumes I and II. EPA 747-R-97-006.

13. USEPA. (1998) Economic Analysis of TSCA Section 403: Lead-Based Paint Hazard Standards.

14. USEPA. (2000) Economic Analysis of TSCA Section 403: Lead-Based Paint Hazard Standards.

15. USEPA. (1994) 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive #9355.4-12, 1994.

16. USEPA. (1998, August 27) Clarification to the 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive #9200.4-27P.

17. USEPA. (1996) Urban Soil Lead Abatement Demonstration Project, Volume I: EPA Integrated Report #600/P93/001aF.

VI. Regulatory Assessment Requirements

A. Executive Order 12866

Under Executive Order 12866, entitled *Regulatory Planning and Review* (58 FR 51735, October 4, 1993), the Office of Management and Budget (OMB) has designated this an "economically significant regulatory action," because this action may result in behavioral changes that involve increased expenditures by owners of target housing and child-occupied facilities, with a potential annual effect on the economy of $100 million or more. Although the establishment of the standards contained in this rule do not, in and of themselves, mandate any action, the Agency recognizes that the existence of the hazard standards may influence the decisions or actions of owners of target housing. This rulemaking was therefore submitted to OMB for review under this Executive Order, and any changes made during that review have been documented in the public version of the official record.

In addition, while EPA does not believe that this action, in and of itself, imposes any requirements, EPA has prepared an economic analysis of the potential impacts of this action, which is contained in a document entitled *Economic Analysis of Toxic Substances Control Act Section 403: Lead-Based Paint Hazard Standards* (Ref.). The Agency believes that, in establishing the standards, it is reasonable to consider the potential costs and benefits associated with the possible actions that an owner could or might take based on the hazard standard. The analysis, in conjunction with other considerations, helped the decision-makers to select the final hazard standards presented in this document. The analysis is available as a part of the public version of the official record for this action and is briefly summarized here.

Building on the economic analysis for the proposed rule (Ref. ?), which is summarized in Unit XII of the proposed rule (63 FR at 30349-30351), the final economic analysis contains one major change. For the final rule, EPA separtely assessed the costs and benefits associated with a separate soil standard for play areas and presented the results in Appendix 7 of the Economic Analysis. The following summary of the economic analysis focuses on this change. A summary of the rest of the analysis was presented in the proposed rule (63 FR at 30349–30351).

In this additional analysis, the revised model goes through a three-step process to estimate which homes might incur a soil abatement and what parts of the yard might be addressed. The first two steps are the same as the original model, a third step was added to address the play area issue. In the original model, if the home's average of near and remote soil concentrations did not exceed the standard, then the model assumed that no soil abatements would occur. In the revised model, if the average soil concentrations were below the soil standard, then the play area (represented by the remote area) soil concentration was compared to the standard. If this alone exceeded the standard, then the model assumed that the play area soil would be removed and replaced.

The Agency notes that the costs presented here for soil response actions are based upon the assumption that those responses would be soil abatement. As noted previously in this preamble, in performing its analyses for this rule, the Agency could not quantitatively compare interim control strategies with abatement strategies because there are only limited data available on the effectiveness of interim controls over extended periods of time, and those data which are available are not suitable for quantitative comparisons with abatements. Nevertheless, experience with interim control programs is increasing and certain organizations, particularly public health and housing agencies, believe they have been able to develop effective programs for interim controls which achieve virtually the same degree of risk reduction as do abatement programs, but at much reduced cost. Thus, to the extent that interim control strategies are used rather than abatement, the actual costs may be different from those presented below.

The play area is assumed to be much smaller than the entire remote area of the yard, and separate soil intervention unit costs were estimated for the play area. The costs assume that the average play area for a single-family home is 200 square feet, and the average play area for a multi-family building is 400 square feet. The play area soil intervention costs are estimated to be: $1,070 for a single-family house ($1,738 if the soil is hazardous), and $1,566 for multi-family buildings ($2,903 if the waste is hazardous). In addition to these soil intervention costs, each home incurs a dust clean-up. Because dust clean-ups are required for certain other interventions, a particular home may already be incurring dust clean-up costs and would not incur a second set of dust clean-up costs.

The total costs (estimated over a 50–year span, and discounted at 3%) for the final dust and soil standards of 40 µg/ft^2 for floor dust, 250 µg/ft^2 for window sill dust and 1,200 ppm for soil, are estimated to be $69 billion, while the total estimated benefits are $192 billion using the IEUBK model and $49 billion using the empirical model, resulting in estimated net benefits of $123 billion using the IEUBK model and $20 billion using the empirical model. About 26.7 million homes are projected to exceed one or more of the standards, and the Agency projected approximately 46.0 million children would experience reduced exposure to household lead in soil, dust, and paint.

B. Regulatory Flexibility Act

Pursuant to section 605(b) of the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*), the Agency hereby certifies that this final rule will not have a significant economic impact on a substantial number of small entities. The factual basis for the Agency's determination is presented in the small entity impact analysis prepared as part of the economic analysis for this rule (Ref. 14), and is briefly summarized here.

It is important to first note that this rule does not, in and of itself, mandate any action, or directly impose any costs. Nevertheless, since the Agency recognizes that the existence of the hazard standards may influence the decisions or actions of owners of target housing, the Agency has considered the potential costs and benefits associated with the possible actions that a small entity could or might take based on the hazard standard. In addition, EPA has already promulgated several regulations implementing other sections of Title X that use or reference the hazard standards contained in this rule, and also has a few other related regulations under development. In promulgating these regulations, the Agency has and will continue to consider the potential adverse impacts on small entities in the context of those regulations, and in compliance with the RFA. In general, EPA strives to minimize potential adverse impacts on small entities when developing regulations to achieve the environmental and human health protection goals of the statute, and the Agency.

For the purpose of analyzing the potential impacts of this rule on small entities, EPA used the definition for small entities that is found in section 601 of the RFA. Under section 601, "small entity" is defined as: (1) A small business that meets Small Business Administration (SBA) size standards codified at 13 CFR 121.201 which uses the NAICS codes to categorize businesses; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The SBA size standard for the types of small businesses potentially impacted by this rule is $5 million in annual revenues for operators of multi-family housing or apartment buildings (NAICS code 531110 and 531311).

It its analysis, the Agency has assumed that this rule would impact small businesses that engage in lead-based paint activities (i.e., abatement, risk assessment, etc.), small businesses that offer LBP activity related training, small businesses that own or manage rental properties involving target housing, small not-for-profit organizations that are engaged in LBP activities and are not dominant in their field, and small governmental jurisdictions that receive assistance through Federal housing programs (i.e., city and county public housing authorities). By definition, States and Federal agencies are not small.

Based on the analysis, the Agency estimates that approximately 99% of the firms would have less than a 1% impact on revenues due to this rule, and approximately 1% of firms could experience impacts between 1% and 3% of rental revenue. A comparison of annual compliance costs to annual rental income is equivalent to the commonly used ratio of compliance costs to sales. Although the rule could impact a substantial number of small entities, this analysis indicates that the potential impact should not be significant.

Information relating to this determination has been provided to the Chief Counsel for Advocacy of the Small Business Administration upon request,

and is included in the public version of the official record for this rulemaking.

C. Paperwork Reduction Act

An Agency may not conduct or sponsor, and a person is not required to respond to a collection of information subject to OMB approval under the Paperwork Reduction Act (PRA) (44 U.S.C. 3501 *et seq.*) unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations, after initial publication in the **Federal Register**, are maintained in a list at 40 CFR part 9.

This final regulatory action does not contain any information collection requirements that require additional OMB approval under the Paperwork Reduction Act (PRA), 44 U.S.C. 3501 *et seq.* Specifically, States and Tribes with authorized programs under 40 CFR part 745, subpart L will still need to demonstrate their standards for identifying lead-based paint hazards and clearance standards for dust, in the reports that they submit to EPA under 40 CFR 745.324(h). This reporting requirement is contained in the regulations implementing TSCA sections 402(a) and 404, for which the Information Collection Request (ICR) has already been approved by OMB under control number 2070–0155 (EPA ICR No. 1715). As a part of the economic analysis, EPA also re-examined this ICR and determined that the burden estimates provided in the ICR would not change as a result of the promulgation of the standards proposed. Because there are no new information collection requirements to consider, or any changes to the existing requirements that might impact the existing burden estimates, additional OMB review and approval under the PRA is not necessary.

D. Unfunded Mandates Reform Act

Pursuant to Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, EPA has determined that this rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and tribal governments, in the aggregate, or the private sector in any 1 year. As indicated previously, this rule does not, in and of itself, mandate any action, or directly impose any costs. Nevertheless, the Agency recognizes that the existence of the hazard standards may influence the decisions or actions of State, local or tribal governmental officials as they relate to lead-based paint activities, i.e., hazard interventions and risk assessments. In addition, EPA has already promulgated several regulations implementing other sections of Title X that use or reference the hazard standards contained in this rule, and has a few other related regulations under development. In promulgating these regulations, the Agency has and will continue to consider the potential impacts on State, local or tribal governments.

The UMRA requirements in sections 202, 204, and 205 do not apply to this rule, because this action does not contain any "Federal mandates" or impose any "enforceable duty" on State/Tribal, or local governments or on the private sector. The requirements in section 203 do not apply because this rule does not contain any regulatory requirements that might significantly or uniquely affect small governments.

E. Executive Order 13132

Executive Order 13132, entitled *Federalism* (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" are defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

This final rule does not have federalism implications, because it will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. Although the standards established by this regulation may be adopted by any State, this regulation does not contain any mandates, and will not, therefore, impose any substantial direct costs on States. Nor would the rule substantially affect the relationship between the national government and the States, or the distribution of power and responsibilities among the various levels of government. Thus, Executive Order 13132 does not apply to this rule.

Although section 6 of Executive Order 13132 does not apply to this rule, EPA involved State and local governmental agencies in an extensive "dialogue" process, which is discussed in more detail in Unit II of the preamble to the proposal (63 FR at 30307). During development of the proposed rule, EPA also consulted with the States at meetings of the Forum on State and Tribal Toxics Action and the annual EPA meeting with State program representatives.

F. Executive Order 13084

Under Executive Order 13084, entitled *Consultation and Coordination with Indian Tribal Governments* (63 FR 27655, May 19, 1998), EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments, or EPA consults with those governments.

This rule does not significantly or uniquely affect the communities of Indian tribal governments, nor does it impose substantial direct compliance costs on such communities. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

Nevertheless, although tribal governments are not required to administer any of the Lead Programs, the Agency consulted with interested Tribal government representatives as part of the Forum on State and Tribal Toxics Action and EPA's annual national lead meeting with States and tribes. The Agency has also provided extensive technical and financial assistance.

G. Executive Order 12898

Pursuant to Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629, February 16, 1994), the Agency has considered environmental justice-related issues with regard to the potential impacts of this action on the environmental and health conditions in minority and low-income populations. The Agency's standards will protect children in minority and low-income communities from disproportionate burdens. This is based on the findings of the Agency's economic analysis which shows that non-white populations receive more of the public health benefit associated with the standards.

In addition, EPA consulted with representatives of a variety of interests, including members of environmental justice advocacy groups. The Dialogue Process, which EPA specifically established to provide input into the decision making process, included a low-income parent, two members of the National Environmental Justice Advisory Council, and representatives

of two other groups who spoke on behalf of disadvantaged populations. These individuals comprised 20% of the membership of the process. Moreover, during the public comment period, EPA held two public meetings where residents of low-income communities and representatives of environmental justice groups offered public comment to EPA. The Agency also received written comments from 50 groups and several hundred individuals raising environmental justice concerns. Consequently, EPA believes that it has complied with the provision of the executive order to provide representatives of environmental justice interests to participate fully in the process and to provide input and comment to the Agency.

Furthermore, recognizing that these standards would be used by and affect millions of people that do not have a comprehensive understanding of the science of lead hazards, EPA made a conscious decision to make the standards simple. For example, instead of joint standards that might have better reflected overall risk under some circumstances, EPA chose to establish media-specific standards because they are easier to understand and use. Outreach documents (e.g, fact sheets) are written and designed with the specific objective of making the regulation easy for the public to understand. In addition, EPA's broader lead outreach program includes extensive elements that specifically target non-white and low income communities.

H. Executive Order 13045

Executive Order 13045, entitled *Protection of Children from Environmental Health Risks and Safety Risks* (62 FR 19885, April 23, 1997), applies to this rule because OMB has determined that this rule is "economically significant" as defined under Executive Order 12866 (see Unit VI.A.). In addition, the environmental health or safety risk addressed by this rule may have a disproportionate affect on children.

In accordance with section 5(501) of Executive Order 13045, EPA has evaluated the environmental health or safety effects of lead-based paint on children in the selection of the hazard standards contained in this rule. The results of this evaluation are contained in the "Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil" and the supplement to this analysis. Copies of these documents have been placed in the public version of the official record for this rule. This analysis focused almost exclusively on assessing exposure and risk to young children.

Moreover, the standards selected by EPA are designed first and foremost to protect children from lead in residential paint, dust, and soil. In this regard, EPA believes that it has selected the most protective standards possible. Although the Agency could have selected numerically more stringent standards, EPA concluded that more stringent standards would afford less protection to children because EPA believes that limited resources would be diluted and possibly diverted from children who are at greatest risk. The standards will also protect children by supporting implementation of other provisions of the national lead program, such as hazard disclosure prior to the sale or rental of most pre-1978 housing and evaluation and control of lead-based paint hazards and Federally-assisted and Federally owned housing prior to disposition.

I. National Technology Transfer and Amendment Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law No. 104-113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

The Agency has determined that there are no voluntary consensus standards for lead-based paint hazards. However, the Agency has, where appropriate, referred to voluntary consensus standards developed by such organizations as the American Society for Testing and Materials (ASTM) with respect to sampling and analytical methods.

J. Executive Order 12630

EPA has complied with Executive Order 12630, entitled *Governmental Actions and Interference with Constitutionally Protected Property Rights* (53 FR 8859, March 15, 1988), by examining the takings implications of this rule in accordance with the "Attorney General's Supplemental Guidelines for the Evaluation of Risk and Avoidance of Unanticipated Takings" issued under the Executive Order.

K. Executive Order 12988

In issuing this rule, EPA has taken the necessary steps to eliminate drafting errors and ambiguity, minimize potential litigation, and provide a clear legal standard for affected conduct, as required by section 3 of Executive Order 12988, entitled *Civil Justice Reform* (61 FR 4729, February 7, 1996).

VII. Submission to Congress and the Comptroller General

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a major rule may take effect, the Agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and the Comptroller General of the United States. EPA has submitted a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives and the Comptroller General of the United States. This rule is a "major rule" as defined by 5 U.S.C. 804(2). A major rule cannot take effect until 60 days after date it is published in the **Federal Register** or is submitted to Congress whichever is later. This rule will take effect on March 6, 2001.

List of Subjects in 40 CFR Part 745

Environmental protection, Hazardous substances, Lead poisoning, Reporting and recordkeeping requirements.

Dated: December 22, 2000.

Carol M. Browner,

Administrator.

Therefore, 40 CFR part 745 is amended as follows:

PART 745—AMENDED

1. The authority citation for part 745 continues to read as follows:

Authority: 15 U.S.C. 2605, 2607, 2681–2692 and 42 U.S.C. 4852d.

2. By adding new subpart D to read as follows:

Subpart D—Lead-Based Paint Hazards

Sec.

745.61 Scope and applicability.
745.63 Definitions.
745.65 Lead-based paint hazards.

Subpart D—Lead-Based Paint Hazards

§ 745.61 Scope and applicability.

(a) This subpart identifies lead-based paint hazards.

(b) The standards for lead-based paint hazards apply to target housing and child-occupied facilities.

(c) Nothing in this subpart requires the owner of property(ies) subject to these standards to evaluate the property(ies) for the presence of lead-based paint hazards or take any action to control these conditions if one or more of them is identified.

§ 745.63 Definitions.

The following definitions apply to part 745.

Arithmetic mean means the algebraic sum of data values divided by the number of data values (e.g., the sum of the concentration of lead in several soil samples divided by the number of samples).

Chewable surface means an interior or exterior surface painted with lead-based paint that a young child can mouth or chew. A chewable surface is the same as an "accessible surface" as defined in 42 U.S.C. 4851b(2)). Hard metal substrates and other materials that cannot be dented by the bite of a young child are not considered chewable.

Common area group means a group of common areas that are similar in design, construction, and function. Common area groups include, but are not limited to hallways, stairwells, and laundry rooms.

Concentration means the relative content of a specific substance contained within a larger mass, such as the amount of lead (in micrograms per gram or parts per million by weight) in a sample of dust or soil.

Deteriorated paint means any interior or exterior paint or other coating that is peeling, chipping, chalking or cracking, or any paint or coating located on an interior or exterior surface or fixture that is otherwise damaged or separated from the substrate.

Dripline means the area within 3 feet surrounding the perimeter of a building.

Friction surface means an interior or exterior surface that is subject to abrasion or friction, including, but not limited to, certain window, floor, and stair surfaces.

Impact surface means an interior or exterior surface that is subject to damage by repeated sudden force such as certain parts of door frames.

Interior window sill means the portion of the horizontal window ledge that protrudes into the interior of the room.

Lead-based paint hazard means hazardous lead-based paint, dust-lead hazard or soil-lead hazard as identified in § 745.65.

Loading means the quantity of a specific substance present per unit of surface area, such as the amount of lead in micrograms contained in the dust collected from a certain surface area divided by the surface area in square feet or square meters.

Mid-yard means an area of a residential yard approximately midway between the dripline of a residential building and the nearest property boundary or between the driplines of a residential building and another building on the same property.

Play area means an area of frequent soil contact by children of less than 6 years of age as indicated by, but not limited to, such factors including the following: the presence of play equipment (e.g., sandboxes, swing sets, and sliding boards), toys, or other children's possessions, observations of play patterns, or information provided by parents, residents, care givers, or property owners.

Residential building means a building containing one or more residential dwellings.

Room means a separate part of the inside of a building, such as a bedroom, living room, dining room, kitchen, bathroom, laundry room, or utility room. To be considered a separate room, the room must be separated from adjoining rooms by built-in walls or archways that extend at least 6 inches from an intersecting wall. Half walls or bookcases count as room separators if built-in. Movable or collapsible partitions or partitions consisting solely of shelves or cabinets are not considered built-in walls. A screened in porch that is used as a living area is a room.

Soil sample means a sample collected in a representative location using ASTM E1727, "Standard Practice for Field Collection of Soil Samples for Lead Determination by Atomic Spectrometry Techniques," or equivalent method.

Weighted arithmetic mean means the arithmetic mean of sample results weighted by the number of subsamples in each sample. Its purpose is to give influence to a sample relative to the surface area it represents. A single surface sample is comprised of a single subsample. A composite sample may contain from two to four subsamples of the same area as each other and of each single surface sample in the composite. The weighted arithmetic mean is obtained by summing, for all samples, the product of the sample's result multiplied by the number of subsamples in the sample, and dividing the sum by the total number of subsamples contained in all samples. For example, the weighted arithmetic mean of a single surface sample containing 60 $\mu g/ft^2$, a composite sample (three subsamples) containing 100 $\mu g/ft^2$, and a composite sample (4 subsamples) containing 110 $\mu g/ft^2$ is 100 $\mu g/ft^2$. This result is based on the equation [60+(3*100)+(4*110)]/(1+3+4).

Window trough means, for a typical double-hung window, the portion of the exterior window sill between the interior window sill (or stool) and the frame of the storm window. If there is no storm window, the window trough is the area that receives both the upper and lower window sashes when they are both lowered. The window trough is sometimes referred to as the window "well."

Wipe sample means a sample collected by wiping a representative surface of known area, as determined by ASTM E1728, "Standard Practice for Field Collection of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination by Atomic Spectrometry Techniques, or equivalent method, with an acceptable wipe material as defined in ASTM E 1792, "Standard Specification for Wipe Sampling Materials for Lead in Surface Dust."

§ 745.65 Lead-based paint hazards.

(a) *Paint-lead hazard.* A paint-lead hazard is any of the following:

(1) Any lead-based paint on a friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction surface (e.g., the window sill, or floor) are equal to or greater than the dust-lead hazard levels identified in paragraph (b) of this section.

(2) Any damaged or otherwise deteriorated lead-based paint on an impact surface that is caused by impact from a related building component (such as a door knob that knocks into a wall or a door that knocks against its door frame.

(3) Any chewable lead-based painted surface on which there is evidence of teeth marks.

(4) Any other deteriorated lead-based paint in any residential building or child-occupied facility or on the exterior of any residential building or child-occupied facility.

(b) *Dust-lead hazard.* A dust-lead hazard is surface dust in a residential dwelling or child-occupied facility that contains a mass-per-area concentration of lead equal to or exceeding 40 $\mu g/ft^2$ on floors or 250 $\mu g/ft^2$ on interior window sills based on wipe samples.

(c) *Soil-lead hazard.* A soil-lead hazard is bare soil on residential real property or on the property of a child-occupied facility that contains total lead equal to or exceeding 400 parts per million ($\mu g/g$) in a play area or average of 1,200 parts per million of bare soil in the rest of the yard based on soil samples.

(d) *Work practice requirements.* Applicable certification, occupant protection, and clearance requirements and work practice standards are found in regulations issued by EPA at 40 CFR part 745, subpart L and in regulations issued by the Department of Housing and Urban Development (HUD) at 24 CFR part 35, subpart R. The work practice standards in those regulations do not apply when treating paint-lead hazards of less than:

(1) Two square feet of deteriorated lead-based paint per room or equivalent,

(2) Twenty square feet of deteriorated paint on the exterior building, or

(3) Ten percent of the total surface area of deteriorated paint on an interior or exterior type of component with a small surface area.

3. In § 745.223, by removing the definitions for "Lead-contaminated dust" and "Lead-contaminated soil," and by revising paragraph (1) of the definition of "Abatement," to read as follows:

§ 745.223 Definitions.

* * * * *

Abatement * * *

(1) The removal of paint and dust, the permanent enclosure or encapsulation of lead-based paint, the replacement of painted surfaces or fixtures, or the removal or permanent covering of soil, when lead-based paint hazards are present in such paint, dust or soil; and

* * * * *

4. In § 745.227, by revising paragraphs (d)(4), (d)(5), (d)(6) introductory text, (d)(7), (e)(7)(i), (e)(7)(ii), (e)(8)(ii), (e)(8)(v)(A), (e)(8)(v)(B), (e)(8)(vii), by redesignating paragraph (d)(8)(ii) as paragraph (d)(8)(iii) and paragraph (h) as paragraph (i), and by adding paragraphs (d)(8)(ii), (e)(8)(viii), and (h) to read as follows:

§ 745.227 Work practice standards for conducting lead-based paint activities: target housing and child-occupied facilities.

* * * * *

(d) * * *

(4) The following surfaces which are determined, using documented methodologies, to have a distinct painting history, shall be tested for the presence of lead:

(i) Each friction surface or impact surface with visibly deteriorated paint; and

(ii) All other surfaces with visibly deteriorated paint.

(5) In residential dwellings, dust samples (either composite or single-surface samples) from the interior window sill(s) and floor shall be collected and analyzed for lead concentration in all living areas where one or more children, age 6 and under, are most likely to come into contact with dust.

(6) For multi-family dwellings and child-occupied facilities, the samples required in paragraph (d)(4) of this section shall be taken. In addition, interior window sill and floor dust samples (either composite or single-surface samples) shall be collected and analyzed for lead concentration in the following locations:

* * * * *

(7) For child-occupied facilities, interior window sill and floor dust samples (either composite or single-surface samples) shall be collected and analyzed for lead concentration in each room, hallway or stairwell utilized by one or more children, age 6 and under, and in other common areas in the child-occupied facility where one or more children, age 6 and under, are likely to come into contact with dust.

(8) * * *

(ii) The rest of the yard (i.e., non-play areas) where bare soil is present.

* * * * *

(e) * * *

(7) * * *

(i) If the soil is removed:

(A) The soil shall be replaced by soil with a lead concentration as close to local background as practicable, but no greater than 400 ppm.

(B) The soil that is removed shall not be used as top soil at another residential property or child-occupied facility.

(ii) If soil is not removed, the soil shall be permanently covered, as defined in § 745.223.

(8) * * *

(ii) Following the visual inspection and any post-abatement cleanup required by paragraph (e)(8)(i) of this section, clearance sampling for lead in dust shall be conducted. Clearance sampling may be conducted by employing single-surface sampling or composite sampling techniques.

* * * * *

(v) * * *

(A) After conducting an abatement with containment between abated and unabated areas, one dust sample shall be taken from one interior window sill and from one window trough (if present) and one dust sample shall be taken from the floors of each of no less than four rooms, hallways or stairwells within the containment area. In addition, one dust sample shall be taken from the floor outside the containment area. If there are less than four rooms, hallways or stairwells within the containment area, then all rooms, hallways or stairwells shall be sampled.

(B) After conducting an abatement with no containment, two dust samples shall be taken from each of no less than four rooms, hallways or stairwells in the residential dwelling or child-occupied facility. One dust sample shall be taken from one interior window sill and window trough (if present) and one dust sample shall be taken from the floor of each room, hallway or stairwell selected. If there are less than four rooms, hallways or stairwells within the residential dwelling or child-occupied facility then all rooms, hallways or stairwells shall be sampled.

* * * * *

(vii) The certified inspector or risk assessor shall compare the residual lead level (as determined by the laboratory analysis) from each single surface dust sample with clearance levels in paragraph (e)(8)(viii) of this section for lead in dust on floors, interior window sills, and window troughs or from each composite dust sample with the applicable clearance levels for lead in dust on floors, interior window sills, and window troughs divided by half the number of subsamples in the composite sample. If the residual lead level in a single surface dust sample equals or exceeds the applicable clearance level or if the residual lead level in a composite dust sample equals or exceeds the applicable clearance level divided by half the number of subsamples in the composite sample, the components represented by the failed sample shall be recleaned and retested.

(viii) The clearance levels for lead in dust are 40 $\mu g/ft^2$ for floors, 250 $\mu g/ft^2$ for interior window sills, and 400 $\mu g/ft^2$ for window troughs.

* * * * *

(h) *Determinations.* (1) Lead-based paint is present:

(i) On any surface that is tested and found to contain lead equal to or in excess of 1.0 milligrams per square centimeter or equal to or in excess of 0.5% by weight; and

(ii) On any surface like a surface tested in the same room equivalent that has a similar painting history and that is found to be lead-based paint.

(2) A paint-lead hazard is present:

(i) On any friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction surface (e.g., the window sill or floor) are equal to or greater than the dust hazard levels identified in § 745.227(b);

(ii) On any chewable lead-based paint surface on which there is evidence of teeth marks;

(iii) Where there is any damaged or otherwise deteriorated lead-based paint on an impact surface that is cause by

impact from a related building component (such as a door knob that knocks into a wall or a door that knocks against its door frame; and

(iv) If there is any other deteriorated lead-based paint in any residential building or child-occupied facility or on the exterior of any residential building or child-occupied facility.

(3) A dust-lead hazard is present in a residential dwelling or child occupied facility:

(i) In a residential dwelling on floors and interior window sills when the weighted arithmetic mean lead loading for all single surface or composite samples of floors and interior window sills are equal to or greater than 40 μg/ft² for floors and 250 μg/ft² for interior window sills, respectively;

(ii) On floors or interior window sills in an unsampled residential dwelling in a multi-family dwelling, if a dust-lead hazard is present on floors or interior window sills, respectively, in at least one sampled residential unit on the property; and

(iii) On floors or interior window sills in an unsampled common area in a multi-family dwelling, if a dust-lead hazard is present on floors or interior window sills, respectively, in at least one sampled common area in the same common area group on the property.

(4) A soil-lead hazard is present:

(i) In a play area when the soil-lead concentration from a composite play area sample of bare soil is equal to or greater than 400 parts per million; or

(ii) In the rest of the yard when the arithmetic mean lead concentration from a composite sample (or arithmetic mean of composite samples) of bare soil from the rest of the yard (i.e., non-play areas) for each residential building on a property is equal to or greater than 1,200 parts per million.

5. In § 745.325, by revising paragraphs (d)(2)(iii)(A) and (d)(2)(iii)(B), by redesignating (d)(2)(iv) and (d)(2)(v) as (d)(2)(v) and (d)(2)(vi), respectively, and by adding paragraphs (d)(2)(iii)(C), (d)(2)(iii)(D), (d)(2)(iv), and (e), to read as follows:

§ 745.325 Lead-based paint activities: State and Tribal program requirements.

* * * * *

(d) * * *

(2) * * *

(iii) * * *

(A) An assessment, including a visual inspection, of the physical characteristics of the residential dwelling or child-occupied facility;

(B) Environmental sampling for lead in paint, dust, and soil;

(C) Environmental sampling requirements for lead in paint, dust, and soil that allow for comparison to the standards for lead-based paint hazards established or revised by the State or Indian Tribe pursuant to paragraph (e) of this section; and

(D) A determination of the presence of lead-based paint hazards made by comparing the results of visual inspection and environmental sampling to the standards for lead-based paint hazards established or revised by the State or Indian Tribe pursuant to paragraph (e) of this section.

(iv) The program elements required in paragraph (d)(2)(iii)(C) and (d)(2)(iii)(D) of this section shall be adopted in accordance with the schedule for the demonstration required in paragraph (e) of this section.

* * * * *

(e) The State or Indian Tribe must demonstrate that it has standards for identifying lead-based paint hazards and clearance standards for dust, that are at least as protective as the standards in § 745.227 as amended on February 5, 2001. A State or Indian Tribe with such a section 402 program approved before February 5, 2003 shall make this demonstration no later than the first report submitted pursuant to § 745.324(h) on or after February 5, 2003. A State or Indian Tribe with such a program submitted but not approved before February 5, 2003 may make this demonstration by amending its application or in its first report submitted pursuant to § 745.324(h). A State or Indian Tribe submitting its program on or after February 5, 2003 shall make this demonstration in its application.

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World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks

May 2003

Prepared by the Contaminants of Potential Concern (COPC) Committee
of the World Trade Center Indoor Air Task Force Working Group

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Foreword

Following the collapse of the World Trade Center on September 11, 2001, federal, state, and municipal health and environmental agencies initiated numerous studies to assess environmental conditions in the area. A multi-agency task force was specifically formed to evaluate indoor environments for the presence of contaminants that might pose long-term health risks to local residents. As part of this evaluation, a task force committee was established to identify contaminants of primary health concern and establish health-based benchmarks for those contaminants in support of ongoing residential cleanup efforts in Lower Manhattan. In September 2002, the committee released a draft document titled "World Trade Center (WTC) Indoor Air Assessment: Selecting Contaminants of Potential Concern (COPC) and Setting Health-Based Benchmarks."

In October 2002, a panel of 11 experts conducted an independent peer review of the draft COPC document to ensure that the evaluations presented in the document were technically based and scientifically sound. A final report with peer reviewers' conclusions and recommendations was released in February 2003. The peer review report and the COPC Committee's response to peer review comments can be accessed on-line at: www.tera.org.

The responsiveness summary provides the formal responses to peer reviewer comments. EPA, through its chairmanship of the multi-agency committee that authored the response to peer review comments, assumes ownership and fully endorses that report's content. The responsiveness summary presents background on the peer review process, an overview of the peer reviewers' main conclusions and recommendations, and the document authors' responses to specific comments. The final COPC document presents the updated approaches for selecting COPC and setting health-based benchmarks, based on peer reviewer input.

Copies of the final COPC document can be obtained on-line at www.epa.gov/WTC. Inquires regarding the content of this document should be directed to:

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This document is just one product that addresses environmental and public health concerns related to the WTC. Individuals interested in other studies and research projects related to the WTC should refer to the following Web pages:

1.01 U.S. EPA: www.epa.gov/WTC
1.02 ATSDR: www.atsdr.cdc.gov/
1.03 NYCDOHMH: http://home.nyc.gov/html/doh/html/alerts/911.html

List of Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ATSDR	Agency for Toxic Substances and Disease Registry
COPC	contaminant(s) of potential concern
CSF	cancer slope factor
EPA	U.S. Environmental Protection Agency
HEAST	Health Effects Assessment Summary Tables
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
$\mu g/m^3$	microgram per cubic meter
mg/m^3	milligram per cubic meter
MRL	ATSDR minimal risk level
NHANES	National Health and Nutrition Examination Survey
NIOSH	National Institute of Occupational Safety and Health
NJDEP	New Jersey Department of Environmental Protection
NYCDEP	New York City Department of Environmental Protection
NYCDOHMH	New York City Department of Health and Mental Hygiene
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
PCM	phase contrast microscopy
PEL	OSHA permissible exposure limit
REL	NIOSH recommended exposure limit
RfD	reference dose
RfC	reference concentration
SVOC	semi-volatile organic compound
TERA	Toxicology Excellence for Risk Assessment
TLV	ACGIH threshold limit value
VOC	volatile organic compound
WTC	World Trade Center

1.0 Introduction

Background

Since September 11, 2001, the outdoor (ambient) environment around the World Trade Center (WTC) site and nearby areas has been extensively monitored by a group of federal, state, and municipal environmental and health agencies. The agencies have taken samples of air, dust, water, river sediments, and drinking water and analyzed them for the presence of contaminants that could pose a health risk to response workers at the WTC site, office workers, and local residents.

While some workers (WTC response as well as office) and local residents may have experienced acute irritant and respiratory effects from the collapse of the towers and associated fires, extended monitoring of the ambient air at and beyond the perimeter of the WTC site over the past year and a half indicates that contaminant concentrations in the ambient air pose a low risk of long-term health effects (EPA 2002). In February 2002, A multi-agency task force headed by EPA was specifically formed to evaluate indoor environments for the presence of contaminants that might pose long-term health risks to local residents. As part of this evaluation, a task force committee was established (COPC Committee) to identify contaminants of primary health concern and establish health-based benchmarks for those contaminants in support of planned residential cleanup efforts in Lower Manhattan.

Purpose

The process of selecting contaminants of potential concern (COPC) and setting health-based benchmarks—the subject of this document — is intended to determine which contaminants are likely associated with the WTC disaster for the purpose of setting health-based benchmarks for the indoor air and settled dust.

As depicted in Diagram 1, the COPC document informs the Indoor Air Residential Assistance/WTC Dust Clean-up Program, which will be referred to as the WTC Clean-up Program through the remainder of this document. In conventional hazardous waste site investigations, the COPC selection process is intended to reduce what is typically an extensive contaminant sampling list to a manageable "short list" of risk-driving chemicals. The risk from this "short list" is then calculated to determine if remedial action is warranted. Regarding the WTC, there was an a priori decision to institute a clean-up program rather than launch a formal remedial investigation to determine if remediation of residential dwellings was necessary. The primary reason for this decision was to eliminate the time-consuming process of initiating a remedial investigation (i.e., developing a sampling and analysis plan, conducting representative sampling of residential dwellings, analyzing a large number of samples, and finally interpreting results) at a time when re-habitation of residential dwellings in Lower Manhattan was nearly complete. As a result of this decision, the COPC selection process associated with the WTC Clean-up Program assumed a somewhat modified purpose. Rather than serve as a process to determine the need for clean-up, the COPC selection process served to facilitate development of health-based benchmarks for the WTC Clean-up Program. By identifying COPC, health-based clearance criteria for individual contaminants could be developed for indoor air and settled dust. To summarize, first and foremost, the intent of the COPC document is to identify risk-driving chemicals and to establish specific health-based benchmarks for the WTC Clean-up Program.

As part of this initiative, the COPC selection process informed two complimentary studies that were undertaken as part of the WTC Clean-up Program. The first was the WTC Residential Confirmation

Cleaning Study (EPA 2003a). This study was initiated to evaluate the effectiveness of various cleaning methods (e.g., high-efficiency particulate air vacuuming, wet wiping) used to clean residences. The COPC selection process provided the list of contaminants to sample for in the WTC Residential Confirmation Cleaning Study. It also enabled the development of health-based benchmarks for indoor air and settled dust so the effectiveness of cleaning methods could be assessed. The cleaning methods employed also served to guide the clean-ups of other heavily impacted unoccupied buildings. Another outcome of the WTC Residential Confirmation Cleaning Study was in streamlining the post-cleaning sampling needs of the WTC Clean-up Program. Although not a specific goal, this effort identified an indicator chemical (i.e., asbestos) that signaled the reduction of all COPC to concentrations below health-based benchmarks. With thousands of residents signed up for cleaning, the use of an indicator contaminant to establish cleaning effectiveness provided a powerful tool in facilitating the WTC Clean-up Program.

The other initiative that the COPC selection process informed was the WTC Background Study (EPA 2003b). The development of remediation goals is influenced by factors such as technical implementation, analytical detection limits, and the background concentration of contaminants in the environmental setting of interest. A literature review of contaminant background concentrations in residential dwellings was conducted to inform the WTC Clean-up Program. Limited information was obtained for asbestos in indoor air and lead and dioxin in settled dust, otherwise the search yielded very little useful data. It was therefore deemed advantageous to conduct a site-specific background study to inform risk management decisions regarding the setting of clean-up goals at health-based or background concentrations. Consequently, The COPC selection process directed the group of contaminants to be sampled for in the WTC Background Study. Conversely, the results of the WTC Background Study provides data to enhance the value of the final COPC document. That is, it provides an estimate of background for COPC in Lower Manhattan to be evaluated alongside health-based benchmarks.

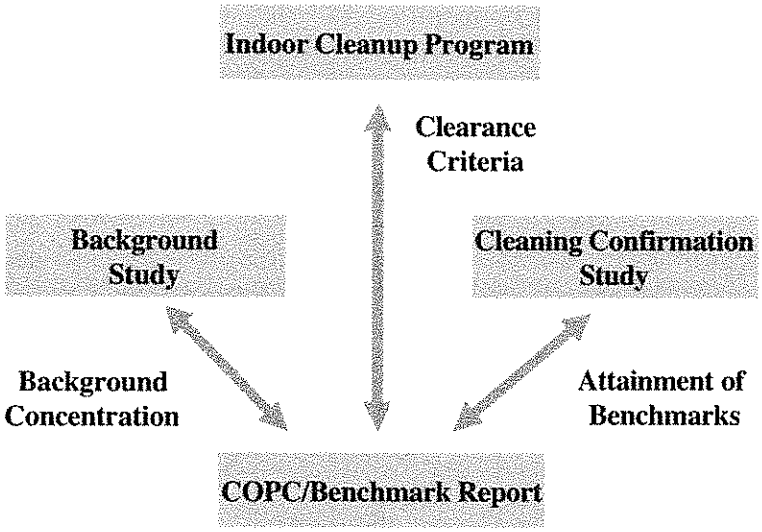


Diagram 1

2.0 Selecting the Contaminants of Potential Concern (COPC)

A systematic risk-based approach was used to select COPC. As shown in Figure 1, the selection process involved multiple steps. The process began with the review of an extremely large environmental data set, including indoor and outdoor air and dust data. This was followed by a two-level screening which considered individual contaminant toxicity, the prevalence of a contaminant within and across media, and the likelihood that a detected contaminant was related to the WTC disaster. The goal of the process was to identify those contaminants most likely to be present within indoor environments at levels of health concern.

This section details the steps and overall findings of the COPC selection process. Two appendices provide supporting documentation for the screening process. Appendix A describes how the health-based screening values used in the process were derived. Appendix B presents the findings of each step of the process.

2.1 Review of Multiple Data Sets to Identify Candidate Substances

The collapse of the WTC released a very broad range of contaminants into the air, many of which deposited with settled dust on surfaces in Lower Manhattan, both indoors and outdoors. To gain the best possible sense of the contamination levels in indoor residential environments, multiple sets of sampling data describing environmental conditions at and near the WTC site between September 11, 2001, and the present were reviewed. The primary goal of this exercise was to review data that might provide insights on the contamination levels inside Lower Manhattan residences. As a result, a large set of bulk dust and settled dust sampling results were reviewed, along with ambient and indoor air sampling data, based on the premise that contaminants entered residences through atmospheric transport.

Sampling data evaluated included those collected by the U.S. Environmental Protection Agency (EPA), Agency for Toxic Substances and Disease Registry (ATSDR), Occupational Safety and Health Administration (OSHA), New York City Department of Environmental Protection (NYCDEP), New York City Department of Health and Mental Hygiene (NYCDOHMH), the New York City Department of Education, the New Jersey Department of Environmental Protection (NJDEP), academic institutions and independent investigators. Overall, we examined results from more than 500,000 environmental samples, with sampling results available for more than 300 contaminants. The contaminants included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, asbestos, silica, other minerals, and synthetic fibers. Every contaminant identified in the sampling data was considered a candidate substance for the COPC selection process. A more complete description, including citations, of the data bases evaluated for selecting COPC can be found in Appendix B.

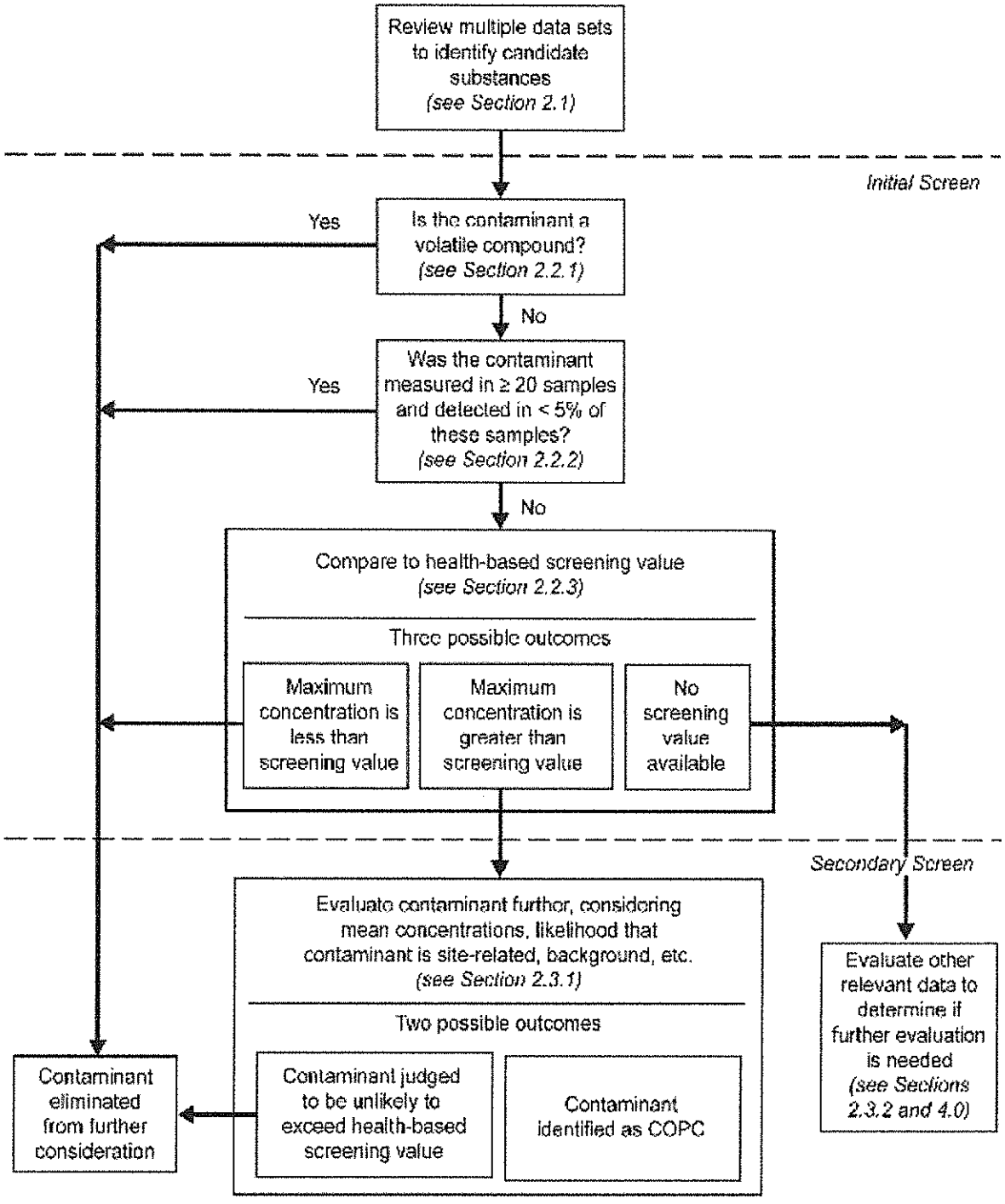


Figure 1. COPC Selection Process

2.2 Initial Screen to Identify Contaminants Requiring Further Consideration

The goal of the initial screening procedure was to sort through a large volume of data in a consistent manner to identify those substances requiring closer evaluation. In this analysis, ambient air, indoor air, bulk dust, and settled dust data were evaluated separately. The initial screening involved three main steps, as described below. The outcome of this process is detailed in Appendix B.

2.2.1 Eliminating volatile compounds

Volatile compounds were eliminated from the COPC selection process, because any volatile compound that might have been released in or adhered to dusts from the WTC site have likely evaporated or greatly dissipated since the time that air emissions from the site were controlled (i.e., since the time that the fires were extinguished - December, 2001). Any contaminant on the target compound list for Method TO-15 (ambient air) and Method 8260 (waste) was considered volatile. Further, chemical similarity to compounds on those lists and boiling point (as a surrogate for vapor pressure) were used to identify additional volatile contaminants not on these methods' target lists.

2.2.2 Eliminating contaminants detected at low frequencies

All contaminants detected in fewer than 5% of samples were removed from the list of candidate contaminants, but only if the contaminant was analyzed for in more than 20 samples. This screening approach based on frequency of detection is consistent with EPA's guidance on human health risk assessment (EPA 1989). The purpose of this step was to focus the COPC selection process on contaminants that were consistently detected, rather than on those that were infrequently detected.

The frequency of detection was calculated based on all relevant sampling data for a particular medium. WTC related environmental samples were obtained throughout Lower Manhattan from 9/11/01 through the present time. Using this approach, a contaminant could be eliminated even if it were detected at a relatively high concentration, but perhaps only in one location or at one point in time. We therefore carefully reviewed the contaminants eliminated in this step of the process to ensure that contaminants possibly linked with the WTC disaster and of potential public health importance did not get eliminated using this procedure. For example, before eliminating PCBs from further consideration, we confirmed that the PCBs detected in fewer than 3% of settled dust samples did not exceed health-based screening values.

2.2.3 Comparing detected concentrations to health-based screening values

For the contaminants that were not eliminated in the previous two steps, the maximum concentration detected in each medium was compared to corresponding health-based screening values. Health-based screening values were derived for air, bulk dust, and settled dust using methodologies, risk equations, and exposure assumptions consistent with established EPA risk assessment guidance. Appendices A and D present the specific risk equations, exposure parameters, and toxicity values used in deriving health-based screening values.

Exposure equations generally stem from EPA's Risk Assessment Guidance for Superfund (RAGS) (EPA 1989). Exposure assumptions used are those recommended in RAGS or supplemental risk assessment guidance, including EPA's Exposure Factors Handbook (EPA 1997b), Child-Specific Exposure Factors Handbook (EPA 2002a), Dermal Exposure Assessment: Principles and Applications (EPA 1992), and RAGS Part E, Supplemental Guidance for Dermal Risk Assessment (EPA 2001a).

To evaluate the settled dust pathway, EPA guidance for residential pesticide exposure assessment (EPA 2001b) was used and further supported by procedures and re-entry guidelines previously developed for scenarios evaluating fine dust particles more analogous to those associated with the WTC collapse (Kim and Hawley 1985; NJDEP 1993; Michaud et al. 1994; Radian 1999).

In calculating health-based screening values, the following criteria were applied to all exposure pathways:

- # Evaluation of both cancer and non-cancer effects, with a target cancer risk of 10^{-4} and a hazard quotient of 1 for non-cancer endpoints—the more sensitive of the two being used to derive screening values.

- # Evaluation of adult and child exposures, with child exposures factoring heavily into the development of dust screening values.

- # Use of the most current toxicity criteria on EPA's Integrated Risk Information System (IRIS) database. In the absence of IRIS toxicity criteria, the following hierarchy of toxicity data sources was used: EPA's Health Effects Assessment Summary Tables (HEAST), ATSDR's minimal risk levels (MRLs), provisional values derived by EPA's National Center for Environmental Assessment, and, in limited cases, the use of surrogate toxicity values or cross-route extrapolations.

Three outcomes were possible from this initial screening:

1) If a contaminant's maximum concentration was lower than the corresponding screening value, that contaminant was eliminated from further consideration. Appendix B presents, by medium, the contaminants that fall into this category, listing the maximum detected concentrations and corresponding screening values.

2) If a contaminant's maximum concentration was greater than the screening value, then we evaluated the contaminant further in the secondary screening step (see Section 2.3.1 below). Fifteen contaminants fell into this category, including:

Aluminum	Chromium	Nickel
Antimony	Dioxins	PAHs (carcinogenic)
Arsenic	Lead	Mercury
Asbestos	Manganese	4,4'-Methylene diphenyl diisocyantate (MDI)
Barium	Naphthalene	Thallium

3) If a contaminant did not have a toxicity value, and therefore did not have a screening value, we reviewed other relevant information (e.g., trends among sampling data, comparisons to background, the likelihood of the contaminant being related to site-specific releases) on a case-by-case basis to determine whether the contaminant should be evaluated further (see Section 2.3.2 below).

2.3 Secondary Screen to Select COPC.

As noted in the previous section, two classes of contaminants required further evaluation after the initial screen: (1) contaminants with a maximum concentrations greater than screening values and (2)

contaminants for which no screening values are available. Sections 2.3.1 and 2.3.2 describe the secondary screening procedure for these two groups of contaminants. Appendix B (Section 5.0) presents detailed justifications for the contaminants included and not included as COPC.

2.3.1 Contaminants with toxicity criteria

For those substances exceeding health-based screening criteria in at least one sample, a detailed review of findings across environmental media was conducted to assess the representativeness of reported maximum concentrations, to study spatial and temporal trends, to determine the relationship of detected concentrations to available background concentrations, and to examine whether there was reason to believe a contaminant was site-related. Professional judgment entered into this part of the process. In general, contaminants with reported concentrations deemed representative of exposure conditions and detected above background (if appropriate comparison data were available) were retained as COPC.

The following list describes the final decisions reached for the 15 contaminants identified as requiring further evaluation:

Asbestos, dioxins, lead, and PAHs. These contaminants were selected as COPC because they were consistently detected across environmental media at concentrations above health-based screening values.

Aluminum, antimony, arsenic, barium, manganese, naphthalene, nickel, MDI, and thallium. These contaminants were not selected as COPC. In each case, closer examination presented strong evidence that these contaminants were not likely present in indoor dusts at levels of health concern (See Appendix B for additional discussion).

Chromium and mercury. These two contaminants were not retained as COPC but deserve some additional discussion. Chromium in ambient air has been shown to exceed health-based screening values, though chromium levels in available bulk and settled dusts collected in Lower Manhattan are not above health-based screening values. Regarding mercury, wipe sampling data indicated that in isolated instances settled dust in Lower Manhattan residences contained mercury at levels greater than health-based screening values. In both cases, it is unclear whether detected levels were associated with the WTC. (See Appendix B for additional discussion.) Regardless, as part of the WTC Clean-up Program, EPA is performing a limited number of wipe samples for 21 non-COPC metals, including chromium and mercury.

2.3.2 Contaminants with no toxicity criteria

A subset of contaminants were detected for which no toxicity criteria or corresponding screening values were available. For these contaminants we considered any occupational or environmental standards and/or evaluated sampling trends, exposure potential, and the likelihood a contaminant was associated with the WTC collapse. The following list describes the final decisions reached for these contaminants:

Fibrous glass and crystalline silica. These contaminants were retained as COPC. Both are components of building materials. Fibrous glass was consistently detected at high concentration in both bulk and settled dust samples collected at and near the WTC site. Crystalline silica, measured as alpha quartz, has been selected as a COPC for the following reasons: (1) indoor dust levels of quartz in Lower Manhattan were found to be significantly higher than those in comparison locations north of 59th Street; (2) quartz has been found in the respirable fraction of

air samples, demonstrating a potential for exposure; and (3) quartz is a known component of building construction materials and was known to be released when the WTC collapsed.

Calcite, gypsum, and portlandite. These contaminants were eliminated from further consideration. Detected concentrations were more than 100 times lower than occupational exposure limits for irritant effects.

Essential nutrients (e.g., calcium, magnesium); a limited number of specific phthalates and PAHs, and SVOCs that are not conventionally measured to support EPA risk assessment. Due to the lack of appropriate comparison data, these substances were not carried any further in the COPC selection process. See Section 4.0 (Uncertainties and Limitations) for perspective on the impact that not evaluating these substances has on the overall COPC selection process.

3.0 Setting Benchmarks for the Contaminants of Potential Concern (COPC)

Health-based benchmarks were developed to be protective of long-term habitability of residential dwellings. The following hierarchal approach was employed for developing benchmark values: use of relevant and appropriate environmental standards/regulations; calculation of health-based benchmarks employing environmental risk assessment guidance, and adaptation of occupational standards with additional safety factors.

3.1 Use of Environmental Standards/Regulations

A review of environmental standards/regulations was conducted for each of the six COPC. The COPC Committee identified an applicable and relevant existing standard to set a health-based benchmark for lead in interior dust. The Residential Lead-Based Paint Hazard Reduction Act (Title X) Final Rule (40 CFR, Part 745, 1/5/01) established uniform national standards for lead in interior dust. Thus, both EPA and the United States Department of Housing and Urban Development (HUD) have set a dust standard for lead of 40 $\mu g/ft^2$ for floors (including carpeted floors) and 250 $\mu g/ft^2$ for interior window sills. To support the development of a dust standard EPA performed an analysis of the Rochester Lead-in-Dust Study (HUD, 1995). At 40 $\mu g/ft^2$ a multimedia analysis shows a 5.3% probability that a child's blood lead level would exceed 10 $\mu g/dl$. Thus, this standard meets the criteria established by EPA (i.e., 95% probability to be below 10 $\mu g/dl$) (EPA 1994a) for managing environmental lead hazards. However, the COPC Committee opted to set the benchmark at the more stringent HUD screening level of 25 $\mu g/ft^2$.

The clearance criteria established in the Asbestos Hazard Emergency Response Act (AHERA 1986) of 70 structures/mm^2 (0.022 f/cc) was utilized to evaluate asbestos samples from the WTC ambient (outdoor) air monitoring effort. Although not specifically risk-based, the AHERA standard was deemed an appropriate benchmark for evaluating ambient airborne asbestos data, especially since exposure to potentially elevated levels of asbestos in the ambient air was not expected to exceed the duration of time needed to clean-up Ground Zero (i.e., less than one year). However, given the potential for extended exposure in residential dwellings, a risk-based approach specifically developed to address long-term exposure was deemed more appropriate.

3.2 Developing Risk-Based Benchmarks for Indoor Air and Settled Dust

In cases where appropriate standards did not exist (e.g., asbestos), risk-based benchmarks were developed using established EPA risk assessment methods: for indoor air, methods described in EPA's "Risk Assessment Guidance for Superfund" (EPA 1989) were used; for settled dust, the most formal EPA guidance which addresses this issue is the "Standard Operating Procedures (SOPs) for Residential Exposure Assessment" originally published by the Office of Pesticides in 1997 and updated in 2001 (Appendix D - EPA 1997a and EPA 2001a). This methodology was employed with modifications. (See Appendix D for a comprehensive discussion of the methods, exposure parameters and equations used to develop risk-based benchmarks for indoor air and settled dust.) The risk-based benchmarks reflect the most current toxicity criteria (Cancer Slope Factors and RfDs/RfCs) on EPA's Integrated Risk Information System (IRIS). IRIS is a regularly updated (quarterly), online database that reports chemical toxicity reference values and information on human health effects that may result from exposure to chemicals in the environment. In the absence of IRIS toxicity criteria, the following hierarchy of toxicity data sources was used: EPA's Health Effects Assessment Summary Tables (HEAST), ATSDR's minimal risk levels (MRLs), provisional values derived by EPA's National Center for Environmental Assessment, and, in limited cases, the use of surrogate toxicity values or cross-route extrapolations. Health based benchmarks for asbestos, dioxin, and PAHs, were derived by this process.

EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model (EPA, 1994) was employed to derive a health-based benchmark for lead in indoor air. EPA developed the IEUBK Lead Model to evaluate multimedia lead exposure to children in residential settings. EPA established a goal of attaining a 95% probability that blood lead levels in children be less than 10 : g g/dl (EPA 1994a). Setting the indoor air lead concentration at 0.7 : g g/m^3 and using site specific (i.e., New York City background) concentrations for lead in water, diet, soil and dust, the IEUBK Lead Model estimates that 95% of the blood lead probability distribution falls below 10 : g/dl. See Appendix E for a detailed discussion of medium-specific lead concentrations, data input spreadsheets and a graphic display of the blood lead probability distribution for children 0-7 years old.

3.3 Developing Benchmark Levels Based on Occupational Health Standards

For contaminants that lacked environmental toxicity criteria from sources listed in Section 3.2, occupational standards served as the starting point for benchmark development. Additional safety factors were added to account for higher exposure and greater sensitivity within the general population. The health-based benchmarks for fibrous glass and crystalline silica in indoor air were developed in this manner. A detailed discussion for each benchmark is provided below.

Fibrous glass. Although the TLV (1 f/cc) is based on irritant effects, the derived benchmark of 0.01 f/cc (100 fold safety factor) is believed to be protective for chronic residential exposure for glass and mineral wool. The COPC Committee did not specifically apportion this adjustment as a duration adjustment or an adjustment for application to a non-worker population. Although this total adjustment of 100 could be considered to cover the 4.2 duration adjustment, and an adjustment above that for application to non-worker population, there is considerable variation in how this second adjustment may be set. The concern is not so much can we assign a specific number for the adjustment which is accurate, but rather is the resulting benchmark protective?

Fibrous glass less than 3 microns in diameter are respirable and available to enter and deposit in the pulmonary regions of the lung (ACGIH 2001). Clearance of these fibers from the lung will be determined by fiber solubility and length (ACGIH 2001; ATSDR 2002a). Fibers cleared from the lung have less potential to create long-term health effects. Less soluble materials have a longer residence time in the lung and therefore have a greater potential to contribute to tissue damage or malignant disease. Within synthetic vitreous fiber (SVF) types, glass fibers and slag wool are considered the most

soluble, and therefore least toxic. Mineral wool is less soluble than glass wool. The fibers observed in indoor and outdoor dust samples from the WTC area contained glass wool and mineral wool, both of which have lower biopersistence than other forms of synthetic vitreous fibers.

Although some animal studies have demonstrated both fibrotic and carcinogenic potential for glass and mineral wools (ACGIH 2001; ATSDR 2002a; IARC 1988), more recent studies do not fully support this finding.[1] Epidemiologic studies on workers exposed to fibrous glass do not provide consistent evidence of pulmonary effects, although some effects were noted (ATSDR 2002a; Bonn et al. 1993). Similarly, when assessing deaths due to lung cancer in workers exposed to glass wool, studies do not provide strong evidence for increased risk of cancer deaths attributable to the glass wool exposure.

The carcinogenic potential of fiberglass has been reviewed by several agencies. The IARC originally classified both glass and mineral wools as Group 2B carcinogens, possibly carcinogenic to humans, based on animal studies (IARC 1987). Similarly these materials were classified as carcinogens by the National Toxicology Program and the American Conference of Governmental Industrial Hygienists (ACGIH 2001; NTP 2001). However a review of the carcinogenic potential of these fibers by IARC in 2001, which takes into account updated human studies, animal inhalation studies, and mechanistic studies, recommends a change in this classification. The IARC has announced that the recent monograph designates both glass and mineral wool as Group 3, unclassifiable as to carcinogenicity in humans, because of inadequate evidence of carcinogenicity in humans and the relatively low biopersistence of the materials.

In contrast, the less soluble and more biopersistent refractory ceramic fibers are still considered potentially carcinogenic and are believed to more toxic than glass and mineral wools. A recent review of the toxicity of synthetic vitreous fibers by ATSDR proposes a Minimal Risk Level for chronic exposure of 0.03 f/cc for these refractory ceramic fibers (ATSDR 2002b). Although ATSDR did not set MRLs for glass and mineral wools, it notes that "insulation wools are markedly less durable and less potent than refractory ceramic fibers." Therefore the benchmark of 0.01 f/cc for glass and mineral wools, which is lower, should be considered protective.

Silica. No threshold has been established and it is possible health effects occur below the NIOSH REL of 50 : g/m3. Although duration adjustments and uncertainty factors can be applied to this REL to develop a benchmark for residential exposure, the resulting level would be below practical detection limits. Therefore the COPC Committee is recommending a benchmark of 5 : g/m^3, which is the lowest amount that can be reliably reported in a reasonable sampling time.

The level of this benchmark is technically limited by sampling constraints, including time and weight loading. It is based upon a reporting limit of 10 micrograms of crystalline silica with no more than about 3 milligrams of total dust on a single filter. (A reporting limit is the smallest amount of a substance for which a quantitative value can be determined.) More than about 3 milligrams of dust on the filter will decrease analytical sensitivity. Collection of 2 cubic meters of air over about 20 hours for a Dorr-Oliver cyclone at 1.7 L/min or about 13.3 hours using an SKC cyclone at 2.5 L/min will provide sufficient sensitivity to measure 5 $\mu g/m^3$ crystalline silica so long as the total dust weight on the filter does not

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[1]Early studies often relied upon injection and implantation studies, which may not accurately predict a pulmonary response from inhalation exposures. A review of inhalation studies indicates that glass wool did not cause pulmonary fibrosis or lung cancer in these animal studies (Bonn et al. 1993). A recent study by Hesterberg indicates no increase in pulmonary fibrosis or lung cancer even at doses of 222 f/cc, although cancer incidence in control animals was considered high.

exceed about 3 milligrams (an airborne dust concentration of 1.5 mg/m^3). Using either the nylon Dorr-Oliver or SKC Aluminum Cyclones, the following limits are possible:

Sampling Equipment (Size selection cyclones)	Duration of sampling	Volume of air (m^3)	Effective reporting limit (μg/m^3)
Dorr-Oliver (OSHA) at1.7 L/min	6 hours (360 min)	0.61	16.3
	8 hours (480 min)	0 .81	12.3
	10 hours (600 min)	1.02	9.8
	19.6 hours (1176 min)	2.0	5.0
SKC Aluminum (NIOSH) at 2.5 L/min	6 hours (360 min)	0.9	11.2
	8 hours (480 min)	1.20	8.4
	10 hours (600 min)	1.5	6.7
	13.3 hours (800min)	2.0	5.0

3.4 Health-Based Benchmarks (Summary Table)

Table 1 lists the COPC health-based benchmarks for indoor air and settled dust. Benchmarks for asbestos, fibrous glass and crystalline silica in settled dust are not provided for the following reason. These three minerals exert their toxicity primarily through the inhalation route of exposure. Therefore, a health-based benchmark for settled dust would be a function of the relationship between the mineral content in settled dust and indoor air. Limited studies (Millette and Hays, 1994) have described the empirical relationships (referred to be the authors as " K factors") between concentrations of asbestos fibers in settled dust and indoor air. These K factors were developed by studying matched air and settled dust samples taken from indoor environments at varying levels of activity. However, due to the numerous factors that influence the relationship between fiber concentration in settled dust and indoor air, including surface porosity, activity patterns, air exchange rates and interior volume, the COPC Committee elected against setting benchmarks for COPC in settled dust based on projected concentrations in indoor air.

COPC	Indoor Air	Settled Dust
Asbestos*	0.0009 f/cc	n/a
Lead	0.7 μg/m^3	25 μg/ft^2
MMVF	0.01 f/cc	n/a
Dioxin	0.001 ng/m3	2 ng/m^2
PAH	0.2 μg/m3	150 μg/m^2
Silica	5 μg/m3	n/a

Table 1

*Risk-based criteria were used to develop the benchmark level for asbestos in air. Conservative assumptions of continuous exposure to a constant level of airborne fibers were combined with the IRIS Slope Factor to establish a benchmark equating to a 1x10-4 excess lifetime cancer risk. This approach makes several assumptions, chief among those is the quantification of asbestos fibers in air based on the PCM equivalent (PCMe) definition of a fiber (greater than 5um in length with an aspect ratio of 3:1 or greater) and the use of the IRIS Slope Factor which was designed to apply to fibers so defined. Although there is some concern regarding shorter fibers, the approach used here represents the current consensus by the US EPA for quantifying risk of airborne asbestos fibers. It should be noted there is ongoing debate regarding the nature of health effects which may be attributed to shorter asbestos fibers. Both EPA and ATSDR are currently pursuing meetings to discuss and further refine these issues. However for the purposes of this response, addressing PCMe fibers is considered protective.

4.0 Uncertainties and Limitations

Overall, the COPC selection process used in evaluating WTC-related contamination enabled us to select appropriate indicator contaminants, leading to the development of benchmark criteria which support ongoing efforts to safely clean up residential environments in Lower Manhattan. However, some uncertainties are inherent in the COPC selection and benchmark setting processes.

The primary uncertainties associated with the COPC selection process include the nature of the environmental data sets used in the selection process and the absence of toxicity criteria for some contaminants. Other uncertainties relate to the exposure assumptions used in setting benchmark values, especially for settled dust. The impact of these factors on the outcome of the process are detailed below.

Data limitations. Outside of the WTC Clean-up Program itself, extensive, systematic sampling of indoor air and dusts in Lower Manhattan residences has not occurred. However, in selecting COPC, we drew from the much larger sampling data from other media to account for this shortcoming. We feel that these data are sufficient to identify those contaminants most likely to be present in indoor environments and to support the derivation of clean-up criteria. Ambient air monitoring data need to be interpreted with caution before being used to evaluate indoor environments. For example, samples collected months after the WTC collapse may not have characterized much of what made it into the residences as dust. Fortunately, indoor air and residual dust sampling being conducted as part of EPA's ongoing residential clean-up program offer additional insight to the nature and extent of contaminants found in indoor environments.

  As discussed earlier, to promote a timely response to the WTC disaster, conventional remedial investigation approaches were not used to generate our study data. That is, an investigation of indoor environments with targeted sampling was not conducted. Instead, to expedite cleanup, we relied on existing data sets realizing that many of the data sets were generated independently, by multiple entities, for various purposes, and with varying data quality objectives. Sampling and analytical methods varied across some studies, and that limited results exist for some contaminants in some media. To the extent possible, we factored contaminant- and study-specific considerations into final decisions on COPC (e.g., sample size, detection limits, etc.). Lastly, environmental sampling data do not specifically "fingerprint" the possible unique pattern of substances that may have been released from the WTC collapse and settled in indoor dust. Nonetheless, we still screened hundreds of contaminants, many of which are known to be associated with building materials or thermal or chemical degradation products (e.g., asbestos, PAHs and other SVOCs, dioxins, and metals). Through a combined analysis of

air and settled dust data, the process enabled the identification of risk-driving contaminants within indoor environments.

Absence of contaminant-specific toxicity criteria. Though toxicity values are not currently available for a subset of contaminants tested for and detected in some air and dust samples in Lower Manhattan, the COPC selected are indicative of the most prevalent, most toxic contaminants associated with the WTC releases. A wide range of contaminant classes were captured, among which some of the more toxic members were identified and screened (e.g., dioxins, PAHs, metals). Basing COPC selection on the contaminants with known toxicity criteria (and arguably some of the more toxic compounds) that are measured at higher levels than the contaminants in question is believed to be appropriate and reasonably health-protective.

The list of contaminants without toxicity criteria that were not carried through the COPC selection process include (1) essential nutrients (e.g., calcium, magnesium), which EPA generally does not carry through its risk assessments; (2) a limited number of specific phthalates and PAHs; (3) and SVOCs that are not conventionally measured to support EPA risk assessment. The lengthiest list of SVOCs for which no toxicity criteria exist comes from Lioy et al. (2002)—a study of three outdoor bulk dust samples collected in Lower Manhattan on September 16 and 17, 2001. Most of the SVOCs that do not have toxicity criteria were not consistently detected across the three samples. Further, the concentrations measured were consistently lower than other SVOCs (e.g., PAHs) that have been selected as COPC. Finally, because many of the SVOCs identified by Lioy are rarely considered in environmental sampling studies, we have no knowledge whether the measured levels are consistent with background concentrations in urban settings or if the levels are unusually high.

Absence of child-specific toxicity criteria. Ideally, toxicity criteria should consider the critical exposure periods and toxicity endpoints relevant to children's health. However, the development of additional toxicity criteria for children to support the COPC selection process is beyond the scope of this effort. Our screening process did consider, however, toxicity endpoints relevant to children's health where available (e.g., lead). As stated earlier, the critical studies and endpoints used in developing IRIS and alternate toxicity values served as the basis for our screening values. Currently, most consensus toxicity values are based on the evaluation of adult exposures, not early-life exposures, though EPA does factor in relevant information on reproductive and developmental endpoints (or the lack thereof) when deriving toxicity values.

It should be noted that research evaluating the significance of early-life exposures to toxic chemicals is ongoing by EPA and others. For example, EPA recently developed draft guidance for assessing cancer susceptibility from early-life exposure to carcinogens (EPA 2003). Because most current cancer slope factors do not account for susceptibility differences with respect to early life stages, agency scientists are exploring the possibility of applying additional uncertainty factors when evaluating childhood carcinogenic risks to some (e.g., mutagenic) carcinogens. Much of the impetus for such an approach is the growing knowledge and understanding of how a particular carcinogen exerts its effect (i.e., its mode of action) and how a particular mode of action may increase the risk of tumor response if exposure occurs during early-life stages. The COPC Committee acknowledge that the current approach of applying existing toxicity criteria to all age groups introduces some uncertainty to the evaluation biased toward an underestimation of risk.

Uncertainty in deriving settled dust screening and benchmark values. As detailed in Appendix D, derivation of settled dust screening values required multiple assumptions in

estimating exposure to surfaces, which add uncertainty to our analysis. For example, factors affecting surface loading and transfers to skin have not been well studied and are likely to be highly variable (e.g., characteristics of different surfaces, activities patterns related to surface contact, and surface cleaning techniques and frequency). As a result, limited data were available for many of the input parameters used to estimate dose from exposure to contaminants in settled dust. However, consistent with general human health risk assessment practice, every effort was made to select exposure input parameters that would define a reasonable maximum exposure and produce protective screening values. Upper-bound exposure estimates were used whenever available. Therefore, overall, the process represents a reasonably protective approach.

Evaluating multiple-contaminant exposures. Benchmarks were developed on a contaminant-by-contaminant basis. It is clearly recognized that the residents in Lower Manhattan are not exposed to environmental contaminants singularly, but instead to combinations of chemical and physical agents. Development of benchmarks, however, was driven by a combined consideration of individual COPC-specific toxicity, background levels, and practicalities and limitations related to sampling. Mixture toxicology was not factored into the derivation process because little or no quantitative dose-response data exist regarding specific interactions across the WTC COPC (asbestos,

dioxins, lead, PAHs, fibrous glass, and crystalline silica)[2].

The contaminant-specific approach is believed to be health protective, however, for the following reasons:

1) For non-carcinogens, COPC benchmarks are set at concentrations well below observed effect levels and generally at or below no-observed-adverse-effect levels (NOAELs). Presumably, exposures to one or multiple substances below or near the NOAEL will not result in adverse effects (EPA 2000b).

2) The likelihood of interactions are increased if substances behave similarly toxicologically. A review of the toxicology of individual COPC (target organ toxicity, mode of action) and any documented chemical interactions among WTC COPC revealed the following:

   < Target organs and critical effects resulting from ingestion and dermal exposures generally differ across individual COPC, though lead, dioxins, and PAHs are all considered potential human carcinogens via the ingestion route. Each of these contaminants can affect a wide range of biological systems, but each generally exerts its effects via different mechanisms.

   < At high concentrations, inhalation exposure to several of the COPC (asbestos, PAHs, fibrous glass, and crystalline silica), as well as the small particulate matter released during the WTC disaster, has been shown to result in point of contact toxicity to the lung. Specific lung effects vary across these substances, ranging from acute irritant effects produced by fibrous glass to cancers of the lung associated with asbestos. Exposures to COPC at or below benchmark concentrations—which are set at levels significantly lower than observable effect levels—would be unlikely to produce effects individually or in combination.

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[2]Note that combined effects within dioxin and PAH mixtures were accounted for in the development of benchmarks using toxic equivalency (TEQ) approaches that account for the relative potency of the components of these complex mixtures. Toxicity equivalent factors used in this approach are based on our understanding of the most toxic component of each mixture (i.e., 2,3,7,8-TCDD for dioxins and benzo(a)pyrene for PAHs).

One EPA study looking at acute airway effects in mice exposed to WTC fine particulate matter (2.5 microns) provides some insights to the magnitude of total dust exposures leading to observable effects. This study revealed that components of WTC dust promotes respiratory inflammation at "high" doses only (EPA 2002). This study does not evaluate the effects of long-term or repeated exposures to lower levels of WTC dust and is not directly useful in the development of benchmarks.

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APPENDIX A

Deriving Health-Based Screening Values for Air and Dust Exposure Pathways

1.0 Introduction

As described in Section 2.0 of the main text, the initial screening step in the COPC selection process involved the comparison of maximum detected air and dust concentrations against health-based screening values. The purpose of this appendix is to describe how screening values used in this step of the process were selected or derived.

Health-based screening values were derived for three exposure pathways as follows:

- *Air pathway*. Contaminants detected in ambient and indoor air were compared to the lower of the following EPA Integrated Risk Information System (IRIS) values: EPA reference concentrations (RfCs) (for noncarcinogens) or air concentrations associated with a 10^{-4} cancer risk (based on inhalation unit risks [IURs]). In the absence of IRIS values, a defined hierarchy was used to obtain toxicity values for this and the other pathways evaluated[3].

- *Bulk dust pathway*. Screening values were developed for bulk dust based on a soil ingestion scenario, considering both child and adult exposures. The exposure equations and age-specific assumptions are detailed below. Oral toxicity values (EPA reference doses [RfDs] for noncarcinogens and cancer slope factors [CSFs]) were used when available. Otherwise, the hierarchy described above was followed.

- *Settled dust pathway*. Screening values were developed based on exposures associated with ingestion and dermal contact with dust residues on indoor surfaces. The derivation of screening values parallels that used in developing benchmark criteria for the settled dust pathway. To evaluate this pathway, we adapted EPA guidance for residential exposure assessment, originally developed to study pesticide residues (EPA 2001). This approach was further supported by procedures and re-entry guidelines previously developed for scenarios evaluating fine dust particles more analogous to those associated with the WTC collapse (Kim and Hawley 1985; NJDEP 1993; Michaud et al. 1994; Radian 1999). Applicable parameters and the justification for selected values are detailed in Appendix D. Toxicity criteria used included EPA's RfDs and CSFs.

2.0 Air

When available, consensus inhalation toxicity values available through EPA's IRIS served as the basis for air screening values. (See above for hierarchy used to obtain toxicity values.) Screening values for cancer and non-cancer risks were derived as follows, with the lower of the two values used in the

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[3]In the absence of IRIS values, the following hierarchy was used to obtain toxicity values:

1.01 EPA Health Effects Assessment Summary Tables (HEAST) values (RfC/RfD, IUR/CSF).

1.02 ATSDR minimal risk level (MRL).

1.03 On a case-by-case basis, other sources were consulted (e.g., EPA's National Center for Environmental Assessment (NCEA) provisional values, National Ambient Air Quality Standards (NAAQS), cross-route extrapolations after consideration of critical effect/target organ).

COPC selection process. A complete list of the toxicity criteria and screening values used in the analysis of air concentrations is presented in Table A-1.

Carcinogens

$$SV = TR / IUR$$

Non-carcinogens

$$SV = THI * RfC$$

Where:

SV	=	screening value (mg/m^3)
TR	=	target cancer risk of 1×10^{-4} (Appendix C explains the rationale for this value)
IUR	=	inhalation unit risk (the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent per unit concentration)
THI	=	target hazard index of 1
RfC	=	reference concentration (mg/m^3) (an estimate of a continuous inhalation exposure to the human population [including sensitive subgroups] that is likely to be without an appreciable risk of deleterious effects during a lifetime)

3.0 Bulk Dust

Screening values for bulk dust were derived based on a residential soil ingestion scenario. This exposure scenario conservatively assumes that exposure to dust will be equivalent to that of incidental ingestion of substances in soil. Because children are expected to ingest more soil per body weight than adults, childhood exposure factors were included in the analysis. Screening values for carcinogens are based on combined childhood and adult exposure. Screening values for non-carcinogens are based on childhood exposure alone.

Equations and assumptions used in the derivation of bulk dust screening values follow, including sample calculations. Table A-2 presents a complete list of the toxicity criteria and screening values used in the analysis of bulk dust.

Carcinogens:

$$SV_{ca} = \left(\frac{TR \times AT \times CF}{EF \times CSFo}\right)\left(\frac{EDc \times IRc}{BWc} + \frac{EDa \times IRa}{BWa}\right)^{-1}$$

Where:

SV_{ca}	=	screening value for cancer effects (mg/kg)
TR	=	target risk of 1×10^{-4} (Appendix C explains the rationale for this value)
AT	=	averaging time (70 years x 365 days/year = 25,500 days)
BWc	=	body weight, child (15 kg)
BWa	=	body weight, adult (70 kg)
CF	=	conversion factor (10^6 mg/kg)
EF	=	exposure frequency (365 days/year)

EDc = exposure duration child, 6 years
EDa = exposure duration adult, 24 years
IRc = ingestion rate, child (200 mg/day)
IRa = ingestion rate, adult (100 mg/day)
CSFo = oral cancer slope factor $(mg/kg/day)^{-1}$

As an example, the SV_{ca} for heptachlor (CSF = 4.5 $mg/kg/day^{-1}$) was derived as follows:

$$SV_{ca} = \left(\frac{10^{-4} \times 25{,}500_{days\ /\ year} \times 10^{6}}{365_{days} \times 4.5_{mg\ /\ kg\ /\ day^{-1}}}\right)\left(\frac{6_{years} \times 200_{mg\ /\ day}}{15_{kg}} + \frac{24_{years} \times 100_{mg\ /\ day}}{70_{kg}}\right)^{-1}$$

SV_{ca} = 14 mg/kg

Non-carcinogens:

$$SV_{nc} = \frac{THI \times RfDo \times AT \times BWc \times CF}{EF \times ED \times IR}$$

Where:

SV_{nc}	=	screening value for non-cancer effects (mg/kg)
THI	=	target hazard index of 1
RfDo	=	oral RfD (mg/kg/day)
AT	=	averaging time (6 years x 365 days/year = 2,190 days)
BWc	=	body weight, child (15 kg)
CF	=	conversion factor (10^6 mg/kg)
EF	=	exposure frequency (365 days/year)
ED	=	exposure duration, child (6 years)
IR	=	ingestion rate (200 mg/day)

For example, the SV_{nc} for cadmium (RfD = 0.001 mg/kg/day) was derived as follows:

$$SV_{nc} = \frac{1 \times 0.001_{mg\,/\,kg\,/\,day} \times 2{,}190_{days\,/\,year} \times 15_{kg} \times 10^6}{365_{days\,/\,year} \times 6_{years} \times 200_{mg\,/\,day}}$$

SV_{nc} = 75 mg/kg

4.0 Settled Dust

Screening values for settled dust were developed based on exposures associated with ingestion and dermal contact with dust residues on indoor surfaces. Continuous age-specific exposure parameters from age 1 through 31 were factored into this approach. Dose rates were estimated based on a number of assumptions—for example, the fraction of dust residues that can be transferred to the skin, daily skin loads, mouthing behaviors for different age groups, and dissipation of surface loading over time. All of these parameters and the justification for selected values are detailed in Appendix D. Table A-3 presents the screening values derived for settled dust, including the toxicity criteria (RfDs and CSFs) used in the process.

Table A-1. Air Screening Values and Supporting Toxicity Criteria

Substance Name	Screening Value (mg/m^3)	Toxicity Value		Toxicity Value Source
		Cancer $(mg/m^3)^{-1}$	Noncancer (mg/m^3)	
SVOCs				
Benzaldehyde	0.35		0.35	IRIS oral RfD[a] (0.1 mg/kg/day)
2-Methylnaphthalene	0.07		0.07	NCEA oral RfD[a] (0.02 mg/kg/day)
4,4'-Methylene diphenyl diisocyanate (MDI)	0.0006		0.0006	IRIS RfC
Inorganics				
Aluminum	0.0035		0.0035	NCEA oral RfD[a] (0.001 mg/kg/day)
Antimony	0.0004		0.0004	NCEA RfC
Arsenic	0.00002	4.3		IRIS IUR
Asbestos	0.0004 f/cc	0.23		IRIS IUR
Barium	0.00049		0.00049	HEAST oral RfD[a] (0.00014 mg/kg/day)
Chromium	0.000008	12	0.0001	IRIS IUR[b], IRIS RfC (chromium VI)
Copper	0.14		0.14	HEAST oral RfD[a] (0.04 mg/kg/day)
Iron	1.05		1.05	NCEA oral RfD[a] (0.3 mg/kg/day)
Lead	0.0015		0.0015	NAAQS
Manganese	0.00005		0.00005	IRIS RfC
Mercury	0.0003		0.0003	IRIS RfC
Naphthalene	0.003		0.003	IRIS RfC
Nickel	0.0002		0.0002	ATSDR c-MRL
Phosphoric Acid	0.01		0.01	IRIS RfC
Vanadium	0.0002		0.0002	ATSDR a-MRL
Zinc	1.05		1.05	IRIS oral RfD[a] (0.3 mg/kg/day)
Dioxins				
2,3,7,8 TCDD TEQ	$3.5x10^{-10}$	$2.9x10^{+5}$		EPA 2000 Dioxin Reassessment CSF[c] ($1x10^{6}$ $mg/kg/day^{-1}$)

[a] Route-to-route extrapolation. RfD converted to RfC using the following equation:
RfC mg/m^3 = RfD mg/kg/day x 70 kg (body weight) / 20 m^3/day (inhalation rate)

[b] The screening value is based upon the IRIS IUR.

[c] Route-to-route extrapolation. CSF converted to IUR using the following equation:
IUR = CSF $mg/kg/day^{-1}$ x 20 m^3/day (inhalation rate)/ 70 kg (body weight)

Table A-2. Bulk Dust Screening Values and Supporting Toxicity Criteria

Substance Name	Screening Value (mg/kg)	Toxicity Value		Toxicity Value Source
		CSF $(mg/kg/day)^{-1}$	RfD (mg/kg/day)	
SVOCs				
Benzyl alcohol	22500		0.3	HEAST
Benzyl butyl phthalate	15000		0.2	IRIS
Biphenyl	3750		0.05	IRIS
bis(2-Chloroethyl)ether	56	1.1		IRIS
bis(2-Chloroisopropyl)ether	873	0.07	0.04	HEAST CSF[a] IRIS RfD
bis(2-Ethylhexyl)phthalate	1500	0.014	0.02	IRIS CSF IRIS RfD[a]
2-Chlorophenol	375		0.005	IRIS
Dibenzofuran	300		0.004	NCEA
Dibutyl phthalate	7500		0.1	IRIS
3,3'-Dichlorobenzidine	136	0.45		IRIS
Diethylphthalate	60000		0.8	IRIS
2,4-Dimethylphenol	1500		0.02	IRIS
2,4-Dinitrophenol	150		0.002	IRIS
4,6-Dinitro-2-methylphenol	7.5		0.0001	NCEA
2,4-Dinitrotoluene	150		0.002	IRIS
2,6-Dinitrotoluene	75		0.001	HEAST
Di-n-octylphthalate	30000		0.4	ATSDR i-MRL
Hexachlorobenzene	38	1.6	0.0008	IRIS CSF[a] IRIS RfD
Hexachloroethane	75	0.014	0.001	IRIS CSF IRIS RfD[a]
Isophorone	15000	0.00095	0.2	IRIS CSF IRIS RfD[a]
2-Methylnaphthalene	1500		0.02	NCEA
2-Methylphenol	3750		0.05	IRIS
4-Methylphenol	375		0.005	HEAST
Naphthalene	1500		0.02	IRIS
Naphthalene, 1-(methylthio)-	1500		0.02	IRIS
Naphthalene, 1,3-dimethylene	1500		0.02	IRIS
2-Nitroaniline	3750		0.05	IRIS
3-Nitroaniline	23	0.02	0.0003	NCEA CSF NCEA RfD[a]
4-Nitroaniline	225	0.02	0.003	NCEA CSF NCEA RfD[a]
Nitrobenzene	37.5		0.0005	IRIS
n-Nitroso-Di-n-propylamine	9	7		IRIS
n-Nitrosodiphenylamine	1500	0.0049	0.02	NCEA

Substance Name	Screening Value (mg/kg)	Toxicity Value		Toxicity Value Source
		CSF (mg/kg/day)$^{-1}$	RfD (mg/kg/day)	
PAHs (total)	0.3	7.3		IRIS (benzo[a]pyrene)
Pentachlorophenol	509	0.12	0.03	IRIS CSF[a] IRIS RfD
Phenol	22500		0.3	IRIS
2,4,5-Trichlorophenol	7500		0.1	IRIS
2,4,6-Trichlorophenol	5557	0.011		IRIS
Pesticides and PCBs				
Aldrin	2		0.00003	IRIS
"-BHC	10	6.3	0.008	IRIS CSF[a] IRIS RfD
$-BHC	34	1.8	0.0006	IRIS CSF[a] IRIS RfD
(-BHC	23		0.0003	ATSDR i-MRL
Carbazole	3056	0.02		HEAST
"-Chlordane	38	0.01	0.0005	IRIS CSF IRIS RfD[a] (technical chlordane)
(-Chlordane	38	0.35	0.0005	IRIS CSF IRIS RfD[a] (technical chlordane)
Chlordanes (total)	45	0.35	0.0006	IRIS CSF ATSDR c-MRL[a]
p,p'-D D D	255	0.24		IRIS
p,p'-D D E	180	0.34		IRIS
p,p'-D D T	38	0.34	0.0005	IRIS
Dieldrin	4	16	0.00005	IRIS CSF IRIS RfD[a]
Endosulfan (I)	450		0.006	IRIS
Endosulfan (II)	450		0.006	IRIS
Endosulfan Sulfate	450		0.006	IRIS
Endrin	23		0.0003	IRIS
Endrin Aldehyde	23		0.0003	IRIS
Endrin Ketone	23		0.0003	IRIS
Heptachlor	14	4.5	0.0005	IRIS CSF[a] IRIS RfD
Heptachlor Epoxide	1	9.1	0.000013	IRIS CSF IRIS RfD[a]
Methoxychlor	375		0.005	IRIS
Metribuzin	1875		0.025	IRIS
Mirex	15		0.0002	IRIS
Prometryn (caparol)	300		0.004	IRIS
Toxaphene	56	1.1		IRIS
PCBs (total)	1.5	2	0.00002	IRIS CSF IRIS RfD[a] (Aroclor 1254)

Substance Name	Screening Value (mg/kg)	Toxicity Value		Toxicity Value Source
		CSF $(mg/kg/day)^{-1}$	RfD (mg/kg/day)	
Inorganics				
Aluminum	75000		1	NCEA
Antimony	30		0.0004	IRIS
Arsenic	23	1.5	0.0003	IRIS CSF IRIS RfD[a]
Barium	5250		0.07	IRIS
Beryllium	150		0.002	IRIS
Cadmium	75		0.001	IRIS
Chromium	225		0.003	IRIS (chromium VI)
Cobalt	1500		0.02	NCEA
Copper	3000		0.04	HEAST
Fluoride	4500		0.06	ATSDR c-MRL
Iron	22500		0.3	NCEA
Lead	400			EPA Soil Screening Value
Lithium	1500		0.02	NCEA
Manganese	1500		0.02	IRIS (non-food)
Mercury	11		0.00014	IRIS (methylmercury)
Molybdenum	375		0.005	IRIS
Nickel	1500		0.02	IRIS
Nitrate	120000		1.6	IRIS
Selenium	375		0.005	IRIS
Silver	375		0.005	IRIS
Strontium	45000		0.6	IRIS
Thallium	5		0.00007	RBC
Titanium	300000		4	NCEA
Uranium	225		0.003	IRIS
Vanadium	525		0.007	HEAST
Zinc	22500		0.3	IRIS
Dioxins				
2,3,7,8 TCDD TEQ	0.00006	1000000		EPA 2000 Dioxin Reassessment

[a] Toxicity value upon which screening value is based.

Table A-3. Settled Dust Screening Values and Supporting Toxicity Criteria

Substance Name	Screening Value[a] ($\mu g/m^2$)	Toxicity Value		Toxicity Value Source
		CSF $(mg/kg/day)^{-1}$	RfD (mg/kg/day)	
Inorganics				
Aluminum	1567888		1.0	NCEA
Antimony	627		0.0004	IRIS
Arsenic	387	1.5	0.0003	IRIS CSF IRIS RfD[b]
Barium	109752		0.07	IRIS
Beryllium	3136		0.002	IRIS
Cadmium	1557		0.001	IRIS
Chromium	4704		0.003	IRIS (chromium VI)
Cobalt	31358		0.02	NCEA
Copper	62716		0.04	HEAST
Iron	940733		0.6	NCEA
Lead	270			HUD standard
Manganese	31358		0.02	IRIS (non-food)
Mercury	157		0.0001	IRIS (methylmercury)
Nickel	31358		0.02	IRIS
Selenium	7839		0.005	IRIS
Silver	7839		0.005	IRIS
Thallium	110		0.00007	RBC
Vanadium	10975		0.007	HEAST
Zinc	470366		0.3	IRIS
Other				
PAHs (total)	145	7.3		IRIS (benzo[a]pyrene)
PCBs (total)	16	2.0		IRIS
Dioxins	0.0017	1000000		EPA 2000 Dioxin Reassessment

[a] Refer to Appendix D for derivation of screening values.

[b] Toxicity value upon which screening value is based.

APPENDIX B

Results of the COPC Selection Process

This appendix presents the results of each step of the COPC selection process. As described in Section 2.0 of the main text, the approach involved a review of multiple data sets to identify candidate substances, followed by an initial and secondary screening process. Ambient air, indoor air, bulk dust, and settled dust were evaluated.

As part of the initial screen for each of these media, volatile contaminants and those detected at low frequencies were eliminated from further consideration. Remaining contaminants were screened against health-based screening values derived for air and dust (see Appendix A). Three outcomes were possible for this step. If a contaminant's maximum concentration was lower than the corresponding screening value, that contaminant was eliminated from further consideration. If a contaminant's maximum concentration was greater than the screening value, then the contaminant was evaluated further in the secondary screening step. If a contaminant did not have a toxicity value, and therefore did not have a screening value, other relevant information (e.g., trends among sampling data, comparisons to background, the likelihood of the contaminant being related to site-specific releases) were reviewed to determine whether the contaminant should be evaluated further. Where possible, occupational or environmental criteria were considered in determining whether contaminants needed further evaluation.

Any contaminant detected even once above a screening value within an individual medium was flagged as requiring further consideration. In the secondary screen, we reviewed findings across environmental media to assess representativeness of reported maximum concentrations, studied spatial and temporal trends, determined the relationship of detected concentrations to available background concentrations, and examined whether there was reason to believe a contaminant was site-related. From this, a judgment was made whether or not to select the contaminant as a COPC.

Sections 1.0 through 4.0 below detail the findings of the initial screening process for each medium. Section 5.0 presents the findings of the secondary screen; it reviews each of the contaminants identified in the initial screen as requiring further consideration and provides justification for selecting a contaminant as a COPC or eliminating it from further consideration.

1.0 Ambient Air

Ambient air sampling results were obtained from the following sources:

- *EPA Region 2's database of environmental sampling results*. The processed database contains more than 200,000 records, with more than half being asbestos sampling results. The database includes sampling conducted by multiple agencies; EPA collected most of the samples, but samples collected by the New York City Department of Environmental Protection (NYCDEP) and New Jersey Department of Environmental Protection (NJDEP) are also included. Sampling results are available for 137 contaminants.[4] The database includes samples

[4]Tentatively identified compounds were not included in the list of contaminants. All measurements for dioxins and furans are considered as one contaminant in this tally, and were screened using a TEQ analysis. All measurements for asbestos are considered one contaminant, though measurements used different analytical methods and counted different subsets of fiber types and sizes. All measurements for PCBs are considered one contaminant, though the studies reported concentrations under several different groupings of congeners (e.g., total PCBs, Aroclors).

with various averaging times (both grab and integrated samples), sampling locations (most samples in Lower Manhattan, but some from locations outside of Manhattan), sampling dates (September 2001 through July 2002), sampling methods, and detection limits.

- *New York City Department of Health and Mental Hygiene (NYCDOHMH)/Agency for Toxic Substances and Disease Registry (ATSDR) public health investigation (2002).* This study documents sampling results from 30 residential buildings in Lower Manhattan and 4 comparison buildings north of 59th Street. Samples were collected in November and December, 2001. The study reports outdoor levels of fibers (PCM) for 32 samples collected in Lower Manhattan, including results from co-located sampling devices. None of the samples from outdoor locations was analyzed for asbestos or synthetic vitreous fibers. Additionally, the study reports concentrations of six minerals in 354 air samples from Lower Manhattan. The sampling results for minerals are applied to both the ambient air and indoor air COPC screening process, because the final study report does not specify what fraction of the 354 samples were collected indoors versus outdoors.

- *New York City Department of Education sampling in schools.* This study documents sampling results from six schools: PS-89, PS-150, PS-234, Stuyvesant High School (M-477), High School for Leadership and Public Services (M-894), and High School of Economics and Finance (M-833). Sampling occurred between September 2001 and June 2002, both indoors and outdoors. Because the database does not clearly distinguish these two types of samples, the COPC selection process considers all of the sampling results both for the indoor air and ambient air analysis. The project database includes more than 30,000 records of air sampling results. Asbestos sampling results account for more than half of these records, with the rest of the results being for more than 70 other contaminants.[1]

- *Chattfield and Kominsky's (2001) survey of indoor air quality.* This study characterizes impacts of WTC dusts in two buildings in Lower Manhattan. The study focuses on the indoor environment, but two outdoor air samples were collected and analyzed for asbestos.

COPC Selection Process for Ambient Air

Step 1: Do not consider volatile contaminants

Volatile contaminants were eliminated from the COPC selection process. Any contaminant on the target analyte list for Method TO-15 (ambient air) and Method 8260 (waste) was considered volatile. Further, chemical similarity to compounds on those lists and boiling point (as a surrogate for vapor pressure) were used to identify additional volatile contaminants not on these methods' target lists.

- 83 contaminants removed from list (see Table B-1)
- 73 contaminants remained for further consideration

Step 2: Do not consider contaminants detected in fewer than 5% of samples, only if more than 20 samples were collected

- 43 contaminants removed from list (see Table B-2)
- 30 contaminants remained for further consideration

Step 3: Compare maximum detected concentrations against health-based screening values

Using the health-based screening values described in Appendix A:

- 8 contaminants removed from list (maximum concentration < screening value, see Table B-3)
- 10 contaminant do not have health-based screening values (see Table B-4)
- 12 contaminants remained for further consideration (listed below)

Contaminants requiring further consideration (see Section 5.0):

1) Aluminum
2) Arsenic
3) Asbestos
4) Barium
5) Chromium
6) Dioxins
7) Lead
8) Manganese
9) Mercury
10) 4,4'-Methylene diphenyl diisocyanate (MDI)
11) Naphthalene
12) Nickel

Table B-1. Volatile Contaminants Removed from COPC Selection Process

1,1,1-Trichloroethane	Carbon disulfide	Methyl isobutyl ketone
1,1,2,2-Tetrachloroethane	Carbon tetrachloride	Methyl tert-butyl ether
1,1,2-Trichloroethane	Chlorobenzene	Methylcyclopentane
1,1-Dichloroethane	Chlorodifluoromethane	Methylene chloride
1,1-Dichloroethylene	Chloroethane	n-Butane
1,2,4-Trimethylbenzene	Chloroform	n-Heptane
1,2-Dibromoethane	Chloromethane	n-Hexane
1,2-Dichlorobenzene	cis-1,2-Dichloroethylene	Nitric acid
1,2-Dichloroethane	cis-1,3-Dichloropropylene	Nitric oxide
1,2-Dichloropropane	Cyclohexane	Nitrogen dioxide
1,3,5-Trimethylbenzene	Dibromochloromethane	n-Pentane
1,3-Butadiene	Dibromomethane	o-Xylene
1,3-Dichlorobenzene	Dichlorodifluoromethane	Ozone
1,3-Dichloropropane	Dichlorotetrafluoroethane	Propane
1,4-Dichlorobenzene	Ethanol	Propylene
1,4-Dioxane	Ethyl acetate	Styrene
1-Heptene	Ethylbenzene	Sulfur dioxide
2-Butanone	Formaldehyde	Tetrachloroethylene
2-Hexanone	Hexachlorobutadiene	Tetrahydrofuran
3-Chloropropylene	Hydrogen bromide	Toluene
4-Ethyltoluene	Hydrogen chloride	trans-1,2-Dichloroethylene
Acetone	Hydrogen cyanide	trans-1,3-Dichloropropylene
Acrylonitrile	Hydrogen fluoride	Trichloroethylene

a-Methylstyrene	i-Propylbenzene	Trichlorofluoromethane
Benzene	Isopentane	Trichlorotrifluoroethane
Bromodichloromethane	Isopropyl alcohol	Vinyl acetate
Bromoform	m,p-Xylene	Vinyl chloride
Bromomethane		Xylene (total)

Table B-2. Contaminants Removed from the COPC Selection Process Due to Frequency of Detection

Contaminant	Samples	Frequency of Detection	Contaminant	Samples	Frequency of Detection
1,2,4-Trichlorobenzene	1010	1.8%	Dibenzo(a,h)anthracene	573	0.0%
1-Methylnaphthalene	573	2.1%	Dibenzofuran	528	0.0%
2,4-TDI	48	0.0%	Fluoranthene	573	0.0%
2,6-Dimethylnaphthalene	528	0.0%	Fluorene	573	0.0%
2,6-TDI	48	0.0%	Halite	354	3.4%
Acenaphthene	573	0.0%	HDI	48	0.0%
Acenaphthylene	573	0.0%	Indeno(1,2,3-cd)pyrene	573	0.0%
Anthracene	570	0.0%	IPDI	48	0.0%
Benzo(a)anthracene	573	0.0%	Isopropylbenzene	430	0.0%
Benzo(a)pyrene	573	0.0%	HMDI	48	0.0%
Benzo(b)fluoranthene	576	0.0%	Mica	354	2.0%
Benzo(e)pyrene	528	0.0%	Molybdenum	471	0.0%
Benzo(g,h,i)perylene	572	0.0%	Phenanthrene	573	0.2%
Benzo(k)fluoranthene	570	0.0%	Potassium	738	3.1%
Benzyl Chloride	1010	1.4%	Pyrene	573	0.2%
Beryllium	738	0.1%	Selenium	737	1.2%
Biphenyl	528	0.0%	Silica Dust	798	4.3%
Cadmium	1216	1.1%	Silver	738	2.2%
Carbazole	528	0.0%	Thallium	738	2.6%
Chrysene	573	0.0%	Tridymite	597	0.0%
Cobalt	1209	4.4%	Total PCBs	633	4.9%
Cristobalite	597	0.0%			

Notes:

TDI toluene diisocyanate

HDI hexamethylene diisocyanate

HMDI methylene bis-(4-cyclohexylisocyanate)

IPDI isophorone diisocyanate

In addition to total PCB data, multiple Aroclors were not detected in any samples collected in six Lower Manhattan schools.

Table B-3. Contaminants with Measured Levels Lower than Health-Based Screening Values

Contaminant	Maximum Concentration (mg/m^3)	Health-based Screening Value (mg/m^3)	Basis for Screening Value
2-Methylnaphthalene	0.009	0.07	Extrapolation from oral RfD
Antimony	0.00033	0.0004	NCEA provisional RfC
Benzaldehyde	0.032	0.35	Extrapolation from oral RfD
Copper	0.063	0.14	Extrapolation from oral RfD
Iron	0.064	1.05	Extrapolation from oral RfD

Phosphoric acid	ND	0.01	IRIS RfC
Vanadium	0.0001	0.0002	ATSDR acute MRL
Zinc	0.0081	1.05	Extrapolation from oral RfD

Table B-4. Contaminants with No Health-Based Screening Values

Bromobenzene	Magnesium
Calcite	Portlandite
Calcium	Quartz
Fibers (PCM)	Sodium
Gypsum	Sulfuric Acid

2.0 Indoor Air

Indoor air sampling results were obtained from the following sources:

- *EPA Region 2's database of environmental sampling results*. The processed database contains 73 records of indoor air sampling results, all for asbestos. EPA collected these samples from three buildings in Lower Manhattan in September and October, 2001. Of the 73 records, 20 document PCM analyses and 53 document TEM analyses.

- *NYCDOHMH/ATSDR (2002) public health investigation*. This study documents sampling results from 30 residential buildings in Lower Manhattan and 4 comparison buildings north of 59th Street. Samples were collected in November and December, 2001. The study reports indoor levels of fibers (PCM) for 96 samples collected in Lower Manhattan, including results from co-located sampling devices. A small subset of these samples was analyzed further for asbestos and synthetic vitreous fibers. Additionally, the study reports concentrations of six minerals in 354 air samples from Lower Manhattan. The sampling results for minerals are applied to both the ambient air and indoor air COPC screening process, because the final study report does not specify what fraction of the 354 samples were collected indoors versus outdoors.

- *New York City Department of Education sampling in schools*. This study documents sampling results from six schools: PS-89, PS-150, PS-234, Stuyvesant High School (M-477), High School for Leadership and Public Services (M-894), and High School of Economics and Finance (M-833). Indoor and outdoor sampling occurred between September 2001 and June 2002. However, because the database does not clearly distinguish these two types of samples, the COPC selection process considers all sampling results both for the indoor air and ambient air analysis. The project database includes more than 30,000 records of air sampling results. Asbestos sampling results account for more than half of these records, with the rest of the results being for more than 70 other contaminants.[1]

- *Chattfield and Kominsky's (2001) survey of indoor air quality*. This study characterizes impacts of WTC dusts in two buildings in Lower Manhattan. The study includes 11 indoor air samples that were collected and analyzed for asbestos.

COPC Selection for Indoor Air

Step 1: Do not consider volatile contaminants

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[1] Tentatively identified compounds were not included in the list of contaminants. All measurements for asbestos are considered one contaminant, though measurements used different analytical methods and counted different subsets of fiber types and sizes. All measurements for PCBs are considered one contaminant, though the schools study reported concentrations for multiple Aroclors.

Volatile contaminants were eliminated from the COPC selection process. Any contaminant on the target analyte list for Method TO-15 (ambient air) and Method 8260 (waste) was considered volatile. Further, chemical similarity to compounds on those lists and boiling point (as a surrogate for vapor pressure) were used to identify additional volatile contaminants not on these methods' target lists.

- 35 contaminants removed from list (see Table B-5)
- 44 contaminants remained for further consideration

Step 2: Do not consider contaminants detected in fewer than 5% of samples, only if more than 20 samples were collected

- 27 contaminants removed from list (see Table B-6)
- 17 contaminants remained for further consideration

Step 3: Compare maximum detected concentrations against health-based screening values

Using the health-based screening values described in Appendix A:

- 6 contaminants removed from list (maximum concentration < screening value, see Table B-7)
- 7 contaminant do not have health-based screening values (see Table B-8)
- 4 contaminants remained for further consideration (listed below)

Contaminants requiring further consideration:

1) Aluminun
2) Asbestos
3) Chromium
4) Mercury

Table B-5. Volatile Contaminants Removed from COPC Selection Process

1,1,1-Trichloroethane	Hydrogen cyanide
1,1,2,2-Tetrachloroethane	m,p-Xylene
1,1-Dichloroethylene	Methylene chloride
1,2-Dibromoethane	n-Heptane
1,2-Dichloroethane	n-Hexane
1,2-Dichloropropane	Nitric oxide
1,3-Dichloropropane	Nitrogen dioxide
1-Heptene	n-Pentane
3-Chloropropylene	o-Xylene
Acetone	Ozone
Acrylonitrile	Styrene
Benzene	Sulfur dioxide
Bromoform	Tetrachloroethylene
Carbon tetrachloride	Toluene
Chlorobenzene	Trichloroethylene
Chloroform	Vinyl chloride
Ethylbenzene	Xylene (total)
Formaldehyde	

Table B-6. Contaminants Removed from the COPC Selection Process Due to Frequency of Detection

Contaminant	Samples	Frequency of Detection	Contaminant	Samples	Frequency of Detection
Acenaphthene	45	0.0%	Halite	354	3.4%
Acenaphthylene	45	0.0%	Indeno(1,2,3-cd)pyrene	45	0.0%
Anthracene	42	0.0%	Isopropylbenzene	430	0.0%
Benzo(a)anthracene	45	0.0%	Magnesium	471	4.2%
Benzo(a)pyrene	45	0.0%	Manganese	471	0.0%
Benzo(b)fluoranthene	48	0.0%	Mica	354	2.0%
Benzo(g,h,i)perylene	45	0.0%	Molybdenum	471	0.0%
Benzo(k)fluoranthene	42	0.0%	Nickel	471	0.6%
Cadmium	478	0.0%	PCBs	32	0.0%
Chrysene	45	0.0%	Phenanthrene	45	2.2%
Cobalt	471	0.0%	Pyrene	45	2.2%
Dibenzo(a,h)anthracene	45	0.0%	Silica Dust	798	4.3%
Fluoranthene	45	0.0%	Zinc	471	0.6%
Fluorene	45	0.0%			

Table B-7. Contaminants with Measured Levels Lower than Health-Based Screening Values

Contaminant	Maximum Concentration (mg/m^3)	Health-based Screening Value (mg/m^3)	Source of Screening Value
2-Methylnaphthalene	0.00092	0.07	Extrapolation from oral RfD

Contaminant	Maximum Concentration (mg/m^3)	Health-based Screening Value (mg/m^3)	Source of Screening Value
Copper	0.00389	0.14	Extrapolation from oral RfD
Iron	0.00577	1.05	Extrapolation from oral RfD
Lead	0.00136	0.0015	NAAQS
Naphthalene	0.00099	0.003	RfC
SVF	0.00025 f/cc	0.03 f/cc	Proposed ATSDR MRL

Table B-8. Contaminants with No Health-Based Screening Values

1-Methylnaphthalene	Gypsum
Bromobenzene	Portlandite
Calcite	Quartz
Fibers	

3.0 Bulk Dust

Bulk dust sampling results were obtained from the following sources:

- *EPA Region 2's database of environmental sampling results*. The processed database contains 1,936 records of bulk dust sampling; 1,930 of the records were from EPA sampling, and 6 were from NYCDEP sampling. Most samples were collected in September and October, 2001; the database also includes results from multiple samples collected in May, 2002. The majority of sampling occurred in Lower Manhattan, but some results are also available for Brooklyn and the Fresh Kills Landfill. The database includes dust samples from indoor and outdoor locations. Samples were analyzed for asbestos, metals, pesticides, PAHs, and other semi-volatile organic compounds.

- *NYCDOHMH/ATSDR (2002) public health investigation*. This study documents sampling results from 30 residential buildings in Lower Manhattan and 4 comparison buildings north of 59th Street. Samples were collected in November and December, 2001. This data summary considered only the dust samples (both indoor and outdoor) collected in Lower Manhattan, and not those from the comparison population. Data are available for asbestos, synthetic vitreous fibers, and six minerals.

- *New York City Department of Education sampling in schools*. This study documents sampling results from six schools: PS-89, PS-150, PS-234, Stuyvesant High School (M-477), High School for Leadership and Public Services (M-894), and High School of Economics and Finance (M-833). Sampling occurred between September 2001 and June 2002. The project database includes nearly 3,000 records of sampling results for bulk settled dust; these samples were collected at various indoor and outdoor locations. The only contaminants analyzed for in the samples were asbestos and fiberglass. All samples were analyzed using polarized light microscopy (PLM).

- *Chattfield and Kominsky's (2001) survey of indoor air quality*. This study characterized impacts of WTC dusts in two buildings in Lower Manhattan. During the study, an indoor dust sample and two outdoor dust samples (rooftop and exterior window ledge) were analyzed for dioxins, PCBs, and metals. Additionally, four exterior dust samples were analyzed for asbestos. All sampling occurred in September, 2001.

- *Lioy et al. (2002) study*. This study documents results from three outdoor bulk dust samples collected in Lower Manhattan on September 16 and 17, 2001. The samples were analyzed for a wide range of compounds, including metals, PCBs, dioxins, pesticides, asbestos, and semi-volatile organic compounds.

- *OSHA's data set*. Results from 11 bulk dust samples collected on June 5, 2002, in a Lower Manhattan building were reviewed. All samples were apparently collected indoors and analyzed for 13 metals.

COPC Selection for Bulk Dust

Step 1: Do not consider volatile contaminants

Volatile contaminants were eliminated from the COPC selection process. Any contaminant on the target analyte list for Method TO-15 (ambient air) and Method 8260 (waste) was considered volatile. Further, chemical similarity to compounds on those lists and boiling point (as a surrogate for vapor pressure) were used to identify additional volatile contaminants not on these methods' target lists.

- 12 contaminants removed from list (see Table B-9)
- 176 contaminants remained for further consideration

Step 2: Do not consider contaminants detected in fewer than 5% of samples, only if more than 20 samples were collected

- 1 contaminant (fiberglass) removed from list
- 175 contaminants remained for further consideration

Step 3: Compare maximum detected concentrations against health-based screening values

Using the health-based screening values for bulk dust described in Appendix A (based on a soil ingestion scenario):

- 84 contaminants removed from list (maximum concentration < screening value, see Table B-10)
- 83 contaminant do not have health-based screening values (see Table B-11)
- 8 contaminants remained for further consideration (listed below)

Contaminants requiring further consideration:

1) Antimony
2) Asbestos
3) Chromium
4) Dioxins
5) Lead
6) Manganese
7) PAHs
8) Thallium

Table B-9. Volatile Contaminants Removed from COPC Selection Process

1,2,4-Trichlorobenzene	2,4-Dimethylheptane
1,2-Dichlorobenzene	2,4-Dimethylhexane
1,3-Dichlorobenzene	3,3-Dimethylhexane
1,4-Dichlorobenzene	Hexachlorobutadiene
2,3,4-Trimethylhexane	Hexachlorocyclopentadiene
2,3-Dimethyl-1-pentanol	n-Octane

Table B-10. Contaminants with Measured Levels Lower than Health-Based Screening Values

Contaminant	Maximum (mg/kg)	Screening Value (mg/kg)	Contaminant	Maximum (mg/kg)	Screening Value (mg/kg)
2,4,5-Trichlorophenol	ND	7500 NC	Endrin	ND	22.5 NC
2,4,6-Trichlorophenol	ND	5557 C	Endrin Aldehyde	ND	22.5 NC
2,4-Dimethylphenol	ND	1500 NC	Endrin Ketone	ND	22.5 NC
2,4-Dinitrophenol	ND	150 NC	Fluoride	0.22	4500 NC
2,4-Dinitrotoluene	ND	150 NC	g-BHC	ND	22.5 NC
2,6-Dinitrotoluene	ND	75 NC	g-Chlordane	0.0081	37.5 NC
2-Chlorophenol	ND	375 NC	Heptachlor	ND	13.6 C
2-Methylnaphthalene	5.1	1500 NC	Heptachlor Epoxide	ND	0.975 NC
2-Methylphenol	0.57	3750 NC	Hexachlorobenzene	0.0019	38 C
2-Nitroaniline	ND	3750 NC	Hexachloroethane	ND	75 NC
3,3'-Dichlorobenzidine	10	136 C	Iron	21000	22500 NC
3-Nitroaniline	ND	22.5 NC	Isophorone	ND	15000 NC
4,6-Dinitro-2-methylphenol	ND	7.5 NC	Lithium	29.52	1500 NC
4-Methylphenol	0.93	375 NC	Mercury	0.38	10.5 NC
4-Nitroaniline	ND	225 NC	Methoxychlor	ND	375 NC
a-BHC	ND	10 C	Metribuzin	22.1	1875 NC
a-Chlordane	ND	38 NC	Mirex	0.0008	15 NC
Aldrin	ND	2 NC	Molybdenum	ND	375 NC
Aluminum	31000	75000 NC	Naphthalene	13	1500 NC
Arsenic	11	23 NC	Naphthalene, 1-(methylthio)-	7.5	1500 NC
Barium	500	5250 NC	Naphthalene, 1,3-dimethylene	5.3	1500 NC
b-BHC	ND	34 C	Nickel	47.29	1500 NC
BDE	3.3	150 NC	Nitrate	0.33	120000 NC
Benzyl alchohol	0.62	22500 NC	Nitrobenzene	ND	37.5 NC
Benzyl butyl phthalate	94.1	15000 NC	N-Nitroso-Di-n-propylamine	ND	8.7 C
Beryllium	3.754	150 NC	N-Nitrosodiphenylamine	ND	1500 NC
Biphenyl	6.5	3750 NC	p,p'-D D D	ND	255 C
bis(2-Chloroethyl)Ether	ND	56 C	p,p'-D D E	0.003	180 C
bis(2-Chloroisopropyl)ether	ND	873 C	p,p'-D D T	0.046	37.5 NC
bis(2-Ethylhexyl)phthalate	21	1500 NC	PCBs (Aroclor 1260)	1.6	30.6 C
Cadmium	8.454	75 NC	Pentachlorophenol	ND	509 C
Carbazole	35	3056 C	Phenol	5.6	22500 NC
Cobalt	14	1500 NC	Prometryn (caparol)	10.7	300 NC
Copper	1327	3000 NC	Selenium	ND	375 NC
Dibenzofuran	18	300 NC	Silver	54	375 NC
Dibutyl phthalate	19.7	7500 NC	Strontium	720.8	45000 NC
Dieldrin	0.0028	3.75 NC	Titanium	1797	300000 NC
Diethylphthalate	31.7	60000 NC	Total chlordanes	0.0056	45 NC
Di-n-octylphthalate	4.4	30000 NC	Toxaphene	ND	56 C
Endosulfan (I)	ND	450 NC	Uranium	4.213	225 NC

Contaminant	Maximum (mg/kg)	Screening Value (mg/kg)	Contaminant	Maximum (mg/kg)	Screening Value (mg/kg)
Endosulfan (II)	ND	450 NC	Vanadium	42.61	525 NC
Endosulfan Sulfate	ND	450 NC	Zinc	3000	22500 NC

Notes:

NC Screening value based on non-cancer endpoint (HQ=1; child exposure)

C Screening value based on cancer endpoint (10-4 risk)

BDE Total bromodiphenyl ethers (BDE47, 99, 100, 153, 154, 209)

Table B-11. Contaminants with No Health-Based Screening Values

Lioy et al. Database	
(E)-2-(6-Nonexnoxy)-tetrahydropyran	Bismuth
1,2,3-Triphenyl-3-vinyl-cyclopropene	Cellulose (%)
12-Acetoxydaphnetoxin	Cesium
1-Azabicyclo[2.2.2]octan-3-one	Chloride
1-Dodecanol, 2-methyl-, (S)-	Chrysotile asbestos (%)
1H-1,2,4-Triazole, 1-ethyl	2-Hexyl-1-decanol
1-Hexadecanol, 2-methyl	3,4-Dihydrocyclopenta(cd)pyrene (acepyrene)
1-Hexyl-2-nitrocyclohexane	Cycloate
1H-Indene, 1-(phenylmethylene)-	Cyclohexanemethanol
1H-Pyrrole-3-propanoic acid, 2,5-dihydro-4-methyl-2,5-dioxo	Dibenzothiophene
1-Hydroxypyrene	Dicyclohexyl phthalate
1-Methylanthracene	Didodecyl phthalate
1-Methylphenanthrene	Dihydrogeraniol
1-Pentacontanol	Diisobutyl phthalate
2-(3'-Hydroxyphenylamino)-5-methyl-4-oxo-3,4-dihydrophyrimidine	Dimethylcyanamide
2,3-Dihydrofluoranthene	Droserone (2,8-dihydroxy-3-methyl-1,4-naphthoquinone)
2,4-DDT	Ether, hexyl pentyl
2-Benzylquinoline	Gallium
3-Methoxycarbonyl-2-methyl-5-(2,3,5-tri-O-acetyl-beta-d-ribofuranosyl)	Hexyl N-butyrate
4,4'-Biphenyldicarbonitrile	Methyl alpha-ketopalmitate
4-Hydroxymandelic acid-TRITMS	Monobutyl phthalate
4-Methyl-2-propyl-1-pentanol	Nefopam
4-Methylphenanthrene	Pentanoic acid, 4,4-dimethyl-3-methylene-, ethyl ester
7-Methyl-3,4,5(2H)-tetrahydroazepine	Phthalate
9,10-Anthraquinone	Phthalic acid, 2-hexyl ester
9H-Fluorene, 9-(phenylmethylene)	Rubidium
Auraptenol	Sulfate
Benzamide, N-acetyl-	Vernolate (vernam)
Benzene, 1,1'-(1,3-butadiyne-1,4-diyl)bis-	Xanthene
Benzimidazo [2,1-a] isoquinoline	
EPA Region 2 Database	
1-Methylnaphthalene	4-Nitrophenol
2,4-Dichlorophenol	bis(2-Chloroethoxy)methane
2,6-Dimethylnaphthalene	d-BHC
2-Chloronaphthalene	Dimethylphthalate
2-Nitrophenol	Calcium
4-Bromophenyl ether	Magnesium

4-Chloro-3-Methylphenol	Potassium
4-Chloroaniline	Sodium
4-Chlorophenyl-phenylether	
ATSDR-NYCDOH Database	
Calcite	Portlandite
Gypsum	Quartz
Halite	SVF (PLM)
Mica	

4.0 Settled Dust

Settled dust sampling results were obtained from the following sources:

- *EPA Region 2's database of environmental sampling results*. The processed database contains more than 500 records of settled dust sampling results. EPA collected wipe samples from three schools (Manhattan Community College, Stuyvesant High School, and PS234) in September 2001. The samples were analyzed for loadings of metals, PCBs, and dioxins.

- *EPA's wipe sampling data*. Preliminary results from EPA's ongoing wipe sampling study of Lower Manhattan residences were reviewed. Only those records labeled as "special pre monitoring" (excluding field blanks) were considered. Overall, 187 samples were analyzed for metals, and 191 samples were analyzed for dioxins. Samples were collected from various indoor locations (e.g., counter tops, floors, walls, window sills).

- *New York City Department of Education sampling in schools*. This study documents sampling results from six schools: PS-89, PS-150, PS-234, Stuyvesant High School (M-477), High School for Leadership and Public Services (M-894), and High School of Economics and Finance (M-833). Settled dust sampling occurred between October 2001 and December 2002. The project database includes more than 6,000 records of sampling results for settled dust; these samples were collected at various indoor and outdoor locations. Samples were analyzed for PAHs, PCBs, dioxins, and metals.

- *Chattfield and Kominsky's survey of indoor air quality*. This study characterized impacts of WTC dusts in two buildings in Lower Manhattan. During the study, six wipe dust samples were analyzed for dioxins, PCBs, and metals. All sampling occurred in September 2001.

- *PCB study by Butt et al. (2002)*. In October 2001, wipe samples were collected to characterize PCB contamination in organic films on building surface, mostly windows. Overall, 9 samples were collected and analyzed for total PCB concentrations.

COPC Selection for Settled Dust

Step 1: Do not consider volatile contaminants

Volatile contaminants were eliminated from the COPC selection process. Any contaminant on the target analyte list for Method TO-15 (ambient air) and Method 8260 (waste) was considered volatile. Further, chemical similarity to compounds on those lists and boiling point (as a surrogate for vapor pressure) were used to identify additional volatile contaminants not on these methods' target lists.

- No contaminants removed from list

- 44 contaminants remained for further consideration

Step 2: Do not consider contaminants detected in fewer than 5% of samples, only if more than 20 samples were collected

- 25 contaminants removed from list (see Table B-12)
- 19 contaminants remained for further consideration

Step 3: Compare maximum detected concentrations against health-based screening values

Using the health-based screening values for settled dust described in Appendix A (based on ingestion/dermal contact scenario):

- 11 contaminants removed from list (maximum concentration < screening value, see Table B-13)
- 5 contaminant do not have health-based screening values (see Table B-14)
- 3 contaminants remained for further consideration (listed below)

Contaminants requiring further consideration:

1) Dioxins
2) Lead
3) Mercury

Table B-12. Contaminants Removed from the COPC Selection Process Due to Frequency of Detection

Contaminant	Samples	Frequency of Detection	Contaminant	Samples	Frequency of Detection
Acenapthene	35	0%	Dibenzo(a)anthracene	35	0%
Acenaphthylene	35	0%	Fluoranthene	35	0%
Anthracene	35	0%	Fluorene	35	0%
Arsenic	215	4.7%	Indeno(1,2,3-cd)pyrene	35	0%
Benzo(a)anthracene	35	0%	Molybdenum	38	0%
Benzo(a)pyrene	35	0%	Naphthalene	35	0%
Benzo(b)fluoranthene	35	0%	PCBs	371	2.7%
Benzo(g,h,I)perylene	35	0%	Phenanthrene	35	0%
Benzo(k)fluoranthene	35	0%	Pyrene	35	0%
Beryllium	215	0%	Silver	215	1.4%
Chrysene	35	0%	Thallium	215	0.5%
Cobalt	250	2.8%	Vanadium	215	3.7%
Decaclhorobiphenyl	1	0%			

Notes:

The number of samples for "PCBs" is the total number of samples that were analyzed for any grouping of PCB congeners, including Aroclors or total PCBs. It should be noted that the highest total PCB concentration reported for a surface measurement (1.398 : g/m^2) is lower than the corresponding health-based screening value (15.6 : g/m^2).

Table B-13. Contaminants with Measured Levels Lower than Health-Based Screening Values

Contaminant	Maximum (:g/m²)	Screening Value (:g/m²)	Contaminant	Maximum (:g/m²)	Screening Value (:g/m²)
Aluminum	102,000	1,570,000	Iron	212,000	941,000
Antimony	377	627	Manganese	3,910	31,400
Barium	3,100	110,000	Nickel	1,160	31,400
Cadmium	429	1,560	Selenium	590	7,840
Chromium	1,900	4,700	Zinc	72,000	470,000
Copper	7,150	62,700			

Table B-14. Contaminants with No Health-Based Screening Values

Asbestos (inhalation value only)	Potassium
Calcium	Sodium
Magnesium	

5.0 Analysis of Contaminants Requiring Further Consideration

Two classes of contaminants required further evaluation after the initial screening described above: (1) contaminants with maximum concentrations greater than screening values and (2) contaminants for which no screening values are available. Sections 5.1 and 5.2 describe the results of this secondary analysis, providing justification for all contaminant-specific decisions.

5.1 Contaminants Found to Exceed Toxicity Criteria

From the initial screening results presented above, fifteen contaminants were detected in at least one sample from at least one medium at concentrations greater than corresponding health-based screening values. This section presents the findings of the secondary screen conducted to determine whether these contaminants would be selected or eliminated as a COPC. The decision process involved assessing the representativeness of reported maximum concentrations, studying spatial and temporal trends, determining the relationship of detected concentrations to available background concentrations, and examining whether there was reason to believe a contaminant was site-related.

From this evaluation, the following contaminants were selected as COPC:

- Asbestos
- Dioxins
- Lead
- PAHs

This evaluation eliminated the following contaminants from further consideration:

- Aluminum
- Antimony
- Arsenic
- Barium
- Manganese
- Naphthalene
- Nickel
- MDI
- Thallium

Two of the metals (chromium and mercury) did not fully meet all the criteria for selection as a COPC and were not designated as such, but some evidence exists that they may be present in indoor environments. Chromium and mercury are therefore highlighted separately below. EPA will continue to sample for these and other non-COPC metals as part of the WTC Clean-up Program.

Contaminants selected as COPC:

1) **Asbestos:** Ambient air sampling conducted by multiple parties has found asbestos concentrations greater than the air screening value (0.0004 fibers/cubic centimeter) based on cancer risk. Additionally, asbestos fibers have been found in indoor and outdoor dust samples collected at various Lower Manhattan locations. Based on these and other trends among the sampling data, our knowledge of the construction materials in the WTC buildings, and ongoing health concerns regarding potential exposure to asbestos, asbestos is being selected as a COPC.

2) **Dioxins:** As the peer review draft COPC document notes, ambient air concentrations of dioxin in samples collected in September and October, 2001, exceeded EPA's screening criteria for dioxin, regardless of whether toxicity screening was based on the current cancer slope factor or on EPA's proposed updated cancer slope factor. Since 2001, EPA has collected and analyzed nearly 200 settled dust samples from Lower Manhattan residences, and dioxin levels in this medium also were found to exceed health-based screening values.[1] Given these observations, and the knowledge that high-temperature combustion sources (like that which occurred at Ground Zero on and following September 11, 2001) release dioxins to the air, dioxins are being considered as a COPC.

3) **Lead:** EPA's ambient air monitoring database includes five samples with lead concentrations greater than the National Ambient Air Quality Standard for lead (0.0015 mg/m^3). This standard is based on a quarterly average air concentration, and quarterly average lead levels near the WTC site have not exceeded this standard. Lead was more commonly found at concentrations greater than 0.0001 mg/m^3, which has been reported as the upper bound of average air concentrations of lead in urban environments. These sampling results, taken alone, do not present extraordinarily high concentrations. However, when considering the lead levels reported in WTC dusts and the mass of material released from the collapse of the towers, potentially significant amounts of lead might have deposited in Lower Manhattan. As evidence of this, EPA's ongoing study of Lower Manhattan residences has found that lead levels in more than 90% of the indoor wipe samples collected to date have exceeded the reported background loading (1.78 : g/ft^2, the 95% UCL based on residential data). Therefore, lead is considered a COPC.

4) **PAHs:** Limited ambient air sampling was conducted for PAHs between September and December, 2001, when fires continued to burn at Ground Zero. However, bulk dust samples collected by EPA and an independent researcher contained PAHs at levels greater than health-based screening values. Based on this observation and the knowledge that combustion processes release soot particles containing PAHs into the air, PAHs are being considered a COPC.

Contaminants eliminated from further consideration:

1) **Aluminum:** Aluminum levels have been measured in more than 200 settled dust samples, 18 bulk dust samples, and more than 1,000 air indoor or ambient air samples. None of the bulk dust samples or settled dust samples collected to date have contained aluminum levels greater than health-based screening values. Fewer than 5% of the air samples had concentrations greater than NCEA's provisional reference concentration (0.0035 mg/m^3). However, no clear spatial or temporal trends are apparent among these samples. The ranges of aluminum concentrations documented in these studies are generally consistent with those that have been reported for other urban areas in the United States (ATSDR 1999a). Based on this review of the data, there is no evidence that aluminum concentrations are unusually high or consistently greater than health-based screening values. As a result, aluminum is not being considered a COPC. However, as part of ongoing cleanup efforts, EPA continues to analyze indoor dust samples for aluminum to evaluate surface loadings.

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[1] The frequency with which dioxin levels in settled dust exceeds health-based screening values depends on how one interprets non-detect observations. Whether one assigns non-detects a value of zero or one-half the detection limit, however, at least one measurement of surface loading exceeds a health-based screening value.

2) **Antimony:** Levels of antimony were measured in more than 200 settled dust samples, 25 bulk dust samples, and nearly 750 air samples. None of the air concentrations or settled dust loadings measured exceeded health-based screening values. Of the 25 bulk dust samples reviewed, only one sample contained antimony (42.1 mg/kg) at levels greater than the health-based screening value (30 mg/kg). That sample was collected from a rooftop in Lower Manhattan. Antimony is not being selected a COPC because the overwhelming majority of sampling results (>99%) are below health-based screening values. To be protective, EPA continues to analyze indoor dust samples for antimony to evaluate surface loadings.

3) **Arsenic:** Arsenic levels have been measured in 17 bulk dust samples and in 215 settled dust samples, but never detected at concentrations or loadings greater than corresponding health-based screening values. On the other hand, since September 11, 2001, 738 air samples collected in and near Lower Manhattan were analyzed for arsenic, and arsenic was detected in 64 (9%) of the samples. The measured concentrations ranged from 0.000007 mg/m^3 to 0.000343 mg/m^3. Thirty-two samples contained arsenic above the screening value (10^{-4} cancer risk) for arsenic (0.00002 mg/m^3). A clear majority of the highest concentrations were observed in samples collected in April and May, 2002, suggesting that sources other than WTC dust likely account for a considerable portion of the ambient levels. This is supported by the observation that the measured ambient air concentrations fall within the range of arsenic levels reported as being observed in urban settings (ATSDR 2000a). Local background data are a little more difficult to interpret. Annual average arsenic levels in Midtown Manhattan between 1992 and 1998 ranged from 0.0000017 mg/m^3 to 0.0000031 mg/m^3 (NYSDEC 2000). However, a direct comparison cannot be made between NYSDEC's Midtown sampling and EPA's Lower Manhattan sampling due to the differences in detection limits and the high frequency of non-detects. Overall, the observations suggest that arsenic in the WTC dusts is not at levels greater than health-based screening values and that airborne arsenic in Lower Manhattan is not unusually high when compared to the arsenic levels routinely observed in urban settings. Consequently, arsenic is not being considered a COPC, but EPA will continue to measure arsenic levels in indoor dust samples to ensure that ongoing exposures to arsenic from WTC dusts, if any, are not at levels of health concern.

4) **Barium:** Since September 11, 2001, barium levels have been measured in 738 ambient air samples, 17 bulk dust samples, and 215 settled dust samples. Of all these measurements, only two air samples had barium concentrations greater than an ambient air screening value (0.00049 mg/m^3) derived from a "HEAST alternate RfDi" reported in EPA Region 3's Risk-Based Concentration Table. Furthermore, EPA's ongoing indoor wipe sampling has found no barium levels greater than corresponding health-based screening values. These observations provide little evidence of barium consistently being greater than screening values, and barium is not being considered a COPC.

5) **Manganese:** Concentrations of manganese have been measured in more than 1,200 air samples, in 28 bulk dust samples, and in 218 settled dust samples. According to EPA's database of air sampling results, manganese levels in 236 air samples collected to date were greater than the RfC (0.00005 mg/m^3). However, the 95% UCL of the mean concentration is lower than the RfC. In bulk dust, the health-based screening value (1,500 mg/kg) was only slightly exceeded (1,600 mg/kg) in a single sample. EPA's ongoing indoor dust sampling events provide further insights into the significance of manganese levels for the indoor environment: to date, all 218 manganese concentrations measured in dusts from Lower Manhattan residences have been lower than corresponding health-based screening values. Based on these trends among the air and dust sampling data, manganese is not being selected a COPC. Nonetheless,

EPA will continue to analyze indoor dust samples for manganese to ensure that surface loadings are not at levels of health concern.

6) **4,4'-Methylene diphenyl diisocyanate (MDI):** The only sampling data available for MDI are 48 ambient air samples collected between December 2001 and February 2002. MDI was detected in three of these samples, all of which were collected on December 19, 2001. The levels measured in the three samples were higher than the RfC (0.0006 mg/m^3). The multiple detections on one day suggest that MDI might be released sporadically by one or more sources in Lower Manhattan. Regardless of the source of the airborne levels, MDI is a highly reactive compound and it is unlikely that MDI released during the collapse of the WTC towers, if any, would still be present in indoor environments today. MDI is not being considered as a COPC, nor will it be analyzed for during the ongoing residential dust sampling effort.

7) **Naphthalene:** The available sampling data include 573 air samples and 22 bulk dust samples. Of these measurements, only a single ambient air sample had a concentration (0.0073 mg/m^3) greater than the RfC (0.003 mg/m^3). This sample is J-qualified and was collected on April 18, 2002, well after WTC-related emissions subsided. Given the extremely limited evidence of naphthalene being found at levels greater than health-based screening values, this contaminant is not being considered as a COPC and indoor dust samples collected in Lower Manhattan residences will not be analyzed for naphthalene.

8) **Nickel:** Levels of nickel have been measured in more than 1,000 ambient air samples, in 28 bulk dust samples, and in more than 200 settled dust samples. The only samples found to have nickel levels greater than health-based screening values are six ambient air samples, which contained nickel at levels greater than ATSDR's inhalation MRL for *chronic* exposure (0.0002 mg/m^3). However, the 95% UCL nickel concentration (a better indicator of chronic exposure levels) is considerably lower than this screening value. Moreover, EPA's ongoing indoor dust sampling efforts show that all of the nickel levels measured in indoor wipe samples at Lower Manhattan residences have been lower than their corresponding health-based screening level. Therefore, nickel is not being considered as a COPC. Nonetheless, EPA will continue to analyze indoor dust samples for nickel to ensure that surface loadings are not at levels of health concern.

9) **Thallium:** Thallium levels have been measured in 738 ambient air samples, 17 bulk dust samples, and 215 settled dust samples. To date, only a single measurement—a bulk dust sample collected in September 2001—had a thallium concentration (11 mg/kg) greater than the corresponding health-based screening value (7 mg/kg). However, EPA's ongoing indoor wipe sampling results are more representative of current and future exposures, and this study has detected thallium in only 1 out of the 187 samples analyzed to date. Thus, thallium is not being considered a COPC, but the indoor wipe sampling program will continue to measure thallium levels to ensure that Lower Manhattan residents are not at risk from ongoing thallium exposures, if any measurable exposures exist.

Chromium and mercury:

1) **Chromium:** In the past 2 years, chromium levels in Lower Manhattan have been measured in air (more than 1,000 samples), bulk dust (28 samples) and settled dust (225 samples). None of the dust samples, including the 187 samples EPA recently collected from Lower Manhattan residences, have contained chromium at levels greater than health-based screening values. These samples are most representative of the current and future exposures that may be occurring in the indoor environment. The air sampling results provide somewhat conflicting results:

   - Chromium was detected in 449 of the 478 samples collected in and near Lower Manhattan schools. Every detected chromium concentration was greater than the screening value for 10^{-4} cancer risk (0.000008 mg/m^3) and the RfC (0.0001 mg/m^3), but additional observations must be noted. Most importantly, these concentrations were measured using NIOSH Method 7300M. NIOSH reports a "working range" for this method as 0.005 to 2.0 mg/m^3, based on a 500-liter sample. However, even the highest level measured in this sampling (0.00119 mg/m^3) is below the working range of the method. Moreover, chromium was consistently detected in blank samples, raising further questions about the validity of the measured concentrations.

   - The other information on ambient chromium levels is documented in EPA's sampling database, which documents the results of 738 samples. Chromium was detected in 23% of these samples; the highest concentration measured was 0.00051 mg/m^3 and the 95% UCL of the mean concentration was 0.000040 mg/m^3. Comments in the EPA database indicate that chromium was detected in several field blanks; however, none of the sampling results are B-qualified.

   Overall, the sampling data provide compelling evidence that chromium in bulk and settled dusts that remain in Lower Manhattan residences are below health-based screening values. Though some questions remain about the chromium found in the ambient air, the 95% UCL concentration of total chromium (0.000040 mg/m^3) collected with the most sensitive method falls within the range of chromium levels typically observed in urban environments (ATSDR 2000). While chromium is not being considered a COPC, EPA will continue to analyze dusts from Lower Manhattan residences for chromium to identify and clean homes found to have elevated levels, even though the available data suggest that chromium in settled dust is consistently less than screening values.

2) **Mercury:** Multiple studies have measured mercury levels in air and dust in Lower Manhattan following September 11, 2001, and these studies have not reached consistent findings:

- Three different parties have analyzed 13 bulk dust samples for concentrations of mercury. The highest concentration measured (0.38 mg/kg) is lower than the corresponding health-based screening value (22.5 mg/kg).

- An independent researcher prepared a report indicating that airborne mercury levels in Lower Manhattan after the WTC collapse were greater than EPA's RfC (0.0003 mg/m^3) and orders of magnitude greater than mercury levels found in non-industrial urban environments (Singh 2002). These conclusions were based on measurements made with a Jerome Mercury Vapor Analyzer, a hand-held field surveying tool with a reported mercury detection limit of 0.003 mg/m^3. These results could not be reproduced, however. A subsequent review questioned the findings from the study, noting that the sampling results could be biased due to low measurement selectivity and various positive interferences (Johnson 2002). Further, EPA initiated a follow-up mercury sampling project, during which mercury levels were measured in four occupied Lower Manhattan residences and at selected outdoor locations (Johnson 2002). In this study, both the maximum air concentration (0.0002 mg/m^3) and the 95% UCL of the mean concentration (0.00006 mg/m^3) were lower than EPA's RfC. Sampling in this study was performed with a Lumex Mercury Vapor Analyzer, which has a detection limit of 0.000002 mg/m^3.

- The New York City Department of Education sampled airborne mercury levels in six Lower Manhattan schools using NIOSH Method 6009. The database of sampling results indicates that some individual measurements were greater than the RfC (0.0003 mg/m^3) and that the 95% UCL of the mean concentration (0.00029 mg/m^3) was just below this screening value. However, the reliability of these measurements is questionable for two reasons. First, the accuracy of the NIOSH method has only been established for concentrations ranging from 0.002 to 0.8 mg/m^3, and the levels reported in this study are typically more than an order of magnitude lower than this range. Second, mercury was detected in about 75% of the blank samples, and the mass of mercury collected in the majority of field samples was indistinguishable from the levels observed in the blanks. Thus, the sampling methodology used in this study does not appear to be capable to measure mercury accurately and precisely at concentrations near the screening level for this evaluation.

- Finally, the sampling results available from EPA's ongoing study of settled dust in Lower Manhattan residences includes 182 measured surface loadings of mercury. Two of the samples collected to date contained mercury at levels greater than the corresponding health-based screening value (157 : g/m^2). Of the 24 contaminants for which data are currently available, mercury is one of only three contaminants (dioxin and lead being the others) that had any measured levels greater than screening values.

Overall, the air sampling study using the most sensitive methodology found that airborne mercury levels in Lower Manhattan (both indoor and outdoor) were lower than the RfC. The two other studies with conflicting conclusions were based on air sampling methodologies that are not designed to generate accurate readings at levels near the screening value. On the other hand, EPA's indoor dust sampling project has found that a very small fraction of Lower Manhattan residences contain settled dust with mercury levels greater than the screening value. The origin of the mercury in this limited number of homes is not known, and it may come from

indoor or outdoor sources. Indoor sources of mercury include industrial instruments (e.g., fluorescent lights, thermometers), some paints, consumer products used for traditional or herbal remedies or religious practices, among others (ATSDR 1999b).

The available data suggest that settled dusts in some Lower Manhattan residences contain mercury at levels greater than health-based screening values; however, it is not clear whether this mercury is related to the WTC site. EPA will continue to analyze dusts from Lower Manhattan residences for mercury to identify and clean homes found to have elevated levels, regardless of the source.)

5.2 Contaminants with No Toxicity Criteria

Contaminants for which no toxicity criteria are available are listed in Tables B-4, B-8, B-11, and B-14. This section presents the findings of a more in-depth evaluation to determine whether any of these contaminants require further consideration. From this evaluation, two additional COPC were identified: fibrous glass and crystalline silica.

Contaminants selected as COPC:

1) **Fibrous glass:** Analysis of WTC bulk dust and debris has consistently identified fibrous glass to be a major constituent of the material (Lioy et al. 2002, USGS 2001). In addition, the NYCDOHMH/ATSDR (2002) study found fibrous glass in the interior settled dust. Air samples collected in areas with fibrous glass in settled dust indicate no fiber levels of immediate concern. Although fiber counts were found in four areas with slightly greater than background (0.004-0.006 fiber/cc), subsequent re-analysis indicated actual fibrous glass concentrations from these areas as 0.00004 to 0.00026 fiber/cc. Air samples from remaining areas showed a maximum 0.003 f/cc total fiber count by Phase Contrast Microscopy. These fibers may be skin, eye, and respiratory tract irritants. Although there are no standards to evaluate the settled dust content, the presence of fibrous glass in settled dust does indicate a potential for exposure. Therefore, fibrous glass is included as a COPC.

2) **Crystalline silica:** Settled dust and air samples taken in indoor and outdoor areas of residential buildings in November and December of 2001 indicate the presence of alpha-quartz. Other forms of crystalline silica were not found. This is consistent with outdoor dust and debris samples collected by the USGS (USGS, 2001) and subjected to mineral analysis. Quartz was found in approximately 49% of the settled dust samples from indoor areas of residential buildings and all of the associated outdoor areas sampled. Levels of quartz ranged as high as an estimated 31.4% of the dust by weight in a residence. Since quartz is a common material in sand, finding this mineral in a city where there is a great deal of concrete is not unusual. However, quartz in dust from a comparison area unaffected by the WTC collapse ranged from non-detect only up to an estimated 2.2% in the residence (NYCDOHMH, 2002). Seventeen residential areas and eleven common areas had quartz levels greater than the associated comparison area. Therefore, quartz was deemed to be elevated in some indoor areas of lower Manhattan relative to the comparison area. Additionally, quartz was found in 13% of the respirable fraction air samples taken in these areas, ranging from an estimated 4-19 $\mu g/m^3$, demonstrating a potential for exposure. Although below occupational standards, this estimated concentration is above the effective NAAQS standard for the silica fraction of respirable particulate matter. Therefore crystalline silica, measured as alpha-quartz, is included as a COPC.

Contaminants eliminated from further consideration:

1) **Calcite, gypsum, and portlandite:** In addition to crystalline silica, calcite, portlandite and gypsum were the most abundant minerals detected in settled dust samples from residential areas in lower Manhattan following the WTC collapse. Mica was detected with much less frequency, generally at less than 0.1% of the dust. Halite (salt) was also detected at trace levels. Calcite, portlandite, and gypsum are typical components of concrete and gypsum based wallboard products, which were present in the WTC buildings. While high concentrations of these minerals in airborne dust constitute a short-term health concern in the form of eye, nose and throat irritation, persisting adverse heath effects would not be anticipated, unless these minerals remained suspended in high concentrations. Indoor and street-level outdoor air sampling done in November and December of 2001 show that the levels of these chemicals, over a time-weighted sample, were below levels associated with irritant effects (see table below).

NIOSH and OSHA exposure limits and estimated maximum values in Lower Manhattan

Mineral	NIOSH REL (: g/m^3)	OSHA PEL (: g/m^3)	*Maximum Estimated Value (J) in Lower Manhattan (: g/m^3)
Gypsum	10,000 : g/m^3 (total) 5,000 (: g/m^3 resp)	15,000 : g/m^3 (total) 5,000 (resp)	14J (PM100) 15J (PM4)
Portlandite	5,000 : g/m^3	15,000 : g/m^3 (total) 5,000 : g/m^3 (resp)	95J (PM100) 84J (PM4)
Calcite	10,000 : g/m^3 (total) 5,000 : g/m^3 (resp)	15,000 : g/m^3 (total) 5,000 : g/m^3 (resp)	14J (PM100) 10J (PM 4)

NIOSH = National Institute of Occupational Safety and Health, Centers for Disease Control and Prevention
REL = recommended exposure level/limit
OSHA = Occupational Safety and Health Administration
PEL = permissible exposure limit.
resp = respirable
* [ATSDR/NYCDOHMH, 2002]

2) **Essential nutrients (e.g., calcium, magnesium, sodium):** EPA does not generally carry these elements through its risk assessments because of their natural occurrence, presence in our diets, and relatively low toxicity.

3) **A limited number of specific phthalates and PAHs and other SVOCs.** The lengthiest list of SVOCs for which no toxicity criteria exist comes from Lioy et al. (2002)—a study of three outdoor bulk dust samples collected in Lower Manhattan on September 16 and 17, 2001. Most of these SVOCs were not consistently detected across the three samples. Further, the concentrations measured were consistently lower than other SVOCs (e.g., PAHs) that have been selected as COPC. Finally, because many of the SVOCs identified by Lioy are rarely considered in environmental sampling studies, we have no knowledge whether the measured levels are consistent with background concentrations in urban settings or if the levels are unusually high.

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APPENDIX C

Basis for Screening Level of 1 E-04 (1×10^{-04})

Defensible analytical methodologies and sampling protocols have been chosen for indoor sampling and analysis activities. The methods chosen are ones that have been published by reputable agencies and are in common practice among testing laboratories. In some cases, minor modifications may be made to the sampling and analytical protocols, but these are modifications that are well established in the laboratory community.

All protocols chosen are designed to reach the lowest level of detection that is reasonable for the established methods. For dioxin, asbestos and PAHs in indoor air the sampling and analytical protocols are designed to reach detection limits that represent risk estimate levels of 1 E-04. To reach risk estimates of 1E-06, extraordinary modifications would have to be employed. These modifications would either have to be incorporated into the analytical protocols to increase the sensitivity of the required instrumentation, incorporated into the sampling protocols to achieve a larger sample, or a combination of both. For the Chemicals of Potential Concern (COPC) list, the analytical protocols chosen are already incorporating the maximum sensitivity of the instrumentation. Therefore, the only legitimate mechanism to lower the overall limits of detection is to modify the sampling protocol. The two means of achieving this goal are to either run the sampling equipment (pumps) at a higher flow rate, or for longer periods of time. For the COPC list modifying flow rates would involve operating the equipment to achieve flow rates on the order of 500 to 1000 liters per minute. The only equipment available to operate at such flow rates are large units that can not be brought inside a residence. Rates this high also present problems with creating excessive negative pressure for indoor environments, plus flow rates this high have not been tested using the sampling protocols, and there is high likelihood of having analyte breakthrough on the collection filters. Therefore, this is not practical. The other option is to run the equipment for long periods of time. Again with the COPC list, sampling periods of up to 800 hours (33 days of continuous operation) would be needed to reach the E-06 risk detection levels.

For silica, the analytical and sampling protocols chosen will give detection levels in the neighborhood of 5 : g/m^3 (see Section 3.3 for more detailed discussion). Instrumental sensitivity can not be set any higher to reach lower detection levels. Also, the sampling protocols involved for this analysis have been thoroughly validated by NIOSH. Any change in pump flow rate or sampling duration beyond what is documented in the method will produce results that have not been validated. Therefore, the sampling protocol should not be changed from that which is documented.

For fibrous glass the methodology is such that detection levels as low as 0.00001 f/cc can be achieved. This is well below required levels of detection for future indoor studies.

Another consideration in setting the target risk level involved the anticipated background level of contaminants such as asbestos, dioxin and PAHs in urban indoor environments. EPA has conducted a study (WTC Background Study - EPA 2003b) to characterize background conditions for WTC COPC in New York City residential dwellings. Preliminary results indicate that background concentrations of asbestos in indoor air and dioxin in settled dust are within the same order-of-magnitude as the analogous health-based benchmarks set at the E-04 risk level. Practical quantitation limits constrain the ability to measure PAH congeners below the E-04 risk level. As part of the WTC Background study, a literature review was conducted to provide a general estimate of background concentrations for carcinogenic COPC in urban indoor environments. It should be noted that the literature is limited in this regard. For asbestos, ATSDR reports that "measured indoor air values range widely, depending on the amount, type, and condition (friability) of asbestos-containing materials used

in the building" (ATSDR, 1995). In its review ATSDR notes that the studies suffer from lack of common measurement reporting units. Study results have been reported as ng/m^3, f/cc (TEM) and f/cc (PCM). Using unit conversion factors recommended by the National Research Council in 1984, ATSDR (1995) reports that the arithmetic mean concentrations of monitoring data from a variety of indoor locations ranged from .00003 - .006 f/cc (PCM). The clearance level for WTC-impacted residential dwellings (.0009 PCM equivalents) is within this background range. Additional literature review (ATSDR 2000, EPA 2003 b) indicates that the background levels of PCM equivalent fibers in residential indoor environments ranges from non-detect (ND) - .002 f/cc.

APPENDIX D

Assessing Exposures to Indoor Air and to Residues on Indoor Surfaces

1.0 Introduction

The purpose of this Appendix is to provide further details on how procedures were selected to estimate exposure to indoor air and to residues on indoor surfaces in residences impacted by the WTC attack.

2.0 Indoor Air

Indoor air clearance criteria were derived using methods described in EPA's "Risk Assessment Guidance for Superfund" [RAGS, 1989]. These methods were developed to assess the risk from contaminants at Superfund sites. The risk based clearance criteria were calculated using the formulas below:

*Carcinogens: Clearance Criteria = (TR * AT) / (ED * EF * IUR)*

*Non-Carcinogens: Clearance Criteria = Target Hazard Index * RfC*

where:

TR = Target Risk
AT = Averaging Time (d)
ED = Exposure Duration (yr)
EF = Exposure Frequency (d/yr)
IUR = Inhalation Unit Risk (risk per : g/m^3)
RfC = Reference Concentration (: g/m^3)

Target Risk (TR) and Target Hazard Index
The target risk identified for these calculations was 1 x 10^{-4} and the target hazard index was 1.0. Appendix C explains the rationale for these values.

Averaging Time (AT) - Carcinogens
For carcinogens, exposure is averaged over a 70-year lifetime (the factor on which the cancer slope factors are based), and the AT is 70 years, in days (25,550).

Exposure Duration (ED)
A value of 30 years is assumed to match upper bound estimate of time in a residence (EPA, 1997b).

Exposure Frequency (EF)
A value of 365 days/year is used to represent a full time resident. Implicitly this approach also assumes exposure occurs continuously, i.e. 24 hr/d.

Inhalation Unit Risk (IUR)
The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a unit concentration. The inhalation unit risk values used in this report are summarized in Table A-1 (Appendix A). Cancer risks for dioxin were evaluated on the basis of a range of unit risk values. An inhalation unit risk of 50,000 per mg/^{m3} can be calculated from the oral slope factor of 1.6 x 10^5 kg-d/mg given in EPA, 1985. The draft Dioxin Reassessment (EPA, 2000) proposes an oral slope factor of 1 x 10^6 kg-d/mg which can be converted to an inhalation unit risk of 290,000 per mg/^{m3}.

Reference Concentration (RfC)

The RfC represents an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfC values used in this report are summarized in Table A-1 (Appendix A).

3.0 Residues on Indoor Surfaces

The most formal EPA guidance which addresses this issue is the "Standard Operating Procedures (SOPs) for Residential Exposure Assessment" originally published by the Office of Pesticides in 1997 and updated in 2001 (EPA, 1997a and EPA, 2001a). This guidance was designed for estimating exposures to pesticides. Pesticides are typically applied to indoor surfaces as liquid or sprayed formulations which would create surface residues which are likely to be somewhat different than the fine dust particles associated with the WTC attack. So while this guidance was selected as the starting point for developing these procedures, a number of other sources were also reviewed including the Superfund guidance on dermal contact (EPA,1989), the procedures used to develop re-entry guidelines for the Binghamton State Office Building (Kim and Hawley, 1985), procedures used by NJDEP for setting interior building surface clean-up goals (NJDEP, 1993), the building clean-up procedures presented by Michaud et al (1994) and an approach developed by the EPA Region III Superfund program that has been employed by the U.S. Army Corps of Engineers to develop risk-based clean-up goals for interior surfaces at the Claremont Polychemical Superfund site in Region II (Radian, 1999). The discussion below presents the OPP procedures and how they were adopted for application to residences near WTC.

The scenario for indoor surface exposures is assumed to be 30 years which represents an upper estimate for how long individuals may live in one residence (EPA, 1997). This contact begins at about 6-12 mo age when infants become mobile. Thus, this exposure scenario is assumed to begin at age 1 and end at 31.

3.1 Dermal Contact

The OPP guidance specifies the following procedure to estimate the Potential Dose Rate (PDR, : g/kg-day) from dermal contact with indoor surfaces:

PDR = (ISR * TC * ET)/ BW

ISR = Indoor Surface Transferable Residue (: g/cm^2)
TC = Transfer Coefficient (cm^2/hr)
ET = Exposure Time (hr/d)
BW = Body Weight (kg)

ISR represents the amount of residue on a surface that can be transferred to skin. The OPP defaults calculate this initially as a fraction of the application rate. Pesticide application rates are not relevant to the WTC situation. Instead, the following approach is recommended.

ISR = CSL * FTSS

CSL = Contaminant Surface Load (: g/cm^2)
FTSS = Fraction Transferred from Surface to Skin (unitless fraction)

Making this substitution and rearranging to allow different parameter values for hard vs soft surfaces gives the following:

$$PDR = [(TC*ET_{hard}*FTSS_{hard}*CSL_{hard})+(TC*ET_{soft}*FTSS_{soft}*CSL_{soft})]/BW$$

The discussion below defines these parameters, provides the OPP default and discusses how they should be changed for the WTC assessment. The OPP procedures provide defaults for two age classes: toddlers (ages 1-6 yr) and adults. The OPP estimate of the surface residue level includes dissipation over time. Dissipation is also expected to occur in the WTC situation, but at potentially different rates and mechanisms than pesticides. This issue is discussed separately below in Section 3.3.

Fraction Transferred from Surface to Skin (FTSS, unitless fraction) - This is the fraction of residue on a surface that can be transferred to skin. The OPP defaults calculate this initially as 5% of application rate for carpets and 10 % for hard surfaces with a subsequent dissipation rate. FTSS will vary depending on type of surface, type of residue, hand condition, force of contact, etc. USEPA has previously assumed a transfer fraction of 0.5 for PCBs (EPA, 1987) based on an Office of Toxic Substances (OTS) assessment. Michaud et al (1994) assumed 0.5 for PCBs and dioxins, but stated that 0.1 might be more realistic. In developing re-entry guidelines for the Binghamton State Office Building after a fire, a 100% transfer was assumed (Kim and Hawley, 1985). In a study of Malathion uptake from different surfaces, USEPA-EMSL found that FTSS of Malathion from painted Sheetrock to human hands was only 0.0003. (Mean transfer from vinyl flooring to hands was 0.0018, and from carpet to hands was 0.0152.) Malathion is a pesticide assumed to have lipophilicity more similar to PCBs than to volatiles or metals. However, the representativeness of such a number for PCBs and dioxins is unknown. PCBs are more lipophilic (have higher Kows) than malathion. Rodes et al. 2001 conducted hand press experiments on particle transfer to dry skin and measured transfers with central values of about 10% from carpets and 50% from hard surfaces. These are considered most relevant to the WTC situation and were adopted in this assessment for transfers to hands leading to ingestion (see discussion below). For dermal contact, it is important to consider that much less transfer will occur to body parts with less intensive surface contact than hands such as the arms, legs, and face. Therefore these values were reduced by half to represent an area weighted transfer to the all exposed skin (i.e. 5% from soft surfaces and 25% from hard surfaces).

Transfer Coefficient (TC, cm^2/hr) - This represents the rate of skin contact with the surface. The OPP defaults are 6000 cm^2/hr for toddlers and 16,700 cm^2/hr for adults. These were derived from pesticide specific studies involving very high activity levels and minimal clothing protection. For chronic exposures assumed for the WTC situation, where exposure is to dust, much lower transfer coefficients would be applicable. A value more representative of this scenario was derived by selecting a TC which yielded total dust on skin loads comparable to measured values in indoor settings. Using the model presented above, the total dust load on skin can be computed and averaged over the exposed skin area (SA) as follows:

$$\text{Daily Skin Load} = [(TC*ET_{hard}*FTSS_{hard}*CSL_{hard})+(TC*ET_{soft}*FTSS_{soft}*CSL_{soft})]/SA$$

The CSL values were set at 50 : g/cm^2 of total dust which represents typical indoor horizontal surfaces based on Rodes et al., 2001 (this value is also consistent with ranges shown in Table 2). The exposed skin surface area was set to 5000 cm^2 for children (half the skin area of 7-8 yr old) and 9000 cm^2 for adults (half the skin area of an adult) (EPA, 1997). The other parameters were set at the values presented above. A TC value of 1200 cm^2/hr was judged to provide reasonably comparable skin loads to measured levels and adopted here (see Table 1).

Table 1. Skin Load Comparisons

	Calculated Skin Load (: g/cm^2)	Measured Skin Load (: g/cm^2)
Child	17	10 - area weighted average for indoor children (EPA, 2000) 40 - area weighted average for daycare children (EPA, 2000)
Adult	9	2 to 6 - range across body parts for Tai Kwon Do students (EPA, 1997b) 2 to 43 - range across body parts for greenhouse workers (EPA, 1997b)

Exposure Time (ET, hr/d) - The OPP defaults are 8 hr/d for carpets and 4 hr/d for hard surfaces. Hard surface time is based on time in kitchen and bathroom. Carpet time is based on remaining indoor time not including sleeping. This was judged to be representative of many children under age 6 who spend most of their time at home. Normally children begin school at age 6 and spend less time at home. So for ages 6-18 this was reduced to 6 hr/d for carpets and 2 hr/d for hard surfaces. After 18, many individuals will spend more time in school or at work. Others, however, may not work or attend school and spend more time at home. To be conservative, it was decided to represent this second scenario and assume that after 18 individuals would spend 8 hr/d on carpets and 4 hr/d on hard surfaces.

Body Weight (BW, kg) - The OPP defaults are 15 kg for toddlers and 71.8 kg for adults. Since this assessment spans ages 1-31, mean weights were used to represent each year based on national data in EPA, 1997.

3.2 Dust Ingestion

The OPP guidance specifies the following procedure to estimate the Potential Dose Rate (PDR, : g/kg-day) from incidental nondietary ingestion of residues on indoor surfaces from hand-to-mouth transfer.

PDR = (ISR * SA * FQ * SE * ET)/ BW

ISR = Indoor Surface Transferable Residue (: g/cm^2)
SA = Surface Area (cm^2/event)
FQ = Frequency of hand to mouth events (events/hr)
SE = Saliva Extraction factor (unitless fraction)
ET = Exposure Time (hr/d)
BW = Body Weight (kg)

As discussed above, ISR is calculated here by multiplying the Contaminant Surface Load (CSL) by the Fraction Transferred from Surface to Skin (FTSS). Making this substitution and rearranging to allow different parameter values for hard vs soft surfaces gives the following:

$$PDR = [(ET_{hard} * FTSS_{hard} * CSL_{hard}) + (ET_{soft} * FTSS_{soft} * CSL_{soft})] * SA * FQ * SE / BW$$

The discussion below defines these parameters, provides the OPP default and discusses how they should be changed for the WTC assessment. The OPP guidance provides defaults for toddlers (ages 1-6 yr) only.

Fraction Transferred from Surface to Skin (FTSS, unitless) - Rodes et al. 2001 conducted hand press experiments on particle transfer to dry skin and measured transfers with central values of about ~~of~~ 10% from carpets and 50% from hard surfaces. These are considered representative of the WTC situation and were adopted in this assessment for transfers to hands leading to ingestion. Rodes et al. presented some data suggesting that transfers to wet skin (which would be associated with mouthing behavior) would be higher than dry skin, but these results were not used since they appeared less reliable.

Surface Area (SA, cm^2/event) - This is the skin area contacted during the mouthing event. The OPP default is 20 cm^2 based on the area of a child's 3 fingers. Total skin surface area increases by about 3 fold from age 2 to an adult (EPA, 1997). Average area of both hands for an adult is about 900 cm^2, so it would be about 300 cm^2 for a 2 year old. Assuming 3 fingers of one hand represents about 5% of the total area of both hands, it would increase from 15 cm^2 to 45 cm^2 from age 2 to adult. On this basis, the SA values used here are assumed to start at 15 cm^2 and increase linearly to 45 cm^2 at age 17 and remain constant after that.

Frequency of hand to mouth events (FQ, events/hr) - The OPP defaults suggest 9.5 events/hr for toddlers, based on observations at day care centers. This will decline with age, but very little data are available for other ages. Michaud et al (1994) assumed a mouthing frequency of twice per day for adults. It was decided to step down this frequency as follows: 1 to 6 yr - 9.5 times/hr, 7 to 12 - 5 times/hr, 8 to 18 yr - 2 times/hr and 19 to 31 yr - 1 time/hr.

Saliva Extraction factor (SE, unitless fraction) - The fraction transferred from skin to mouth will depend on the contaminant, mouthing time and other behavioral patterns. The OPP default is 50%, based on pesticide studies. Michaud et al (1994) assumed that all of the residues deposited on the fingertips would be transferred to the mouth, twice per day. In the Binghamton re-entry guideline derivation, a range of factors were used: 0.05, 0.1, and 0.25 representing the fraction of residue on hand that is transferred to the mouth (Kim and Hawley, 1985). For purposes of this assessment, the OPP default of 50% was selected for all ages.

Exposure Time (ET, hr/d) - Same as dermal contact, see discussion above.

Body Weight (BW, kg) - Same as dermal contact, see discussion above.

3.3 Dissipation

The surface loading of the contaminant in the dust is likely to diminish over the 30 year exposure period as a result of volatilization, chemical degradation, surface cleaning and transfers to skin/clothing. While some redeposition will also occur, the net long term effect should be a gradual decline. The discussion below provides a review of the literature related to this issue.

Several studies indicate that the main source of new dust indoors is track-in from footwear. Thatcher and Layton (1995) found a mass increase on tracked but not cleaned/vacuumed floor surfaces of 0.01 grams/day-m^2 for linoleum, 0.15 for upstairs carpet and 0.31 for downstairs carpet. They reported a value for the front doormat of 6.2 grams /day-m^2. Allot (1992) also indicated that the main mechanism for introduction of dust indoors is tracking by footwear and noted a smaller contribution from deposition dust particles suspended in air. Without regular indoor cleaning the dust inputs would accumulate. With time, they would likely become noticeable or objectionable to the inhabitants, prompting cleaning. Lioy (2002) indicates that in a survey of 36 homes, an average time since the last cleaning was 14.2 days (range 1-150 days). Roberts et al. (1999) determined that the median value of dust loading on 11 carpets before cleaning was 1.3 g/m^2. This agrees with Camann and Buckley's (1994) estimate of the

median surface loading on 362 carpets of 1.4 g/m^2. Lioy et al. (2002) report ranges of dust loadings in homes from 0.05-7 g/m^2 for floors and <1 to 63 g/m^2 for rugs. See summary in Table 2.

Table 2. Dust Loads on Indoor Surfaces

	Dust Load (: g/cm^2)	Reference
Hard Surfaces	5-700 floors	Lioy et al. (2002)
Soft Surfaces	130 - median for carpets before cleaning (n=11) 10 - median for carpets after cleaning (n=10) 140 - median for carpets (n=362) <100 to 6300 - range for rugs	Roberts et al. (1999) Roberts et al. (1999) Camann and Buckley (1994) Lioy et al. (2002)

Elevated non-porous surfaces such as walls, table tops, counters, etc. receive much of their dust loads from deposition of suspended dust. The mean dustfall rate in 100 American homes in five cities was 0.02 g/day-m^2 (Schaefer et al 1972, quoted in Roberts, Budd, et al. 1992) . This indicates that the dust inputs to these surfaces are considerably smaller than track-in for carpets near entryways.

In order to maintain a fairly constant dust loading on surfaces, dust would have to be removed by cleaning at a rate equal to the rate of input from outside sources. Otherwise dust will accumulate and probably further prompt cleaning because it would be noticeable or objectionable. Assuming an input of 0.31 grams /day-1 m-2 for track-in to a downstairs carpet (Thatcher and Layton (1995)), dust must be removed by cleaning at this rate to maintain a constant dust load on carpet. At a track-in rate of 0.31 g/day/m^2, an initially clean carpet would require about 5 days to achieve a dust loading of 1.3 g/m^2.

If cleaning occurred on a periodic basis as it normally does, newly tracked-in dust would continually be mixed with and removed by cleaning with dust in the carpet from previous tracking events. With continued cleaning eventually the dust reservoir (from past tracking events) would be replaced with newly tracked-in dust. This means that any initial, residual load of dust containing contaminants in a carpet would be gradually removed over time with periodic cleaning and no new significant input of contaminated dust. Roberts et al. (1999) determined that the residual lead loading in carpets could be reduced by 90 to 99% in 6 months by removing shoes on entering (lead was being tracked in from the outside), use of a doormat, and use of an efficient vacuum twice a week. They determined that vigorous vacuuming was efficient in removing the contaminated dust reservoir from carpets. If a carpet is initially loaded with a contaminated dust, a half-life for its removal can be calculated assuming 90% removal in 6 months using the Roberts et al. (1999) data. This results in a 2-month half-life for dust removal from carpets using vigorous cleaning by vacuuming. It would take roughly 12 months to reduce the initial contaminant load by 99.9% using the above scenario. With no new, significant inputs of contaminated dust to a carpet an initial, residual load would be reduced over time with regular vigorous cleaning.

Roberts (1999) also determined that the dust on the surface of 11 carpets could be reduced by 90% in 1 week with the use of a Hoover Self-Propelled Vacuum with Embedded Dirt Finder (HSPF). The pre- and post-cleaning surface loadings were as follows: pre-cleaning fine dust loading: min. 0.32 g/m^2, max. 14.4 g/m^2, median 1.30 g/m^2; final fine dust loading: min. 0.019 g/m^2, max. 0.289 g/m^2, median 0.102 g/m^2. A cumulative vacuuming rate of 6 to 45 min/m^2 of vacuuming with the HSPF removed deep dust from these carpets. The median surface loadings of fine dust in these carpets were reduced by 91%, in 1 to 15 hours of cumulative vacuuming

The above analysis deals with a carpeted surface that can act as a dust reservoir and which is a difficult surface to clean. Non-porous surfaces such as floors and tables, etc. don't have the same degree of storage potential for dust and are easily cleaned. These surfaces will have a faster removal half-life than the approximately 2 months for carpets calculated above. However, they may get re-contaminated from dust re-suspension from the carpets (carpets become the source of contamination) until the carpet contaminant load is reduced.

Further data concerning the removal half-life of dioxins in indoor dust is available from the study of the Binghamton State Office Building (BSOB) (NYSDOH 2002). The building had closed in February 1981 after an intense transformer fire spread an oily soot contaminated with polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) throughout the 18-story structure. After extensive decontamination, testing and reconstruction, the BSOB was reopened late in 1994. Pre-occupancy sampling in July 1994 found that PCB and PCDD/F levels in air and on surfaces in workspaces were considerably less than the guidelines set for reoccupancy. In fact, they were similar to levels found in buildings that have never experienced a transformer fire. Seven rounds of dust wipe sampling of tops of in-ceiling light fixtures were performed post-occupancy. PCDD/F levels on the tops of in-ceiling light fixtures averaged 1.1 nanograms per square meter at the final round of sampling, less than any previous measurements. The seven dust wipe sampling rounds indicated a gradual decline of PCDDs over-time on the light fixtures (see Figure 1). Since reoccupancy, surfaces above the ceiling were cleaned twice, once before the March 1997 sampling and again before the sixth round of sampling in August 1998. Since reoccupancy, average PCDD/F levels in dust on light fixtures have declined steadily by about one-half every 20-22 months (a half-life of 20-22 months).

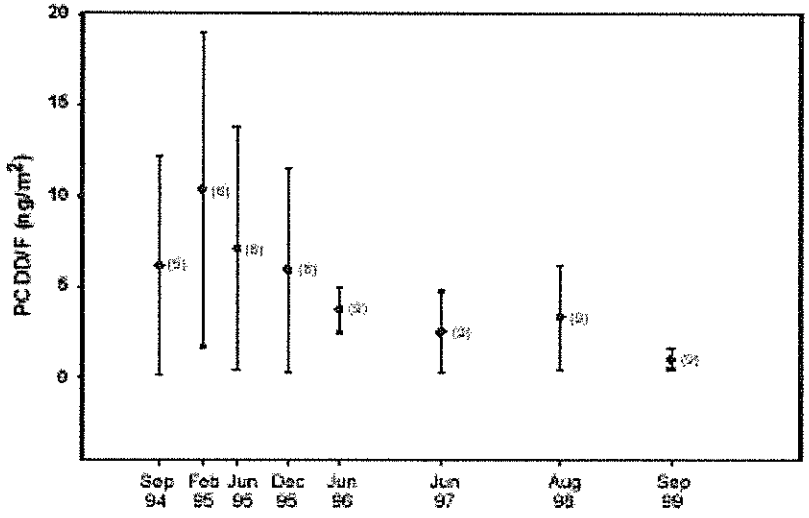


Figure 1. Average PCDD/F levels on the tops of light fixtures since September 1994. Bars are the 95% confidence interval for the means. The numbers in parentheses are the number of samples for each date.

The BSOB PCDD dust half-life value shown above was based on dust wipe sampling of the tops of light fixtures which were inaccessible to regular cleaning and only cleaned twice in 5 years. The mechanism of removal of the contaminated dust was probably a combination of cleaning, resuspension and dilution with uncontaminated dust (and possibly some volatilization). This half-life is a conservative, upper bound estimate of a removal half-life for dioxins in dust for areas that are cleaned routinely (such as would be expected were people would have daily contact). The BSOB half-life should be acceptable and conservative for use in the COPC risk assessment scenario which addresses exposure to accessible surfaces. It will capture the mechanism of dust removal from a residence due to regular cleaning that is discussed by Roberts et al. (1999) and Allot (1992) cited above and is a slower removal of dioxins in dust than would be predicted using these carpet vacuuming studies.

Further support for considering dissipation is presented below:

- The OPP guidance (EPA, 1997a and EPA, 2001a) uses a "dissipation" factor to account for degradation and other loss mechanisms after pesticide application. Similarly, Durkin et al (1995) has proposed a time-dependent transfer coefficient method for lawn treatment pesticides.
- Michaud et al (1994) proposed a mass balance model which accounts for losses from surfaces associated with building clean-ups.

Based on the above discussion, there is strong support for considering dissipation in setting criteria for building clean-ups. The recently completed study at the Binghamton State office Building described above found that dioxin has dissipated over time according to first order kinetics with a 20 to 22 month half life. As discussed above this dissipation is thought to occur from a combination of cleaning, resuspension and dilution with uncontaminated dust (and possibly some volatilization). These same physical dissipation processes would apply to other compounds addressed in this study as well. Therefore the other compounds were assumed to dissipate at the same rate as dioxin. Note that this leads to some overestimate of risk for the organic compounds with higher volatility than dioxin. In summary, a 22 month half life (decay rate constant of 0.38 yr^{-1}) was adopted here and assumed to apply to all contaminants. Exposures were calculated in a in a series of time steps where the residue level was assumed to dissipate according to first order kinetics:

$CSL = CSL_{initial}\ e^{-kt}$
CSL = Contaminant Surface Load (: g/cm^2)
$CSL_{initial}$ = Initial Contaminant Surface Load (: g/cm^2)
k = Dissipation Rate Constant (yr^{-1})
t = Time (yr)

3.4 Calculating Clearance Criteria

The dose rates for dermal contact and ingestion were used to estimate cancer risk and noncancer hazard. The clearance criteria for surface dust loadings were derived by adjusting the levels iteratively until the risks reached the target levels. Cancer risks and noncancer hazards were calculated as follows:

Cancer Risk = LADD * CSF

Noncancer Hazard = ADD/RfD

LADD = Lifetime Average Daily Dose (: g/kg-d)
CSF = Cancer Slope Factor (kg-d/ : g)
ADD = Average Daily Dose (: g/kg-d)
RfD = Reference Dose (: g/d)

For carcinogens, LADD is calculated by summing daily doses (PDR) over ages 1 to 31 and then averaging over a lifetime of 70 years. For noncarcinogens, ADD is calculated by summing daily doses over ages 1-6 and averaging over this 5 year period. Implicitly this procedure assumes that the exposure frequency is every day during the exposure period. This procedure also involves multiplying the potential dermal dose by an absorption fraction to get the absorbed dose. Absorption fraction and toxicity values are discussed below.

Oral Absorption Fraction (ABSo)
For chemicals whose dose-response parameters are based on experiments in which the absorption fraction is similar to the one expected in the exposure scenario, there is no need to adjust the RfD or CSF.

Dermal Absorption Fraction (ABSd)
This parameter is chemical-specific. Dermal absorption fractions of 0.06 for PCBs and 0.03 for dioxins from soil were first proposed in USEPA, 1992 and more recently adopted in EPA 2001b. Michaud et al (1994) used 0.02 for dioxins and 0.03 for PCBs uptake from a sooty surface, based on the ranges of estimated ABSd values for soil. The Binghamton panel used a range of values for PCBs (0.01, 0.1, and 0.5) and dioxins (0.01 and 0.1) (Kim and Hawley, 1985).

Reported ranges for dermal uptake for PCBs in solvent vehicles are reported to range from 15 to 56%, with most of the values clustering around 20% (ATSDR, 1993). Reported ranges for 2,3,7,8-TCDD in solvent vehicles are reported to range from 1 to 40% (ATSDR, 1988). Therefore, it seems that even if absorption from the wall material might be enhanced by residual solvent, the maximum possible absorption of 100% would be unrealistic even for worst-case exposure.

The values recommended here of 3% for dioxins and 13% for PAHs are based on EPA, 2001b.

Toxicity Values
Two toxicity values are used here, a Reference Dose (RfD) for non-carcinogenic compounds and a Cancer Slope Factor (CSF) for carcinogenic compounds. The RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. The CSF is defined as an upper bound, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100. The RfD and Cancer Slope Factor values used in this report are summarized in Table A-1 (Appendix A).

Cancer risks for dioxin were evaluated on the basis of a range of slope factors. EPA (1985) provides an oral slope factor of 1.6×10^5 kg-d/mg and the draft Dioxin Reassessment (EPA, 2000) proposes an oral slope factor of 1×10^6 kg-d/mg.

3.5 Uncertainties

Dose Adjustments

The procedure used here, estimates the absorbed dose from dermal contact. Since dose-response relationships are typically based on an administered oral dose, ideally some adjustment is needed before calculating risks. EPA (2000) states that about 80% of dioxin in food is absorbed and therefore recommends multiplying an absorbed dose by 1.25 (100%/80%) to adjust it to a comparable administered oral dose. Since the basis for this dioxin adjustment is somewhat uncertain and similar data for other chemicals were not available, no adjustments were made for this purpose in this document. This could lead to relatively small under estimates of risk.

A similar issue applies to the ingestion pathway. Organic contaminants are likely to be more tightly bound (i.e. less bioavailable) from dust than food used in calculating dose-response relationships. About 30% of dioxins in soil are absorbed orally (EPA, 2000). On this basis, EPA recommended multiplying the ingested dose of dioxin in soil by 0.375 (80%/30%) to adjust it to a comparable basis. Given the similarity of dust and soil, this adjustment may also apply to dust. Since the basis for this dioxin adjustment is somewhat uncertain and similar data for other chemicals were not available, no adjustments were made for this purpose in this document. This could lead to over estimates of risk.

Surface to Skin Transfers

No standardized procedures have been established for estimating dust transfers to skin in indoor settings. As discussed above, the procedure used here is derived from the pesticide guidance. Pesticides are clearly different than dust. The default values for key parameters provided in the pesticide guidance (transfer fractions and transfer coefficients) were derived from experiments specific to pesticides. Although considerable judgement was used to adjust these to indoor dust, the adjusted values give total dust on skin loads that are consistent with measured values (as shown in Table 1). These uncertainties could lead to either over or under estimates of risk.

Dust Ingestion

No standardized procedures have been established for estimating indoor dust ingestion. As discussed above, the procedure used here is derived from the pesticide guidance which has uncertain application to the WTC scenarios. One way to evaluate this approach is to compute the implied dust ingestion rate:

$$\text{Ingestion Rate} = [(ET_{hard}*FTSS_{hard}*CSL_{hard})+(ET_{soft}*FTSS_{soft}*CSL_{soft})]*SA*FQ*SE$$

The CSL values were set at 50 : g/cm^2 of total dust which represents typical indoor horizontal surfaces based on Rodes et al., 2001 (this value is also consistent with ranges shown in Table 2). The other parameters were set at the values presented above. This yields an ingestion rate of 13 mg/d for children and 6 mg/d for adults. EPA (1997) recommends central estimates of total soil ingestion rates of 100 mg/d for children and 50 mg/d for adults. It is logical that lower ingestion rates would apply to dust only, however, it is uncertain how much less. This uncertainty appears to have more potential for leading to under than over estimates of risk.

Dioxin Toxicity

The toxicity of dioxin-like compounds have been intensively debated over many years. EPA currently uses an oral slope factor of 1.6×10^5 kg-d/mg based on EPA, 1985. The draft Dioxin Reassessment (EPA, 2000) proposes an oral slope factor of 1×10^6 kg-d/mg. Thus, the uncertainty in this factor spans a range of at least 6 fold.

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APPENDIX E

IEUBK Lead Model Results for Lead in Air

EPA developed the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model (EPA 1994) to evaluate multimedia lead exposure to children in residential settings. EPA established a goal of attaining a 95% probability that blood lead levels in children be less than 10 μg/dl (EPA 1994a). To meet the aforementioned goal, The IEUBK Lead Model was run using multimedia input parameters that are applicable to the residential community in Lower Manhattan. To be conservative, the IEUBK Lead Model was run under the assumption that a child would be indoors 24 hours a day. The following discussion details the basis for individual input parameters.

Lead in Drinking Water - The source of NYC's drinking water (the Catskill/Delaware and Croton systems) is remarkably low in lead. The average lead concentration is 1 μg/l in the Catskill/Delaware system and <1 μg/l in the Croton system (NYCDEP - Drinking Water Quality Test Results, 2001 - see www.nyc.gov/dep). However, the concentration of *lead* in tap water can be increased by lead containing components (pipes, solder) of a building's distribution system. Consequently, the Safe Drinking Water Act "Lead and Copper Rule" (Federal Register, June 7, 1991) requires large water systems to monitor led concentration at the tap. If more than 10% of the samples exceed the federal "Action Level" of 15 μg/l, corrective steps (e.g., source treatment, corrosion control) must be carried out. The IEUBK Lead Model is intended to run with input values that represent the average lead concentration in the environmental media of interest. As reported by NYCDEP, 2001, the median lead concentration from a total of 107 samples obtained at the tap was 3 μg/l. It should be noted that these samples represent a high bias in that they were obtained from homes where there is reason to believe that lead service lines exist. The median lead concentration in tap water city-wide is likely to be lower. However, for the purpose of this site-specific application of the IEUBK Lead Model, a value of 3 μg/l is used as a conservative central tendency estimate of lead in tap water.

Lead in Diet - No data could be located relating to the lead content in food items for residents living in Lower Manhattan. Since there is very little home gardening taking place in this community it was deemed appropriate to use data that reflects national trends for commercially available food items. EPA recently evaluated dietary lead content in children in support of revising default input parameters for the IEUBK Lead Model (EPA 2002). Lead residues in food were obtained from the Food and Drug Administration's (FDA's) Total Dietary Survey. Food consumption trends were obtained from the National Health and Nutrition Examination Survey (NHANES) . The average lead content in the diet of children 0 - 7 years old is 2.8 μg/day. Consequently, the input value of 2.8 μg/day was employed as the estimate of average daily lead intake from diet.

Lead in Soil - Numerous studies have been conducted to evaluate soil and street dust lead concentrations in New York City (NYCDOHMH, 2003). In the studies reviewed, soil/dust samples were taken by a variety of methods over a long period of time (1924 - 1993). Summary statistics were compiled by the NYCDOHMH based on whether the studies assessed known lead sources or background conditions. Ruling out studies on specific sources such as bridges, a median soil lead concentration of 200 ppm and street dust lead concentration of 895 ppm was reported. Data are lacking with regard to the relative contribution of street dust to a child's daily "soil" intake. Given this uncertainty, the median values of soil and dust were averaged to provide a composite soil/dust concentration of 548 ppm. This value was used as the soil lead concentration in the site-specific application of the IEUBK Lead Model

Lead in Indoor Dust - Although there exists a substantial amount of lead "load" data (i.e., mass per unit area - typically recorded in units of micrograms per square foot as per HUD reporting requirements) as a measure of lead contamination in residential dwellings, the IEUBK Lead Model requires lead concentration in settled dust to be reported in terms of concentration (i.e., mass per unit mass - typically recorded as parts per million). The WTC Background Study reported lead in house dust both in terms of lead load ($\mu g/ft^2$) and concentration (ppm) although more limited sampling was obtained of lead concentration (ppm) measurements. Nonetheless, because these data were specifically intended the assess background conditions in Lower Manhattan, they were used in the site-specific application of the IEUBK Model. The mean concentration of lead in settled dust in the WTC Background Study was 126 ppm (EPA 2003a). Consequently, this was the value used for lead in indoor dust for the site-specific application of the IEUBK Lead Model.

Site specific application of the IEUBK resulted in a *lead* benchmark for indoor air of 0.7 $\mu g/m^3$. Displayed below are data input spreadsheets and a graphic display (Page E-6) of model results.

LEAD MODEL FOR WINDOWS Version 1.0 Build 251

==========

Model Version: 1.0 Build 251
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research

==========

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 100.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (ug Pb/m^3)
.5-1	0.000	2.000	32.000	0.700
1-2	0.000	3.000	32.000	0.700
2-3	0.000	5.000	32.000	0.700
3-4	0.000	5.000	32.000	0.700
4-5	0.000	5.000	32.000	0.700
5-6	0.000	7.000	32.000	0.700
6-7	0.000	7.000	32.000	0.700

****** Diet ******

Age	Diet Intake(ug/day)

.5-1	2.800
1-2	2.800
2-3	2.800
3-4	2.800
4-5	2.800
5-6	2.800
6-7	2.800

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 3.000 ug Pb/L

****** Soil & Dust ******

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
.5-1	548.000	126.000
1-2	548.000	126.000
2-3	548.000	126.000
3-4	548.000	126.000
4-5	548.000	126.000
5-6	548.000	126.000
6-7	548.000	126.000

****** Alternate Intake ******

Age	Alternate (ug Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

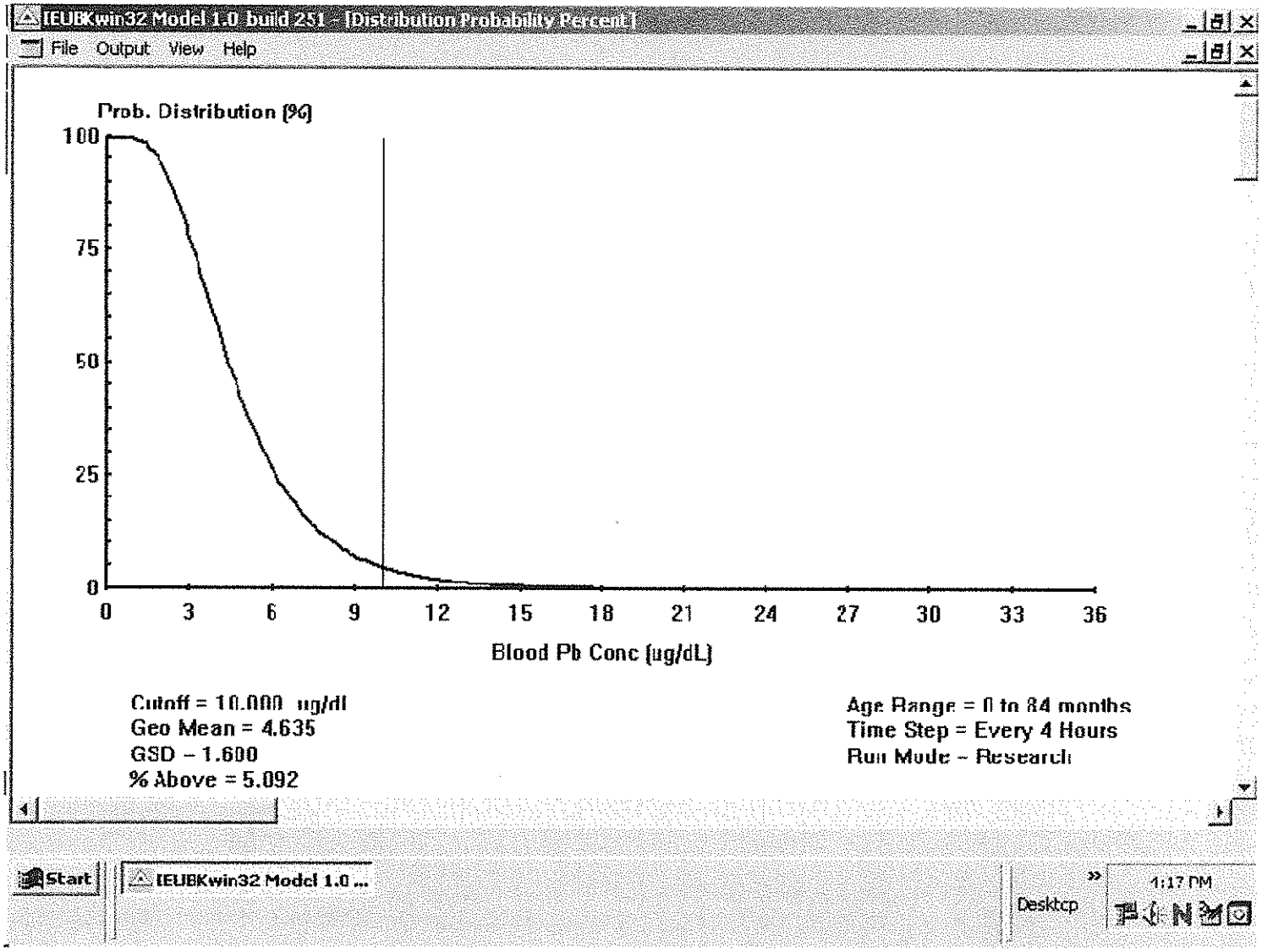
****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.448	1.265	0.000	0.271
1-2	0.672	1.244	0.000	0.667
2-3	1.120	1.265	0.000	0.705
3-4	1.120	1.282	0.000	0.728
4-5	1.120	1.318	0.000	0.777
5-6	1.568	1.332	0.000	0.828
6-7	1.568	1.340	0.000	0.847

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	7.280	9.264	5.0
1-2	11.373	13.956	5.7
2-3	11.558	14.647	5.4
3-4	11.718	14.848	5.2
4-5	8.920	12.135	4.3
5-6	8.113	11.841	3.7
6-7	7.708	11.462	3.3


IEUBKwin32 Model 1.0 build 251 - [Distribution Probability Percent]
File Output View Help
Prob. Distribution (%)
100
75
50
25
0
0 3 6 9 12 15 18 21 24 27 30 33 36
Blood Pb Conc (ug/dL)
Cutoff = 10.000 ug/dl
Geo Mean = 4.635
GSD = 1.600
% Above = 5.092
Age Range = 0 to 84 months
Time Step = Every 4 Hours
Run Mode = Research
Start
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World Trade Center Indoor Environment Assessment: Response to Peer Review Comments on the Report for Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks

May, 2003

Prepared by the Contaminants of Potential Concern (COPC) Committee
of the World Trade Center Indoor Air Task Force Working Group

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Foreword

Following the collapse of the World Trade Center on September 11, 2001, federal, state, and municipal health and environmental agencies initiated numerous studies to assess environmental conditions in the area. A multi-agency task force was specifically formed to evaluate indoor environments for the presence of contaminants that might pose long-term health risks to local residents. As part of this evaluation, a task force committee was established to identify contaminants of primary health concern and establish health-based benchmarks for those contaminants in support of ongoing residential cleanup efforts in Lower Manhattan. In September 2002, the committee released a draft document titled "World Trade Center (WTC) Indoor Air Assessment: Selecting Contaminants of Potential Concern (COPC) and Setting Health-Based Benchmarks."

In October 2002, a panel of 11 experts conducted an independent peer review of the draft COPC document to ensure that the evaluations presented in the document were technically based and scientifically sound. A final report with peer reviewers' conclusions and recommendations was released in February 2003. The authors of the draft COPC document have reviewed and responded to all peer reviewer comments.

This report—or responsiveness summary—provides the formal responses to peer reviewer comments. EPA, through its chairmanship of the multi-agency committee that authored the response to peer review comments, assumes ownership and fully endorses the report's content. The responsiveness summary presents background on the peer review process, an overview of the peer reviewers' main conclusions and recommendations, and the document authors' responses to specific comments. In addition to preparing this responsiveness summary, which will become part of EPA's peer review record for the WTC site, document authors have prepared a revised, and final, COPC document. The final document presents the updated approaches for selecting COPC and setting health-based benchmarks, based on peer reviewer input.

Copies of the final COPC document can be obtained on-line at www.epa.gov/WTC. Copies of this report are available at www.tera.org. Inquires regarding this report should be directed to:

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This report is just one response to environmental and public health concerns related to the WTC. Individuals interested in other studies and research projects related to this site should refer to the following Web pages:

- U.S. EPA: www.epa.gov/WTC
- ATSDR: www.atsdr.cdc.gov/
- NYCDOHMH: http://home.nyc.gov/html/doh/html/alerts/911.html

List of Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ATSDR	Agency for Toxic Substances and Disease Registry
COPC	contaminant(s) of potential concern
CSF	cancer slope factor
EPA	U.S. Environmental Protection Agency
HEAST	Health Effects Assessment Summary Tables
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
$\mu g/m^3$	microgram per cubic meter
mg/m^3	milligram per cubic meter
MRL	ATSDR minimal risk level
NHANES	National Health and Nutrition Examination Survey
NIOSH	National Institute of Occupational Safety and Health
NJDEP	New Jersey Department of Environmental Protection
NYCDEP	New York City Department of Environmental Protection
NYCDOHMH	New York City Department of Health and Mental Hygiene
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
PCM	phase contrast microscopy
PEL	OSHA permissible exposure limit
REL	NIOSH recommended exposure limit
RfD	reference dose
RfC	reference concentration
SVOC	semi-volatile organic compound
TERA	Toxicology Excellence for Risk Assessment
TLV	ACGIH threshold limit value
VOC	volatile organic compound
WTC	World Trade Center

I. Introduction

Following the collapse of the World Trade Center (WTC) towers and nearby buildings on September 11, 2001, federal, state, and municipal health and environmental agencies have been characterizing and evaluating levels of contamination near the site. Under EPA's leadership, these agencies participated in a task force to assess the potential impact to the indoor environment from contaminants that might pose long-term health risks to local residents. The working group is called the "World Trade Center Indoor Air Task Force Working Group." Agencies participating in this task force working group include the U.S. Environmental Protection Agency (EPA), the Agency for Toxic Substances and Disease Registry (ATSDR), the Occupational Safety and Health Administration (OSHA), the New York State Department of Health (NYSDOH), the New York City Department of Health and Mental Hygiene (NYCDOHMH), and the New York City Department of Environmental Protection (NYCDEP).

The task force working group formed a committee—the "Contaminants of Potential Concern (COPC) Committee"—to address potential contamination of the indoor environment near the WTC site. The primary activity of the COPC Committee was to prepare a document that identifies COPC for indoor environments and sets health-based benchmarks for long-term exposures. In September, 2002, the committee released its draft peer review document, titled "World Trade Center Indoor Air Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks" (COPC 2002). For ease of reference, the draft peer review document will be referred to throughout this report as "the draft COPC document." EPA decided to have the draft COPC document peer reviewed by a panel of independent experts to ensure that the committee's evaluations are technically based and scientifically sound.

This report is the COPC Committee's responsiveness summary to the independent peer review. Section II of this report presents important background on the peer review process, including an overview of the peer reviewers' main conclusions and recommendations. The COPC Committee's specific responses to the peer reviewers' findings are documented in Section III. In addition to preparing this report, which will become part of EPA's peer review record for the WTC site, the committee is also preparing a revised, and final, COPC document (COPC 2003). As EPA's peer review policy requires, this report explains how the peer reviewers' recommendations will be reflected in the final COPC document, or reasons are provided for why certain recommendations are not incorporated.

The final COPC document, therefore, presents the COPC Committee's updated approach for selecting COPC and setting health-based benchmarks. Copies of that report can be obtained by contacting EPA, using the contact information provided in the Foreword to this report. The report will also be available on the EPA Web site (www.epa.gov/WTC).

II. Overview of the Peer Review Process

The independent peer review was implemented through Toxicology Excellence for Risk Assessment (TERA), a contractor to EPA, in accordance with specifications in EPA's "Peer Review Handbook" (EPA 2000a). TERA identified 11 independent peer reviewers from different affiliations and with expertise in various relevant fields, including risk assessment, exposure assessment, indoor air sampling techniques, and toxicology. According to the peer review report, "most of the peer reviewers stated that they had no prior work activity related to the WTC disaster or any known conflicts and felt they could participate fully in the meeting" (TERA 2003).

The peer reviewers provided their feedback on the review document during a 2-day meeting on October 21–22, 2002, in New York City. The meeting, which was open to the public, was split into

two general sessions: reviewing the approach used to select COPC, and reviewing the approach used to set health-based benchmarks. At the beginning of each session, authors of the draft COPC document gave brief presentations, after which the peer reviewers discussed and debated the scientific merits of the document. This open discussion was framed around a series of charge questions that TERA asked the peer reviewers to address. Observers were allowed to comment at designated times during the peer review meeting.

TERA released a final summary report in February 2003 that documents the discussions among the independent peer reviewers (TERA 2003). These discussions ultimately led to 16 specific conclusions and recommendations that are documented in the peer review report. To respond to the peer reviewers' comments, the COPC Committee addressed each of these conclusions and recommendations. When preparing our responses, we referred to the summary of the peer reviewers' discussions related to each conclusion or recommendation. Therefore, this responsiveness summary addresses the major themes and issues expressed throughout the peer review report, but our responses are framed around the final conclusions and recommendations.
In addition, the COPC Committee reviewed both verbal and written comments submitted by observers to the peer review meeting. Some observer comments addressed components of the WTC Clean-up Program that were outside the scope of the peer review. Substantive comments relating to the draft COPC document (e.g., data sources for COPC screening, target risk range) have been addressed in the course of responding to the peer reviewers' comments.

III. Responses to Peer Review Comments

When responding to peer review comments, EPA prepares (as per its guidance on peer review) a written record "responding to the peer review comments specifying acceptance or, where thought appropriate, rebuttal and non-acceptance" (EPA 2000a). This section presents the COPC Committee's responses to the peer reviewers' 16 main conclusions and recommendations: 7 that pertain to selecting COPC (see Section III.A), and 9 that pertain to setting health-based benchmarks (see Section III.B). Each conclusion and recommendation is addressed individually, and our response indicates what, if any, changes were made to the draft COPC document to address the comment. If no changes were made, our response explains why.

A. Responses to Comments on Selecting Contaminants of Potential Concern

The peer reviewers made seven conclusions and recommendations related to the COPC selection process in the draft COPC document. These are presented on pages 16–17 of the peer review report, and are reproduced below. Each conclusion and recommendation is followed immediately by the COPC Committee's response to the comment.

Comment COPC #1:

The document should more clearly state the intended use of the COPC selection process.

Response:

The selection of COPC was intended to inform the Indoor Air Residential Assistance - WTC Dust Clean-up Program, which we will refer to as the WTC Clean-up Program. In conventional hazardous waste site investigations, the COPC selection process is intended to reduce what is typically an extensive contaminant sampling list to a manageable "short list" of risk-driving chemicals. The risk from this "short list" is then calculated to determine if remedial action is warranted. Regarding the WTC, there was an a priori decision to institute a clean-up

program rather than launch a formal remedial investigation to determine if remediation of residential dwellings was necessary. The primary reason for this decision was to eliminate the time-consuming process of initiating a remedial investigation (i.e., developing a sampling and analysis plan, conducting representative sampling of residential dwellings, analyzing a large number of samples, and finally interpreting results) at a time when re-habitation of residential dwellings in Lower Manhattan was nearly complete. As a result of this decision, the COPC selection process associated with the WTC Clean-up Program assumed a somewhat modified purpose. Rather than serve as a process to determine the need for clean-up, the COPC selection process served to facilitate development of health-based benchmarks for the WTC Clean-up Program. By identifying COPC, benchmarks for individual contaminants could be developed for indoor air and settled dust. To summarize, first and foremost, the intent of the COPC selection process was to identify risk-driving chemicals and to establish specific health-based benchmarks for the WTC Clean-up Program.

As part of this initiative, the COPC selection process informed two complimentary studies that were undertaken as part of the WTC Clean-up Program. The first was the WTC Residential Confirmation Cleaning Study (EPA 2003a). This study was initiated to evaluate the effectiveness of various cleaning methods (e.g., high-efficiency particulate air vacuuming, wet wiping) used to clean residences. The COPC selection process provided the list of contaminants to sample for in the WTC Residential Confirmation Cleaning Study. It also enabled the development of health-based benchmarks for indoor air and settled dust so the effectiveness of cleaning methods could be assessed. The cleaning methods employed also served to guide the clean-ups of other heavily impacted unoccupied buildings. Another outcome of the WTC Residential Confirmation Cleaning Study was in streamlining the post-cleaning sampling needs of the WTC Clean-up Program. Although not a specific goal, this effort identified an indicator chemical (i.e., asbestos) that signaled the reduction of all COPC to concentrations below health-based benchmarks. With thousands of residents signed up for cleaning, the use of an indicator contaminant to establish cleaning effectiveness provided a powerful tool in facilitating the WTC Clean-up Program.

The other initiative that the COPC selection process informed was the WTC Background Study (EPA 2003b). The development of remediation goals is influenced by factors such as technical implementation, analytical detection limits, and the background concentration of contaminants in the environmental setting of interest. A literature review of contaminant background concentrations in residential dwellings was conducted to inform the WTC Clean-up Program. Limited information was obtained for asbestos in indoor air and lead and dioxin in settled dust, otherwise the search yielded very little useful data. It was therefore deemed advantageous to conduct a site-specific background study to inform risk management decisions regarding the setting of clean-up goals at health-based or background concentrations. Consequently, The COPC selection process directed the group of contaminants to be sampled for in the WTC Background Study. Conversely, the results of the WTC Background Study provides data to enhance the value of the final COPC document. That is, it provides an estimate of background for COPC in Lower Manhattan to be evaluated alongside health-based benchmarks.

Comment COPC #2:

The document should "include a clear presentation of the logic used to select COPC."

Response:

As noted in the previous response, the COPC selection process described in the draft COPC document was driven by the need to develop clean-up criteria for those contaminants with the potential to pose the greatest public health risk. The semi-quantitative approach initially used to select COPC examined the contaminants detected in environmental samples collected in Lower Manhattan and contaminants believed to be released from the WTC disaster (e.g., combustion by-products, building materials). COPC were originally selected based on a combined consideration of the substances' toxicities, the frequencies at which substances were detected, and the likelihood that detected substances were related to the WTC disaster.

Peer reviewers acknowledged the constraints under which the COPC selection approach was developed, but commented that the COPC list seemed to have been narrowed fairly rapidly and recommended that additional data sets be considered and the description of the process be more transparent. In response to this comment, the authors conducted a systematic review of the COPC selection process. This involved a careful re-examination of multiple supporting environmental data sets, consideration of newly available data sets, and a review of the exposure assumptions and toxicity criteria used in establishing screening values.

Though we made some modifications in approach, the final COPC list remains unchanged. The authors revised the COPC document, however, to more clearly present the steps taken and the logic followed in selecting COPC. We hope that these revisions will help readers fully understand the COPC selection process and will demonstrate that the selection process was comprehensive, technically sound, and, most importantly, protective of public health. Our conceptual approach for selecting COPC, including the underlying logic, is summarized below. Appendix B of the final COPC document describes in greater detail how each step was applied and what contaminants, by medium, were eliminated or retained for further consideration.

Review of multiple data sets to identify candidate substances. The collapse of the WTC released a very broad range of contaminants into the air, many of which deposited with settled dust on surfaces in Lower Manhattan, both indoors and outdoors. To gain the best possible sense of the contamination levels in indoor residential environments, the authors reviewed an extremely large set of sampling data describing environmental conditions at and near the WTC site between September 11, 2001, and the present. Our goal was to review data that might provide insights on the contamination levels inside Lower Manhattan residences. As a result, we reviewed a large set of bulk dust and settled dust sampling results, and we also reviewed ambient and indoor air sampling data, based on the premise that contaminants entered residences through atmospheric transport.

  We reviewed sampling data collected by EPA, ATSDR, OSHA, NYCDEP, NYCDOHMH, the New York City Department of Education, the New Jersey Department of Environmental Protection, and independent investigators. A complete list of the data sources we reviewed is included in the final COPC document. Overall, we examined results from more than 500,000 environmental samples, with sampling results available for more than 300 contaminants. The contaminants included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, asbestos, silica, other minerals, and synthetic fibers. Every contaminant identified in the sampling data was considered a candidate substance for the COPC selection process.

Initial screen to identify contaminants requiring further consideration. The authors used an initial screening procedure to identify the contaminants that require further consideration before being selected as COPC. This initial screening procedure identified contaminants that are most likely to be present in dust at levels greater than health-based screening values. This initial screening involved three steps:

< First, all VOCs were eliminated from the COPC selection process, because any VOCs that might have been released in or adhered to dusts from the WTC site have likely evaporated or greatly dissipated since the time that air emissions from the site were controlled (i.e., since the time, December, 2001, that the fires were extinguished).

< Second, all contaminants detected in fewer than 5% of samples were removed from the list of candidate contaminants, but only if the contaminant was analyzed for in more than 20 samples. This screening approach based on frequency of detection is consistent with EPA's guidance on human health risk assessment (EPA 1989). By requiring a minimum of 20 samples to apply the frequency of detection screening step, we believe we have addressed the peer reviewers' concern that the frequency of detection might not be an appropriate screening criterion because the "available data reviewed were limited" and the "goal of the screening process was to be inclusive." A review of the contaminants that were screened out by frequency of detection revealed that none were found at concentrations above health-based screening values.

< Third, for the contaminants that were not eliminated in the previous two steps, we compared the maximum concentration detected in each medium to corresponding health-based screening values. (Refer to our response to COPC #3 for further information on how these screening values were derived.) Three outcomes were possible for this step. If a contaminant's maximum concentration was lower than the corresponding screening value, that contaminant was eliminated from further consideration. If a contaminant's maximum concentration was greater than the screening value, then we evaluated the contaminant further in the secondary screening step, described below. If a contaminant did not have a toxicity value, and therefore did not have a screening value, we reviewed other relevant information (e.g., occupational or environmental standards, trends among sampling data, comparisons to background, the likelihood of the contaminant being related to site-specific releases) to determine whether the contaminant should be evaluated further.

Secondary screen to select COPC. For those substances exceeding health-based screening criteria in at least one sample, we reviewed findings across environmental media to assess representativeness of reported maximum concentrations, studied spatial and temporal trends, determined the relationship of detected concentrations to available background concentrations, and examined whether there was reason to believe a contaminant was site-related. Professional judgment entered into this part of the process, as the peer reviewers noted would be necessary. In general, contaminants with reported concentrations deemed representative of exposure conditions and detected above background (if appropriate comparison data were available) were retained as COPC. The final COPC document provides detailed justification for contaminants eliminated as part of the secondary screen.

This selection process yielded the final list of COPC:

- *Asbestos*
- *Dioxins*
- *Lead*
- *Polycyclic aromatic hydrocarbons (PAHs)*
- *Fibrous glass*
- *Crystalline silica*

Asbestos, dioxins, lead, and PAHs were selected as COPC because they were consistently detected across environmental media at concentrations above health-based screening values. *Fibrous glass* and *crystalline silica* also were selected as COPC, but from the list of contaminants that do no have health-based screening values. In the absence of consensus toxicity criteria to apply in the quantitative screening used for most other contaminants, we used environmental and occupational standards coupled with an evaluation of overall exposure potential knowing that these and other building materials were deposited in a large cloud from the collapse of the WTC. Section 2.3.2 of the final COPC document lists the specific reasons why fibrous glass and silica were selected as COPC.

As a final note, the committee reviewed preliminary data from settled dust wipe samples in Lower Manhattan residences which infrequently identified *mercury* at levels greater than health-based screening values. Further, *chromium* in ambient air has been shown to exceed health-based screening values, though chromium levels in available bulk and settled dusts collected in Lower Manhattan are not above health-based screening values. A more detailed discussion of the evaluation of environmental sampling data for *mercury* and *chromium* can be found in Appendix B of the final COPC document. In both cases, it is unclear whether detected levels are associated with the WTC collapse. Regardless, as part of the WTC Clean-up Program, EPA is conducting wipe sample testing for 21 non-COPC metals, including mercury and chromium in approximately 250 apartments.

Comment COPC #3:

The document should "more clearly describe the basis for the choice of toxicity values and exposure assumptions used to estimate COPC screening criteria."

Response:

Upon examination of peer reviewer comments, we agree that the document would benefit from a more detailed description of and justification for the toxicity values and exposure assumptions used in estimating WTC screening values. Therefore, the document will be revised to further describe the basis for developing air and dust screening values. The toxicity and exposure parameters used to develop screening values for bulk and settled dust will therefore be included in the final COPC document.

The methodology, risk equations, and exposure assumptions used in developing WTC screening values are consistent with established EPA risk assessment guidance. Exposure equations generally stem from EPA's Risk Assessment Guidance for Superfund (RAGS) (EPA

1989). For deriving screening values for residues on indoor surfaces (settled dust), we adapted EPA guidance for residential exposure assessment, originally developed to study pesticide residues (EPA 2001a). This approach was further supported by procedures and re-entry guidelines previously developed for scenarios evaluating fine dust particles more analogous to those associated with the WTC collapse (Kim and Hawley 1985; NJDEP 1993; Michaud et al. 1994; Radian 1999). Exposure assumptions used are those recommended in RAGS or supplemental risk assessment guidance, including EPA's Exposure Factors Handbook (EPA 1997b), Child-specific Exposure Factors Handbook (EPA 2002a), Dermal Exposure Assessment: Principles and Applications (EPA 1992), and RAGS Part E, Supplemental Guidance for Dermal Risk Assessment (EPA 2001b).

The final COPC document will present the following general framework used in deriving screening values:

< The consideration of cancer and non-cancer effects, with a target cancer risk of 10^{-4} and a hazard quotient of 1 for non-cancer endpoints—the more sensitive of the two being used to derive screening values.

< The evaluation of adult and childhood exposures, with child exposures factoring heavily into the development of screening values for *dioxin* and *PAHs* in settled dust.

< The use of the most current toxicity criteria on EPA's Integrated Risk Information System (IRIS) database. In the absence of IRIS toxicity criteria, the following hierarchy of toxicity data sources was used: EPA's Health Effects Assessment Summary Tables (HEAST), ATSDR's minimal risk levels (MRLs), provisional values derived by EPA's National Center for Environmental Assessment, and, in limited cases, the use of surrogate toxicity values or cross-route extrapolations.

Medium-specific approaches and assumptions are detailed in the final COPC document, as outlined below:

< *Air pathway*. Contaminants detected in ambient and indoor air were compared to the lower of the following IRIS values: EPA reference concentrations (RfCs) (for non-carcinogens) or air concentrations associated with a 10^{-4} cancer risk (based on inhalation unit risks [IURs]). In the absence of IRIS values, the hierarchy presented above was used.

< *Bulk dust pathway*. Screening values were developed for bulk dust based on a soil ingestion pathway scenario, considering both childhood and adult exposures. The exposure equations and age-specific assumptions used are detailed in Appendix A of the final COPC document. Oral toxicity values (EPA reference doses [RfDs] for non-carcinogens and cancer slope factors [CSFs]) were used when available. Otherwise, the hierarchy described above was followed.

< *Settled dust pathway*. Screening values were developed based on exposures associated with ingestion and dermal contact with dust residues on indoor surfaces. As per peer review comments, a childhood exposure scenario was incorporated into this pathway. Dose rates were estimated based on a number of assumptions—for example, the fraction of dust residues that can be transferred to the skin, daily skin loads, mouthing behaviors for different age groups, and dissipation of surface loading over time. All of these parameters and the justification for selected values are detailed in

Appendix D of the final COPC document. Toxicity criteria used included EPA's RfDs and CSFs.

Contaminants for which no consensus or provisional toxicity values are available were reviewed on a case-by-case basis. In some cases, occupational standards and environmental standards were considered in developing COPC screening criteria (e.g., crystalline silica and other minerals).

Comment COPC #4:

The document should "more clearly describe the limitations of the methods used to screen COPC."

Response:

Overall, we are confident that the COPC selection process used in evaluating WTC-related contamination enabled us to select appropriate indicator contaminants, leading to the development of benchmark criteria which support ongoing efforts to safely clean up residential environments in Lower Manhattan. The authors recognize, however, that limitations associated with the COPC selection process exist. The primary limitations include the nature of the environmental data sets used in the selection process and the absence of toxicity criteria for some contaminants. However, the general framework for selecting COPC was developed based on our complete understanding of these limitations. The impact of these factors on the outcome of the COPC selection process is described in more detail below. An uncertainty section will be added to the final COPC document to clearly describe these limitations.

Data limitations. Extensive systematic sampling of indoor air and settled dust in Lower Manhattan residences had not occurred at the time the draft COPC document was released. However, partial results of sampling associated with the WTC Residential Clean-up Program will be available to inform the final COPC document. In selecting COPC, we drew from the much larger sampling data from other media to account for this shortcoming. We feel that these data are sufficient to identify those contaminants most likely to be present in indoor environments and to support the derivation of clean-up criteria. We agree with peer reviewer comments that ambient air monitoring data need to be interpreted with caution before being used to evaluate indoor environments. For example, peer reviewers expressed concern that samples collected weeks and months after the building collapse would not have characterized much of what made it into the residences as dust. Fortunately, as mentioned above, indoor air and residual dust sampling being conducted as part of EPA's WTC Residential Clean-up Program offer additional insight to the nature and extent of contaminants found in indoor environments.

  As described in our response to COPC #1, to promote a timely response to the WTC disaster, conventional remedial investigation approaches were not used to generate our study data. That is, an investigation of indoor environments with targeted sampling was not conducted. Instead, to expedite cleanup, we relied on existing data sets realizing that many of the data sets were generated independently, by multiple entities, for various purposes, and with varying data quality objectives. We recognize that sampling and analytical methods varied across some studies, and that limited results exist for some contaminants in some media. To the extent possible, we factored contaminant- and study-specific considerations into our final decisions on COPC (e.g., sample size,

detection limits, etc.). Lastly, we also acknowledge, as noted by the peer reviewers, that environmental sampling data do not specifically "fingerprint" the possible unique pattern of substances that may have been released from the WTC collapse and settled in indoor dust. Nonetheless, we still screened hundreds of contaminants, many of which are known to be associated with building materials or thermal or chemical degradation products (e.g., asbestos, PAHs and other SVOCs, dioxins, and metals). Through a combined analysis of air and settled dust data, we believe that the process has enabled us to identify risk-driving contaminants within the indoor environment.

Absence of contaminant-specific toxicity criteria. Though toxicity values are not currently available for a subset of contaminants tested for and detected in some air and dust samples in Lower Manhattan, the COPC selected are indicative of the most prevalent, most toxic contaminants associated with the WTC releases. A wide range of contaminant classes were captured, among which some of the more toxic members were identified and screened (*e.g., dioxins, PAHs, metals*). Basing COPC selection on the contaminants with known toxicity criteria (and arguably some of the more toxic compounds) that are measured at higher levels than the contaminants in question is believed to be appropriate and reasonably health-protective.

The list of contaminants without toxicity criteria that were not carried through the COPC selection process include (1) essential nutrients (e.g., calcium, magnesium), which EPA generally does not carry through its risk assessments; (2) a limited number of specific phthalates and PAHs; (3) and SVOCs that are not conventionally measured to support EPA risk assessment. The lengthiest list of SVOCs for which no toxicity criteria exist comes from Lioy et al. (2002)—a study of three outdoor bulk dust samples collected in Lower Manhattan on September 16 and 17, 2001. Most of the SVOCs that do not have toxicity criteria were not consistently detected across the three samples. Further, the concentrations measured were consistently lower than other SVOCs (*e.g., PAHs*) that have been selected as COPC. Finally, because many of the SVOCs identified by Lioy are rarely considered in environmental sampling studies, we have no knowledge whether the measured levels are consistent with background concentrations in urban settings or if the levels are unusually high.

Uncertainty in deriving settled dust screening values. As described in the response to COPC #3 and detailed in Appendix D of the final COPC document, derivation of settled dust screening values required multiple assumptions in estimating exposure to surfaces, which add uncertainty to our analysis. For example, factors affecting surface loading and transfers to skin have not been well studied and are likely to be highly variable (e.g., characteristics of different surfaces, activities patterns related to surface contact, and surface cleaning techniques and frequency). As a result, limited data were available for many of the input parameters used to estimate dose from exposure to residues on surfaces. However, consistent with general human health risk assessment practice, every effort was made to select exposure input parameters that would define a reasonable maximum exposure and produce protective screening values. For the most part, upper-bound exposure estimates were used whenever available. Overall, we feel the process represents a reasonably protective approach.

Comment COPC #5:

The document should "include a spreadsheet or sample calculations to document how the screening values were calculated."

Response:

The final COPC document has been revised to present the results of the step-by-step screening process used in this assessment. The equations used in developing the screening values for bulk and settled dust are included, with all assumptions clearly stated. Sample calculations are now provided to illustrate the derivation process.

Comment COPC #6:

"COPC selection should primarily be based on a risk-based screening approach for settled dust and air pathways that uses exposure parameters appropriate for children and reflects toxicity endpoints relevant to children's health. The panel suggested three exposure scenarios: including a child at home for a 1-year exposure duration, an adult at home for a 30-year exposure duration (time-weighted average 6 years of child exposure parameters and 24 years of adult exposure parameters), and an adult at work for a 25-year exposure duration."

Response:

The authors agree that COPC selection should be based on a risk-based screening approach for the settled dust and air pathways and adjusted the process accordingly. The revised COPC selection process evaluates a chronic residential exposure scenario, considering both child and adult exposures. We did not, however, specifically evaluate exposures to a child at home for 1 year or to adult workers for the following reasons:

The tiered approach in the original COPC document was designed to evaluate sub-chronic exposure (i.e., 1 year). That approach has been replaced in the final COPC document to consider chronic exposures only. The incorporation of child-specific exposure parameters in the chronic (i.e., 30 year) exposure scenario, as recommended by the peer reviewers, will be protective of sub-chronic exposure to more highly-exposed child receptors.

A worker exposure scenario was not adopted due to the residential nature of the clean-up program. However, screening values developed for the residential exposure scenario are considered to be adequately protective of workers.

Consistent with peer reviewer recommendations, child exposure considerations now factor into our COPC selection process. The methodologies used to develop WTC screening values account for differences between adults and children with respect to exposure factors (e.g., body weight, intake rates, mouthing behaviors). For bulk dust, the chronic residential exposure scenario is time-weighted to include 6 years of child exposure and 24 years of adult exposure for screening carcinogens. A child soil ingestion scenario serves as the basis for non-cancer screening values. For the evaluation of residues on indoor surfaces, we considered continuous age-specific exposure parameters from age 1 through 31 for carcinogens and 1 through 6 for non-carcinogens.

Peer reviewers also noted that, ideally, the process needs to consider the critical exposure periods and toxicity endpoints relevant to children's health. Peer reviewers acknowledged, however, and we agree that development of additional toxicity criteria for children to support this COPC selection process is beyond the scope of this effort. Our screening process did consider, however, toxicity endpoints relevant to children's health where available (e.g., lead). As stated earlier, the critical studies and endpoints used in developing IRIS and alternate

toxicity values served as the basis for our screening values. Currently, most consensus toxicity values are based on the evaluation of adult exposures, not early-life exposures, though EPA does factor in relevant information on reproductive and developmental endpoints (or the lack thereof) when deriving toxicity values.

It should be noted that research evaluating the significance of early-life exposures to toxic chemicals is ongoing by EPA and others. For example, EPA recently released draft guidance for assessing cancer susceptibility from early-life exposure to carcinogens (EPA 2003). Because most current cancer slope factors do not account for susceptibility differences with respect to early life stages, agency scientists are exploring the possibility of applying additional uncertainty factors when evaluating childhood carcinogenic risks to some (e.g., mutagenic) carcinogens. Much of the impetus for such an approach is the growing knowledge and understanding of how a particular carcinogen exerts its effect (i.e., its mode of action) and how a particular mode of action may increase the risk of tumor response if exposure occurs during early-life stages.

In the meantime, we acknowledge that the current approach of applying existing toxicity criteria to all age groups introduces some uncertainty to the evaluation biased toward an underestimation of risk. Nevertheless, the overall conservative assumptions built into standard risk assessment methodology used in the COPC selection process offer a health protective screen. As pointed out by one peer reviewer, "it would be hard to imagine a more conservative approach than applying Appendix D [settled dust screening values] with childhood parameters as a COPC screening process," which is the final approach that we used.

Comment COPC #7:

"The panel recognized that once risk-based screening criteria based on dust have been developed, the list of COPC could potentially change. In addition, the panel observed that additional sources of relevant data discussed during the meeting suggest that contaminants which should be further evaluated to determine whether they should be listed as COPC include phthalates, arsenic, beryllium, polybrominated diphenyl ethers, and polybrominated dibenzofurans, as well as other potential COPC identified in the public observer comments."

Response:

The inclusion of risk-based screening criteria for the dust pathway and consideration of data sets made available subsequent to the release of the draft COPC document did not change the final list of COPC. We examined the contaminants noted by peer reviewers with consideration to factors applied to all candidate contaminants. The specified contaminants were not included as COPC for the following reasons:

< *Phthalates*. Phthalates were sampled for and detected in a limited number of bulk dust samples. Phthalates for which toxicity criteria are available (e.g., benzyl butyl phthalate, bis[2-ethylhexyl phthalate], diethylphthalate, di-n-octylphthalate) were detected at levels orders of magnitude lower than respective screening values providing justification for their exclusion as COPC. Phthlates for which no toxicity criteria are available were reported at comparably low concentrations.

- *Arsenic*. Arsenic levels have been measured in 17 bulk dust samples and in 215 settled dust samples, but never detected at concentrations or loadings greater than corresponding health-based screening values. Arsenic has been detected in 64 out of 738 (9%) ambient air samples. Half of these detections exceeded health-based screening values, but generally fall within the range of arsenic levels reported in urban settings, based on our review of national and regional background data (ATSDR 2000). Because arsenic has not been detected at levels of potential health concern in dust samples and detected levels in ambient air are consistent with urban background, it has not been selected as a COPC. Note, however, as part of the WTC Clean-up Program, EPA will continue to analyze indoor dust samples for non-COPC metals, including arsenic.

- *Beryllium*. Beryllium was detected infrequently and at low concentrations. Beryllium was detected in only 0.1% of 738 ambient air samples and in none of the 215 settled dust samples. It was detected in 17 out of 28 bulk dust samples, but the maximum reported concentration (3.754 mg/kg) was considerably lower than the screening value (150 mg/kg).

- *Polybrominated diphenyl ethers (PBDEs)*. Due to the use of PBDEs as a flame retardant in building materials and textiles, it is reasonable to consider this class of compounds as a possible WTC-related contaminant. Lioy et al. (2002) sampled for PBDEs in bulk dust. Though available results represent three samples only, PBDEs were detected at concentrations below the bulk dust screening value (150 mg/kg), which is based on the RfD for pentabromodiphenyl ether. The highest total concentration of PBDEs across available samples was 3.3 mg/kg.

- *Polybrominated dibenzo-p-dioxins and dibenzofurans (PBDDs/PBDFs)*. Based on the presence of phthalates and PBDEs (albeit at relatively low concentrations), one peer reviewer suggested that PBDFs be considered or at least mentioned in the COPC document. No sampling results are available for PBDDs/PBDFs, nor do toxicity criteria exist for this class of compounds. Therefore, interpretation of data, if they were to exist, would be highly uncertain. We do know that this group of contaminants is more or less similar to the chlorinated dioxins and dibenzofurans (dioxins) in their persistence and toxicity (WHO 1998), which have been retained as a COPC.

B. Responses to Comments on Setting Health-Based Benchmarks

The peer reviewers made nine conclusions and recommendations related to how the COPC Committee proposed setting health-based benchmarks in the draft COPC document. These are presented on pages 32–33 of the peer review report, and are reproduced below. Each conclusion and recommendation is followed immediately by the Committee's response to the comment.

Comment BENCH #1:

> "The rationale and purpose of each tier should be more fully described in the document. Specifically, the document should describe the application for each tier and indicate how the benchmarks for that tier are constructed to fulfill the intended application. This recommendation particularly applies to the Tier II criteria. In addition, the document needs to more clearly describe the 'aggressive cleaning' versus 'diligent cleaning' that are used to define Tier I

compared with Tier II benchmarks and show a difference in risk would result from using these two different cleaning approaches."

Response:

A tiered approach for health-based benchmarks was initially intended to address sub-chronic, as well as chronic, exposures associated with the WTC collapse. At the time the draft COPC document was initially conceived (March 2002), it was 6 months post-disaster and the assessment of sub-chronic exposure was still a significant concern. However, the development of health-based benchmarks (tiered, or otherwise) were not specifically intended to address the methods or intensity of cleaning protocols associated with the WTC Clean-up Program. These engineering issues were evaluated in a separate study (The WTC Residential Cleaning Confirmation Study) (EPA 2003a). The inclusion of cleaning methods associated with each benchmark was more intended for illustrative purposes rather than as particular recommendations for cleaning. The authors regret the inclusion of cleaning methods in this context as it directs attention away from the primary purpose of the document (i.e., to identify COPC and set health-based benchmarks). The final COPC document will not include any recommendations on cleaning methods.

As previously mentioned, the tiered approach was originally intended to address multiple exposure scenarios. The WTC Clean-up Program that was put in place focused on long-term protectiveness from residual contamination in residential dwellings. As such, the Tier III benchmark (equating to a 30 year exposure duration) was most applicable to this purpose.

Also noteworthy is that The WTC Clean-up Program was available to any resident regardless of extent of residual contamination in their dwelling. Since this program was not linked to a particular level of risk that might be represented by a tiered benchmark approach, establishment of multiple tiers was deemed of less utility than originally construed. The Tier III benchmark which has and continues to serve as a benchmark for long-term habitability of residential dwelling is therefore the primary focus in revising the COPC document.

The peer review panel articulated the benefit of a tiered benchmark approach as potentially useful in the prioritization of clean-up actions/decisions. Since the decision was made to clean without the need for pre-cleaning sampling to establish an unacceptable level of risk, this potential benefit was not realized. Conversely, the peer review panel also expressed apprehension over the lack of clarity in how the tiered benchmarks would inform the WTC Clean-up Program. As per the meeting notes: "Some panelists considered whether the Tier I and Tier II criteria should be removed from the existing document, leaving just a single criterion for each COPC equivalent to the respective Tier III criteria." Upon reviewing the entirety of the peer review comments on this subject, the authors agree with the position of panel members as quoted above. Accordingly, the final COPC document will contain only Tier III (i.e., long-term) health-based benchmarks.

Comment BENCH #2:

"In general, the panel recommends using a risk-based approach to develop benchmarks for the COPC, but indicated that when a benchmark is based on occupational or existing environmental standards, the document should clearly describe the underlying risk assessment for the standard, and discuss how the scientific basis of the standard is relevant to the WTC situation. Also, it was suggested that the document specify a confidence level in each benchmark developed."

Response:

The comment applies to benchmarks based on occupational or existing environmental standards. The COPC document currently uses such standards to derive benchmarks for fibrous glass, silica and lead. Following are the responses to this comment for each of these contaminants:

Fibrous glass. The fibrous glass benchmark is based on the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 1 f/cc (ACGIH 2001). Fibrous glass was observed to be an upper respiratory tract and skin irritant to workers in environments where air sampling indicated greater than 1 f/cc fibers as measured by phase contrast microscopy (PCM) (ACGIH 2001; ATSDR 2002a). The ACGIH standard is written with the intention of preventing this irritant effect. To the COPC Committee=s knowledge, no quantitative risk assessment was used to establish this standard. Little data exist to provide a threshold below which fibrous glass would not be an airborne or contact irritant, especially when considering the effects on the general public, which may include sensitive individuals.

  Irritant effects are not the only health effects possible from fibrous glass exposure. Fibrous glass less than 3 microns in diameter are respirable and available to enter and deposit in the pulmonary regions of the lung (ACGIH 2001). Clearance of these fibers from the lung will be determined by fiber solubility and length (ACGIH 2001; ATSDR 2002a). Fibers cleared from the lung have less potential to create long-term health effects. Although some animal studies have demonstrated both fibrotic and carcinogenic potential for glass and mineral wools (ACGIH 2001; ATSDR 2002a; IARC 1988), more recent studies do not fully support this finding. Although the potential for these adverse health effects is not the scientific basis of the ACGIH TLV, it is believed the resulting benchmark is adequately protective (see response to BENCH Comment 9). It should be noted this benchmark is lower than the proposed ATSDR chronic minimal risk level (MRL) for refractory ceramic fibers (0.03 f/cc), which are considered more toxic than the glass and mineral wools described in dust from both indoor and outdoor dust around the WTC. Therefore, there is fair confidence this level should be protective.

Lead. The COPC Committee identified an applicable and relevant existing standard to set a health benchmark for lead in interior dust. The Residential Lead-Based Paint Hazard Reduction Act (Title X) Final Rule (40 CFR, Part 745, 1/5/01) established uniform national standards for lead in interior dust. Thus, both EPA and the United States Department of Housing and Urban Development (HUD) have set a dust standard for lead of 40 $\mu g/ft^2$ for floors (including carpeted floors) and 250 $\mu g/ft^2$ for interior window sills. To support the development of a dust standard EPA performed an analysis of the Rochester Lead-in-Dust Study (HUD, 1995). At 40 $\mu g/ft^2$ a multimedia analysis shows a 5.3% probability that a child's blood lead level would exceed 10 $\mu g/dl$. Thus, this standard meets the criteria established by EPA (i.e., 95% probability to be below 10 $\mu g/dl$) (EPA 1994a) for managing environmental lead hazards. However, the COPC Committee opted to set the benchmark at the more stringent HUD screening level of 25 $\mu g/ft^2$.

Silica. The crystalline silica benchmark presented in the draft COPC document was based on the OSHA Permissible Exposure Limit (PEL) for "dust containing quartz." This standard varies with the crystalline silica content of the dust and applies to dust

samples which may contain as little as 1% crystalline silica. Because this standard is for respirable dust, and varies by crystalline silica content, different conditions would yield different standards viewed either as total dust or effective silica concentration. For example, in the case where the dust is 100% crystalline silica, the standard is 100 : g/m^3. In contrast, in the case where a dust is 1% crystalline silica, the PEL is 3.3 mg/m^3 for respirable dust containing crystalline silica. Because only 1% of this total dust is crystalline silica, the effective crystalline silica concentration in this case is 33 : g/m^3. This OSHA standard is based on the 1969 ACGIH TLV value, adopted by OSHA in 1971. Subsequent follow-up to the original occupational cohorts on which this standard was based and other cohorts studied show mixed results. Some studies uphold the standard and others show a need to lower it. OSHA is considering a change. Because of the complicated nature of the data and sampling issues, OSHA has not yet decided on a new standard. And until such time, the PEL stands in effect.

However, both the ACGIH and National Institute of Occupational Safety and Health (NIOSH) have examined the data and have lowered their recommended exposure limits to 50 : g/m^3. This is based upon concern that there appears to be more silicosis in exposed cohorts than was recognized by the older recommendation. A recent review by NIOSH of their recommended exposure limit (REL) indicates that adverse health effects may be observed in workers exposed at or below the current REL (NIOSH 2002). However, technical concerns regarding the ability to reliably measure respirable crystalline silica in the workplace below the REL (see response to BENCH #9) prevent NIOSH from lowering their REL at this time (NIOSH 2002). Although not the quantitative basis for the current REL, NIOSH reviewed several health effects associated with chronic exposure to crystalline silica in the workplace including: silicosis, lung cancer, emphysema and chronic obstructive pulmonary disease. A threshold for these health effects has not been defined although some analyses do provide exposure response relationships and suggest a point of departure for observable health effects. Cumulative exposure, peak exposure, duration of exposure and latency time have all been positively related to adverse pulmonary health effects. In light of these considerations, the benchmark for silica is now being based on the NIOSH REL. (See the response to BENCH #9 for additional information on the derivation of the silica benchmark from the REL.)

Comment BENCH #3:

"For defining the different tiers, the panel recommended that Tier I benchmarks be based on a 1-year exposure, child exposure parameters, and where available, child-specific toxicological endpoints. The panel recommended that Tier III benchmarks be based on a 30-year exposure, where 6 years are based on child exposure parameters and 24 years are based on adult exposure parameters."

Response:

As discussed in our response to BENCH #1, the Tier III benchmark which has and continues to serve as a benchmark for long-term habitability of a residential dwelling, will be the focus of the revised COPC document. Benchmark criteria have been developed therefore to evaluate chronic (30-year) exposures only, with consideration of childhood exposure within that time frame. For the evaluation of residues on indoor surfaces, we factored in continuous age-specific exposure parameters from age 1 through 31. Appendix D in the final COPC document details

the approach and exposure parameters used in deriving benchmark criteria for long-term exposures.

Child-specific toxicological criteria were considered where available (*e.g., lead*). As described in the responses to COPC #6, EPA's IRIS database served as the primary source for toxicity criteria most of which are based on animal and human data looking at adult exposures. The final COPC document will note this factor as an additional uncertainty in the process. However, we feel that the approach used relied on the best available science and risk assessment methodologies and enabled the generation of reasonably protective benchmark criteria. As stated earlier, development of child-specific toxicity criteria for screening COPC and setting health-based benchmarks is beyond the scope of this project.

Comment BENCH #4:

"Panel members disagreed with the rationale provided in the document for using an upper level excess lifetime cancer risk level of 1×10^{-4} in calculating the benchmarks for each tier. The panel noted that the sampling and analysis limitations described in the document for asbestos that limit the risk evaluation to a 1×10^{-4} risk level could be easily overcome and lower risk levels could be achieved for other COPC. The panel did not address specifically the risk management decision of whether using a 1×10^{-4} versus a risk level of 1×10^{-5} or 1×10^{-6} would be most appropriate."

Response:

The level of 10^{-4} lifetime risk was chosen on the basis of practical sampling limitations particular for *asbestos*. The level specified by the document, 0.0009 fibers/cc, is near the practical detection level given the large scope of the WTC Clean-up Program. The reviewers suggested that a somewhat lower risk, perhaps as low as 10^{-6}, might be achieved by compositing multiple samples. Measuring to a risk level of 10^{-6} requires 100 times more air volume per sample.

The detection limit for a sample varies based on the volume of air which passes through the filter, and/or by the number of grids (i.e., area) on the filter read by the microscopist. Resources, both human and financial, prohibited the analysis of additional filter grids as a means of lowering detection limits. Still, lower detection limits could be achieved by higher volumes of air. However, in order to lower the detection limit 10 fold (to target a 10^{-5} risk instead of 10^{-4} risk) 10 times the air would need to be drawn through the filter. So a sample would run for 80 hours instead of 8, assuming the volumetric flow rate (already at the high end of the recommended range) of the sample remains constant. Similarly, a risk level of 10^{-6} would require a sampling time of 800 hours. In addition to the logistical problems of running a pump in someone's home for such an extended time, there are additional technical concerns.

In urban atmospheres, there are many substances in the air other than *asbestos* fibers, which interfere with detection of *asbestos* in ways that increase with the volume of air sampled. *Asbestos* is unlike chemical species analysis where samples might be combined. Non-fibrous dust and other general particulate matter collect on the filter along with any asbestos fibers. This dust obscures fibers, and because *asbestos* fibers are counted manually on a known surface area of filter, this limits the detectable level of *asbestos*. The authors acknowledge that running multiple pumps concurrently, in theory, might mitigate overloading potential and reduce total sample time. The WTC Clean-up Program was set up such that every room in a residential dwelling (with a minimum of three samples) would need to meet the clearance criteria

before the residence was deemed effectively cleaned. Given that more than 6,000 individual residences signed up for the cleaning test only program, the prospect of running multiple pumps to obtain a single sample was determined to be beyond practical implementation. Additional discussion in support of a 10^{-4} risk level for asbestos and other carcinogenic COPC is presented in Appendix C of the final COPC document.

Comment BENCH #5:

"The panel recommended that for some COPC, the authors should develop benchmarks for contaminants on hard surfaces and benchmarks for contaminants on soft surfaces, instead of just developing a single benchmark for contaminants in settled dust. The panel noted that, although there are limited data available in order to recommend soft-surface benchmarks, some methods for this have been developed to address exposure to pesticides. These methods could be applied to the WTC situation. The panel recommended that for each COPC, the document clearly analyze the chemical properties and the potential exposure pathways to that contaminant before determining whether an air, hard-surface, or soft-surface benchmark is needed."

Response:

The committee generally agrees with this comment and has modified the assessment procedures to explicitly consider differences in exposure to soft and hard surfaces. The revised procedure has been adopted from EPA's pesticide guidance (as suggested in the comment) and treats the surfaces differently in terms of degree of particle transfer to skin and contact time. The comment also implies that the clearance criteria for the two surfaces may differ. The assessment procedure assumes a residence has both soft and hard surfaces and the total exposure results from contact with both surfaces. For the sake of simplicity, the committee decided to set equal criteria for the two surfaces. Also as suggested in the comment, this procedure is applied on a chemical-by-chemical basis and considers chemical properties such as dermal absorption.

It should be understood, however, that the procedures for estimating exposure to surfaces is highly uncertain. The factors affecting surface loading and transfers to skin have not been well studied and are likely to be highly variable. These include:

- Surface characteristics affecting deposition and removal (e.g., porosity, roughness, static charge)
- Activity patterns related to surface contact.
- Surface cleaning techniques and frequency.

These uncertainties are highlighted in the final COPC document, both in the newly included section on uncertainties and limitations and in Appendix D.

Comment BENCH #6:

"The panel suggested that the document more clearly describe how mixture toxicology is being considered in developing benchmarks."

Response:

Benchmark criteria were developed on a contaminant-by-contaminant basis. The final COPC document will explain why this approach was taken and is considered health protective, as summarized below.

The COPC Committee clearly recognizes that the residents in Lower Manhattan are not exposed to environmental contaminants singularly, but instead to combinations of chemical and physical agents. Development of benchmarks, however, was driven by a combined consideration of individual COPC-specific toxicity, background levels, and practicalities and limitations related to sampling. Mixture toxicology was not factored into the derivation process because little or no quantitative dose-response data exist regarding specific interactions across the WTC COPC (*asbestos, dioxins, lead, PAHs, fibrous glass, and crystalline silica)*[1].

We feel the contaminant-specific approach is health protective for the following reasons:

The process for developing benchmarks based on non-cancer effects sets concentrations well below observed effect levels and generally at or near no-observed-adverse-effect levels (NOAELs). Presumably, exposures to one or multiple substances below or near the NOAEL will not result in adverse effects (EPA 2000b).

The likelihood of interactions are increased if substances behave similarly toxicologically. We therefore qualitatively examined the toxicology of individual COPC to review what is known about target organ toxicity, mode of action, and any documented chemical interactions among WTC COPC. Review of EPA's toxicological reviews (including the 2000 dioxin reassessment) and ATSDR's toxicological profiles revealed the following:

< Target organs and critical effects resulting from ingestion and dermal exposures generally differ across individual COPC, though *asbestos, lead, dioxins, and PAHs* are all considered potential human carcinogens via the ingestion route. Each of these contaminants can affect a wide range of biological systems, but each generally exerts its effects via different mechanisms.

< At high concentrations, inhalation exposure to several of the COPC (*asbestos, fibrous glass, and crystalline silica*), as well as the small particulate matter released during the WTC disaster, has been shown to result in point of contact toxicity to the lung. Specific lung effects vary across these substances, ranging from acute irritant effects produced by fibrous glass to cancers of the lung associated with asbestos. Again, although uncertainty exists due to the limited study of chemical mixtures, exposures to COPC at or below benchmark concentrations—which are set at levels significantly lower than observable effect levels—would not be expected to produce effects individually or in combination.

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[1]Note that combined effects within dioxin and PAH mixtures were accounted for in the development of benchmarks using toxic equivalency (TEQ) approaches that account for the relative potency of the components of these complex mixtures. Toxicity equivalent factors used in this approach are based on our understanding of the most toxic component of each mixture (i.e., 2,3,7,8-TCDD for dioxins and benzo(a)pyrene for PAHs).

One EPA study looking at acute airway effects in mice exposed to WTC fine particulate matter (2.5 microns) provides some insights to the magnitude of total dust exposures leading to observable effects. This study revealed that components of WTC dust promotes respiratory inflammation at "high" doses only (EPA 2002). This study does not evaluate the effects of long-term or repeated exposures to lower levels of WTC dust and is not directly useful in the development of benchmarks.

Comment BENCH #7:

"For the air benchmark for lead, the panel recommended incorporating local exposure loading data into the IEUBK model."

Response:

The draft COPC document utilized average background concentrations for multi-media sources of *lead* based on national data for lead in drinking water, diet, soil and indoor dust as input parameters for the IEUBK Lead Model. As per the peer review recommendations, local data was researched for site-specific input parameters. The discussion below details the source, analysis and application of these data.

EPA developed the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model (EPA 1994) to evaluate multimedia *lead* exposure to children in residential settings. EPA established a goal of attaining a 95% probability that blood lead levels in children be less than 10 μg/dl (EPA 1994a). To meet the aforementioned goal, The IEUBK Lead Model was run using multimedia input parameters that are applicable to the residential community in Lower Manhattan. The following discussion details the basis for individual input parameters.

Lead in Drinking Water - The source of NYC's drinking water (the Catskill/Delaware and Croton systems) is remarkably low in lead. The average lead concentration is 1 μg/l in the Catskill/Delaware system and <1 μg/l in the Croton system (NYCDEP - Drinking Water Quality Test Results, 2001 - see www.nyc.gov/dep). However, the concentration of lead in tap water can be increased by lead containing components (pipes, solder) of a building's distribution system. Consequently, the Safe Drinking Water Act "Lead and Copper Rule" (Federal Register, June 7, 1991) requires large water systems to monitor led concentration at the tap. If more than 10% of the samples exceed the federal "Action Level" of 15 μg/l, corrective steps (e.g., source treatment, corrosion control) must be carried out. The IEUBK Lead Model is intended to run with input values that represent the average lead concentration in the environmental media of interest. As reported by NYCDEP, 2001, the median lead concentration from a total of 107 samples obtained at the tap was 3 μg/l. It should be noted that these samples represent a high bias in that they were obtained from homes where there is reason to believe that lead service lines exist. The median lead concentration in tap water city-wide is likely to be lower. However, for the purpose of this site-specific application of the IEUBK Lead Model, a value of 3 μg/l is used as a conservative central tendency estimate of lead in tap water.

Lead in Diet - No data could be located relating to the lead content in food items for residents living in Lower Manhattan. Since there is very little home gardening taking place in this community it was deemed appropriate to use data that reflects national trends for commercially available food items. EPA recently evaluated dietary lead content in children in support of revising default input parameters for the IEUBK Lead Model (EPA 2002). Lead residues in food were obtained from the Food and Drug Administration's (FDA's) Total Dietary Survey. Food consumption trends were obtained from the National Health and Nutrition Examination Survey (NHANES) . The average lead content in the diet of children 0 - 7 years old is 2.8 μg/day. Consequently, the input value of 2.8 μg/day was employed as the estimate of average daily lead intake from diet.

Lead in Soil - Numerous studies have been conducted to evaluate soil and street dust lead concentrations in New York City (NYCDOHMH, 2003). In the studies reviewed, soil/dust samples were taken by a variety of methods over a long period of time (1924 - 1993). Summary statistics were compiled by the NYCDOHMH based on whether the studies assessed known lead sources or background conditions. Ruling out studies on specific sources such as bridges, a median soil lead concentration of 200 ppm and street dust lead concentration of 895 ppm was reported. Data are lacking with regard to the relative contribution of street dust to a child's daily "soil" intake. Given this uncertainty, the median values of soil and dust were averaged to provide a composite soil/dust concentration of 548 ppm. This value was used as the soil lead concentration in the site-specific application of the IEUBK Lead Model

Lead in Indoor Dust - Although there exists a substantial amount of lead "load" data (i.e., mass per unit area - typically recorded in units of micrograms per square foot as per HUD reporting requirements) as a measure of lead contamination in residential dwellings, the IEUBK Lead Model requires lead concentration in settled dust to be reported in terms of concentration (i.e., mass per unit mass - typically recorded as parts per million). The WTC Background Study reported lead in house dust both in terms of lead load ($\mu g/ft^2$) and concentration (ppm) although more limited sampling was obtained of lead concentration (ppm) measurements. Nonetheless, because these data were specifically intended the assess background conditions in Lower Manhattan, they were used in the site-specific application of the IEUBK Model. The mean concentration of lead in settled dust in the WTC Background Study was 126 ppm (EPA 2003a). Consequently, this was the value used for lead in indoor dust for the site-specific application of the IEUBK Lead Model.

Site specific application of the IEUBK resulted in a reduction of the *lead* benchmark for indoor air form 1 $\mu g/m^3$ to 0.7 $\mu g/m^3$. See Appendix E of the final COPC document for data input spreadsheets and graphic display of model results.

Comment BENCH #8:

"The panel did not endorse the asbestos settled dust benchmark because the only relevant exposure pathway for asbestos is inhalation and K-factor methodology is, at this time, inadequate for predicting inhalation exposure from asbestos surface loading measurement. However, the panel did note that settled asbestos is a potential source of airborne asbestos if disturbed or not remediated."

Response:

The comment addresses the use of K-factors in the draft COPC document to derive Tier I benchmarks for *asbestos and fibrous glass* in settled dust. As our response to comment BENCH #1 indicates, we are now assigning one health-based benchmark to each COPC, rather than using three tiers of benchmarks for each contaminant. As per the peer review recommendations, the benchmarks for *asbestos and fibrous glass* in the final COPC document have been developed only for indoor air, and reflect an environmental risk-based paradigm and modified occupational standards, respectively. None of the benchmarks in the final COPC document are based on the K-factor methodology. The COPC Committee agrees with observations made by members of the peer review panel that due to the numerous factors that influence the relationship between fiber concentration in settled dust and indoor air, including surface porosity, activity patterns, air exchange rates and interior volume, benchmarks for *asbestos and fibrous glass* in settled dust should be omitted. Our responses to comments

BENCH #2 and BENCH #9 further discuss the rationale behind the final set of health-based benchmarks.

Comment BENCH #9:

"For setting benchmarks based on occupational standards, duration-based adjustment factors should be used that weigh chemical-specific issues. Specifically, the panel suggested that a duration adjustment of 4.2 is typical to extrapolate from occupational to environmental exposure, and that additional adjustments of 10 or 100 (for a total factor of 42 or 420) may be needed to address the underlying, chemical-specific biological factors (toxicokinetics and toxicodynamics)."

Response:

The comment applies to benchmarks based on occupational standards. The draft COPC document used such standards to derive benchmarks for *fibrous glass and silica*. Our responses to this comment for these two COPC follow:

Fibrous glass. Although the TLV is based on irritant effects the resulting benchmark of 0.01 f/cc is believed to be protective for chronic residential exposure for glass and mineral wool. In developing the three tiered approach initially designed to prioritize and define the level of response needed in different environments surrounding the WTC area, the committee worked from the existing TLV. Anything above the TLV was not considered acceptable for residential use. The TLV was adjusted by a factor of ten for each Tier resulting in a total adjustment of 100 for the Tier III level. The committee did not specifically apportion this adjustment as a duration adjustment or an adjustment for application to a non-worker population. Although this total adjustment of 100 could be considered to cover the 4.2 duration adjustment, and an adjustment above that for application to non-worker population, there is considerable variation in how this second adjustment may be set. The Peer review committee itself recommends a range between 10 and 100 resulting in a total adjustment between 42 and 420. The question is not so much can we assign a specific number for the adjustment which is accurate, but rather is the resulting standard protective.

Fibrous glass less than 3 microns in diameter are respirable and available to enter and deposit in the pulmonary regions of the lung (ACGIH 2001). Clearance of these fibers from the lung will be determined by fiber solubility and length (ACGIH 2001; ATSDR 2002a). Fibers cleared from the lung have less potential to create long-term health effects. Less soluble materials have a longer residence time in the lung and therefore have a greater potential to contribute to tissue damage or malignant disease. Within synthetic vitreous fiber (SVF) types, glass fibers and slag wool are considered the most soluble, and therefore least toxic. Mineral wool is less soluble than glass wool. The fibers observed in indoor and outdoor dust samples from the WTC area contained glass wool and mineral wool, both of which have lower biopersistence than other forms of synthetic vitreous fibers.

Although some animal studies have demonstrated both fibrotic and carcinogenic potential for glass and mineral wools (ACGIH 2001; ATSDR 2002a; IARC 1988), more recent studies do

not fully support this finding.[2] Epidemiologic studies on workers exposed to fibrous glass do not provide consistent evidence of pulmonary effects, although some effects were noted (ATSDR 2002a; Bonn et al. 1993). Similarly, when assessing deaths due to lung cancer in workers exposed to glass wool, studies do not provide strong evidence for increased risk of cancer deaths attributable to the glass wool exposure.

The carcinogenic potential of fiberglass has been reviewed by several agencies. The IARC originally classified both glass and mineral wools as Group 2B carcinogens, possibly carcinogenic to humans, based on animal studies (IARC 1987). Similarly these materials were classified as carcinogens by the National Toxicology Program and the American Conference of Governmental Industrial Hygienists (ACGIH 2001; NTP 2001). However a review of the carcinogenic potential of these fibers by IARC in 2001, which takes into account updated human studies, animal inhalation studies, and mechanistic studies, recommends a change in this classification. The IARC has announced that the recent monograph designates both glass and mineral wool as Group 3, unclassifiable as to carcinogenicity in humans, because of inadequate evidence of carcinogenicity in humans and the relatively low biopersistence of the materials.

In contrast, the less soluble, and more biopersistent refractory ceramic fibers, are still considered potentially carcinogenic and are believed to more toxic than glass and mineral wools. A recent review of the toxicity of synthetic vitreous fibers by ATSDR proposes a Minimal Risk Level for chronic exposure of 0.03 f/cc for these refractory ceramic fibers (ATSDR 2002b). Although ATSDR did not set MRLs for glass and mineral wools, it notes that "insulation wools are markedly less durable and less potent than refractory ceramic fibers." Therefore the benchmark of 0.01 f/cc for glass and mineral wools, which is lower, should be considered protective.

\# *Silica*. In response to other peer review comments on this document, as well as the current stage of clean-up and assessment projects ongoing in Lower Manhattan, it has been decided to remove the tiered approach provided to screen and prioritize clean-up and response efforts. Therefore the only benchmark needed for crystalline silica is that which would be protective for the general public in a chronic exposure scenario. No threshold has been established and it is possible health effects occur below the NIOSH REL of 50 : g/m3. Although duration adjustments and uncertainty factors can be applied to this REL to develop a benchmark for residential exposure, the resulting level would be well below practical sampling limits. Therefore this committee is recommending a benchmark of 5 : g/m^3, which is the lowest amount that can be reliably reported in a reasonable sampling time.

The level of this benchmark is technically limited by sampling constraints, including time and weight loading. It is based upon a reporting limit of 10 micrograms of crystalline silica with no more than about 3 milligrams of total dust on a single filter. (A reporting limit is the smallest amount of a substance for which a quantitative value can be

---

[2]Early studies often relied upon injection and implantation studies, which may not accurately predict a pulmonary response from inhalation exposures. A review of inhalation studies indicates that glass wool did not cause pulmonary fibrosis or lung cancer in these animal studies (Bonn et al. 1993). A recent study by Hesterberg indicates no increase in pulmonary fibrosis or lung cancer even at doses of 222 f/cc, although cancer incidence in control animals was considered high.

determined.) More than about 3 milligrams of dust on the filter will decrease analytical sensitivity. Collection of 2 cubic meters of air over about 20 hours for a Dorr-Oliver cyclone at 1.7 L/min or about 13.3 hours using an SKC cyclone at 2.5 L/min will provide sufficient sensitivity to measure 5 $\mu g/m^3$ crystalline silica so long as the total dust weight on the filter does not exceed about 3 milligrams (an airborne dust concentration of 1.5 mg/m^3). Using either the nylon Dorr-Oliver or SKC Aluminum Cyclones, the following limits are possible:

Sampling Equipment (Size selection cyclones)	Duration of sampling	Volume of air (m^3)	Effective reporting limit ($\mu g/m^3$)
Dorr-Oliver (OSHA) at1.7 L/min	6 hours (360 min)	0.61	16.3
	8 hours (480 min)	0 .81	12.3
	10 hours (600 min)	1.02	9.8
	19.6 hours (1176 min)	2.0	5.0
SKC Aluminum (NIOSH) at 2.5 L/min	6 hours (360 min)	0.9	11.2
	8 hours (480 min)	1.20	8.4
	10 hours (600 min)	1.5	6.7
	13.3 hours (800min)	2.0	5.0

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Addendum/Errata to the report titled "World Trade Center Indoor Environmental Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks (May, 2003)."

February, 2004

Copies of the "World Trade Center Indoor Environmental Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks (May, 2003) report and this "Addendum/Errata" sheet can be obtained on-line at www.epa.gov/WTC. Inquiries regarding the content of both of these documents should be directed to:

Mark A. Maddaloni Dr. P.H., DABT
U.S. Environmental Protection Agency, Region 2
290 Broadway
New York, NY 10007-1866

Phone (212) 637-3590
E-mail maddaloni.mark@epa.gov

Section 3.4 Health Based Benchmarks - Expanded Discussion of PCM Equivalence

Asbestos clearance criteria was based on long (i.e., > 5 um) fiber counts. The use of a minimum fiber length of 5 um for carcinogenic activity represents current scientific consensus and is documented in both NIOSH methods 7400 & 7402 and EPA's Integrated Risk Information System (IRIS) toxicity data base.

The footnote to Table 1 in the report titled "World Trade Center Indoor Environmental Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks" documents this minimum length requirement along with a minimum length-to-width aspect ratio of 3:1 as prescribed in the NIOSH asbestos analytical methods 7400 & 7402. This counting method applies to phase contrast microscopy (PCM) analysis.

The asbestos counting rules employed for the WTC Indoor Clean-up Program was designed to record phase contrast microscopy equivalent (PCMe) fibers. This analytical method utilized transmission electron microscopy (TEM) and followed AHERA (Asbestos Hazard Emergency Response Act) counting rules. Fibers > 5 um were distinguished from total (i.e., >0.5 um) fiber counts. AHERA also stipulates a minimum 5:1 aspect ratio. Modification was made to AHERA (by obtaining larger samples volumes) in order to achieve the lower detection limits necessitated by use of risk-based clearance criteria.

NIOSH method 7402 is an alternative approach for estimating PCMe fibers by TEM analysis. The method counting rules differs slightly from the above approach in the it stipulates a minimum aspect ratio of 3:1 and a minimum fiber width of 0.25 um. The minimum fiber width reflects the optical resolution of PCM. Compared to NIOSH method 7402, the PCMe counts recorded for the WTC Indoor Clean-up Program may be marginally higher or lower. Extremely thin fibers (width < 0.25 um) were recorded but would have been excluded using NIOSH 7402 counting rules. The actual magnitude of this over count (relative to NIOSH 7402) is unknown but likely to be small. Conversely, asbestos fibers with an aspect ratio between 3:1 and 5:1 were not counted but would have been recorded using NIOSH 7402 counting rules. Similarly, the actual magnitude of this undercount is unknown but likely to be small - especially since the vast majority of identified asbestos fibers were chrysotile (which typically has a relatively high aspect ratio).

Appendix A: Deriving Health-Based Screening Values for Air and Dust Exposure Pathways

The screening values for settled and bulk dust employed a 30 year exposure duration to reflect an upper-bound estimate of time in residence, as per the recommendations in the Risk Assessment Guidance for Superfund (RAGS, 1989). (Screening values for asbestos in settled and bulk dust were not developed due to the highly uncertain relationship between settled and airborne asbestos.) Where applicable, the health-based benchmarks for the contaminants of potential concern listed in Table 1 of

the report also reflect a 30 year exposure duration. However, an oversight occurred in the screening values for inhalation carcinogens (e.g., asbestos). Rather than using the same 30 exposure duration employed for the dust pathway, the screening value employed the inhalation unit risk (IUR) which is based on lifetime (i.e., 70 yr) exposure duration. Consequently, the air screening value for asbestos listed in Appendix A (Table A-1) is 0.0004 f/cc (reflecting a 70 year exposure duration), while the health-based benchmark for asbestos listed in Section 3.4 (Table 1) is 0.0009 f/cc (reflecting a 30 year exposure duration).

Appendix D: Assessing Exposures to Indoor Air and Residues on Indoor Surfaces

The paradigm for assessing exposure from residues on indoor surfaces captures mouthing activity through an input parameter then assigns the number of hand-to-mouth contacts per hour as a function of age. The following mouthing frequency is listed in Appendix D (P. D-5): 1 to 6 yr - 9.5 times/hr; 7 to 12 yr - 5 times /hr; 8 to 18 yr - 2 times/hr; and, 19 to 31 yr - 1 time/hr. As listed in the report, two age groups (7 to 12 and 8 to 18) overlap. The actual breakdown by age is correctly listed in the table below under the column "COPC Spreadsheet." In addition, Appendix D lists mouthing activity for adults (19 to 31 yr) as 1 time/hr, when in reality the spreadsheet (and therefore the calculations used to develop heath-based benchmarks for indoor surfaces) employed an adult (19 to 31 yr) mouthing rate of 2 times/hr. The impact of using two rather than one mouthing events per hour for adults has a negligible impact on the health-based benchmark and what little effect it has is biased toward a more stringent value.

Ages (yr)	**COPC Report**	**COPC Spreadsheet**
1 - 6	9.5	9.5
7 - 12	5	5
8 - 18	2	2 (age 13 -18)
19 - 31	1	2

EXHIBIT C

Melissa Cooper

From: escrowagen@aol.com
Sent: Wednesday, April 04, 2012 3:44 PM
To: Melissa Cooper
Subject: Fwd: Updated Zone 1A Bubble Statistics
Attachments: multivariate_results_update.docx; R_results_ttest.docx

Dload n print

-----Original Message-----
From: Marc Glass <mglass@downstreamstrategies.com>
To: EscrowAgen@aol.com <escrowagen@aol.com>; Billy Sublett <bsublett@gtandslaw.com>; Mike Jacks <mjacks@gtandslaw.com>; Diandra Debrosse <ddebrosse@gtandslaw.com>
Sent: 04-Apr-2012 16:40:31 +0000
Subject: Updated Zone 1A Bubble Statistics

Ed, et. al,
Please find attached two word files explaining the results of the updated statistical comparison between Zone 1A v. Zone 1A Bubble Soil analytical results. This analysis includes all soil sampling data received from these study areas to date.

The results for the Multivariate analysis (MANOVA) test on the means indicates with 95% confidence that there is no statistical difference between the means for arsenic, cadmium, lead, and zinc in Zone 1A v. Zone 1A Bubble. This is consistent with the result from the test performed previously with fewer soil samples.

When individual constituents As, Cd, Pb, Zn were looked at individually, The results for the t-tests indicate with 95% confidence that:

1.) For both As and Pb, there is no evidence that the means for the Zone 1A and Zone 1A Bubble populations are different.
2.) For both Cd and Zn, the means for Zone 1A and Zone 1A Bubble populations are different.

In summary, these results are consistent with the statistical tests performed previously.

Please notify me if you would like to discuss results further.
Sincere Thanks,
Marc
--

Marc Glass | **Downstream Strategies**

Principal
(office) 304.292.2450

(cell) 304.216.5294

mglass@downstreamstrategies.com

www.downstreamstrategies.com

Manova testing all data untransformed

> summary(fit,test="Pillai")

Df Pillai approx F num Df den Df Pr(>F)

Group 1 0.10437 12.761 4 438 7.825e-10 ***

= significant test, the groups (bubble vs nonbubble) are different

Residuals 441

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Generalized Shapiro-Wilk test for Multivariate Normality

data: x

MVW = 0.9659, p-value < 2.2e-16 **The data is not normal

Manova testing all data transformed

> summary(fit.transformed,test="Pillai")

Df Pillai approx F num Df den Df Pr(>F)

Group 1 0.2307 32.837 4 438 < 2.2e-16 ***

= significant test, the groups (bubble vs nonbubble) are different

Residuals 441

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

I removed Pb and Zn because they were redundant with Cd

Generalized Shapiro-Wilk test for Multivariate Normality

data: a

MVW = 0.9408, p-value < 2.2e-16**The data is not normal, but Manova is fairly robust to non-normality

Manova testing only non-redundant data transformed

```
> summary(fit.transformed2)
          Df  Pillai approx F num Df den Df    Pr(>F)
Group      1 0.15455   40.216      2    440 < 2.2e-16 ***
= significant test, the groups (bubble vs nonbubble) are different

Residuals 441
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

As.test--No evidence to show that the 2 population sample means are different

Welch Two Sample t-test

data: As and As.bubble

t = -0.434, df = 75.411, p-value = 0.6655

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-1.5137877 0.9721046

sample estimates:

mean of x mean of y

12.86746 13.13830

> Pb.test-- No evidence to show that the 2 population sample means are different

Welch Two Sample t-test

data: Pb and Pb.bubble

t = 1.2217, df = 56.669, p-value = 0.2269

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-37.61724 155.30774

sample estimates:

mean of x mean of y

340.2474 281.4021

> Zn.test—95% confidence that the mean Zn level of the bubble sites is different than the mean Zn level of the non-bubble sites

Welch Two Sample t-test

data: Zn and Zn.bubble

t = 16.2057, df = 394.099, p-value < 2.2e-16

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

1785.005 2277.899

sample estimates:

mean of x mean of y

2751.7070 720.2553

> Cd.test-95% confidence that the mean Cd level of the bubble sites is different than the mean Cd level of the non-bubble sites

Welch Two Sample t-test

data: Cd and Cd.bubble

t = 15.0824, df = 382.59, p-value < 2.2e-16

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

18.28994 23.77346

sample estimates:

mean of x mean of y

26.617020 5.585319

EXHIBIT D

PROPERTY REMEDIATION PROGRAM WORKING BUDGET

PROJECTION OF REMEDIATION PROGRAM EXPENSES AND POSSIBLE SURPLUS, ASSUMING A 30 MONTH LIFE COMMENCING MAY 15, 2012

A.	Estimated May 15, 2012 Remediation Fund Balance	$33,200,000
B.	Estimated Remediation Expenses (Assuming only Contaminated Properties are cleaned) (160 Soils and 600 houses)	
	1. Remediation Company (Lowest Qualifying Bid Plus 10%)	$16,302,000
	2. Claimant Relocation Expenses (Attached Estimate)	$ 700,000
	3. Post-Remediation Sampling (Attached Memo)	$ 400,000
	4. Balance of Claimant Annoyance Payments (Attached Memo)	$ 1,600,000
	5. Technical Advisor ($25,000 per month)	$ 750,000
	6. Claims Administrator and Related Expenses ($150,000 per month)	$ 4,500,000
	7. Outside Auditor for 3 years	$ 100,000
	8. 10% Reserve for Contingencies	$ 2,435,200
	9. Total	$ 26,787,200
C.	Possible Surplus	$ 6,412,800

Subj: Property Remediation Relocation Plan Development; 4609-7
Date: 3/15/2012 10:51:05 A.M. Central Daylight Time
From: ddebrosse@glandslaw.com
To: escrowagen@aol.com

160 Properties to Be Remediated for soil (tested above level)
1,050 property claims filed. So far, 900 have been tested (all but 5 have been occupied). So far, we don't final number on how (600 is estimate that is in RFP).

Hotel stay for 600 Properties/ Families

(Assuming $115 per night/ for 5 nights or $575 per family) = $345,000.00

Assuming that 15% have older children who also reside with the residents who may need separate lodging @ the same rate = $51,750.00

Per Diem Breakfast and Dinner Amount @ $100/day per family for 5 days (or $500/family) = $300,000.00
(as they will be leaving homes in which they had food which they will be unable to bring with them to cook)

TOTAL ESTIMATED RELOCATION COST:
= $696,750

Assumptions:
The goal of course is to negotiate a rate much lower than $115 per night but this is the standard rate and so it was used.
We estimate 600 residential remediation projects, but not all may need to be relocated. A

Other Activity in Developing Relocation Program:
I have asked Edith to create a chart with hotels in the following cities:
Lumberport
Clarksburg
Meadowbrook
Hepzibah
Shinnston
Lambert Run
Arlington

I will be contacting all of these hotels to negotiate rates and may send some WV office folks to check on the quality of the hotels.

Thanks,

Diandra S. "Fu" Debrosse
Shareholder

Melissa Cooper

From:	Mike Jacks
Sent:	Wednesday, March 14, 2012 1:42 PM
To:	Ed Gentle (escrowagen@aol.com)
Cc:	Melissa Cooper
Subject:	Calculation of post remediation sampling and inconvenience payment reserves
Attachments:	Memorandum - Calculation of post remediation sampling and inconvenience payment reserves 3-14-12 MAJ.pdf

Ed,

Please see the attached memorandum as to the calculation of post remediation sampling and inconvenience payment reserves.

Michael Jacks, Esq.
Gentle Turner & Sexton
P.O. Box 257
Spelter WV 26438

Office Phone 304-622-7443
Office Fax 304-622-7447
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mjacks@gtandslaw.com



GENTLE TURNER & SEXTON
ATTORNEYS & COUNSELORS AT LAW

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MEMORANDUM

TO: Edgar C. Gentle, Esq.

FROM: Michael A. Jacks, Esq.

DATE: March 14, 2012

RE: Perrine DuPont Settlement; Our File No. 4609-1 {C; DD-10; DD-14}
Sampling and Inconvenience Payment Costs to Date; Necessary Reserves

---

This memorandum provides a summary of sampling and inconvenience payments made to date by the Settlement. This memorandum also suggests amounts to set aside as reserves for completion of post-remediation sampling and payment of the remaining amounts owed to claimants as inconvenience payments. Based on the following analysis, I believe we should reserve $400,000.00 for post remediation sampling and $1,600,000.00 for the remaining annoyance and inconvenience payments.

I have reviewed all nine invoices submitted by CORE and tables for each invoice are attached. The total amount invoiced by CORE to the Settlement to date is $273,628.17. This amount reflects start-up costs like Quality Assurance Plan Development and the performance bond, as well as sampling and laboratory analysis for 854 houses and 224 soil properties. There are still a few properties that have been sampled but not invoiced, and a few more that will be sampled. I predict, conservatively, that no more than 1000 houses and 240 soil properties will be admitted to the program and sampled, pre-remediation.

Since we are currently projecting remediation of 600 houses and 160 soil properties, the amount of $273,628.17 (which coves 854 houses and 224 soil properties) would appear

to be more than enough to cover our post-remediation sampling costs, because we will only conduct post-remediation sampling on properties that we remediate.

Even if we open remediation to every house and property that we have sampled, we may not remediate to the RFP estimates (600 houses and 160 soil properties) because many claimants may choose not to participate. To be safe, I recommend that we reserve $400,000.00 for post-remediation sampling costs, which I believe would be a very conservative, probably excessive, amount.

I spoke with Stephen Creed about the amount of annoyance and inconvenience payments issued to date. Mr. Creed ran reports through QuickBooks for the amounts issued, which included checks that had been voided and returned, because those amounts have not removed from his records at this time. The total amount issued for house payments, as of March 13, 2012, was $94,940.00. The total amount for soil payments was $217,600.00. I believe these numbers are slightly high, because some of the checks that were issued and included in the reports have been returned, voided, or not cashed.

To estimate our house inconvenience payment reserve, I calculate that no more than 1,000 houses will ultimately be eligible for the program and receive a payment. Since each house represents a $500 obligation to the Settlement, the total potential outlay is $500,000.00. We have already issued $94,940.00 of that amount. Accordingly, it appears that our reserve for house inconvenience payments should be approximately $400,000.00.

For our soil inconvenience payment reserve, we must remember that the Upper B. Street property owners have not received any soil payments, but have already received house payments, where warranted. We have approved and sampled 18 Upper B. Street properties to date, and the maximum number that could be approved and added to the soil

remediation program is 24. Accordingly, at $5,000.00 per property, their inclusion in the Program would result in a maximum obligation of $120,000.00 for soil inconvenience payments.

The soil property owners that are already eligible have received $217,600.00 to date. Since that amount is 20% of the ultimate payment we are obligated to provide, we are currently obligated to pay $870,400.00 (217,600 x 5 = 1,088,000.00 minus 217,600.00 already paid). There may be additional 1A soil properties approved, which would result in their owners being owned $5,000 each, but I cannot see more than 10-20 additional properties being approved at this time.

Therefore, I think our soil inconvenience payment reserve should be $1,200,000.00. Even if 20 additional 1A properties are approved ($100,000.00), the 24 Upper B. Street properties are all approved and included in the soil clean-up program ($120,000.00), and all of the property owners we have currently approved participate in the program ($870,400.00), I think this amount will pay these obligations and provide a safe cushion of approximately an additional $109,600.00.

Accordingly, I think a reasonable reserve for post-remediation sampling is $400,000.00 (assuming that CORE agrees to provide the same services at the same rates). I think a reasonable inconvenience payment reserve is $400,000.00 for house payments and 1,200,000.00 for soil payments, for a total of $1,600,000.00.

Therefore, $2,000,000.00 should cover both obligations.

3/14/2012		CORE	Invoice	Summary	Tables	
Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
1 (CORE Invoice 1070140)	Weeks 1 + 2 (October through Nov. 12, 2011)	Quality Assurance Plan Development and Health & Safety Plan Development	1	2,420.00		
		House Sampling	89 houses x $80.75 per house	7,186.75		
		Soil Sampling	96 properties x $204.57 per property	19,638.72		
		Bond	1	12,000		
		Invoice Total			$41,245.47	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
2 (CORE Invoice 10760)	Weeks 3 + 4 (November 13-24)	House Sampling	70 Houses x $80.75 per house	5652.5		
		Soil Sampling	85 properties x $204.57 per property	17,388.45		
		Invoice Total			23,040.95	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
3 (CORE Invoice 10891)	Weeks 5 + 6 (Nov. 27 to Dec. 10)	House Sampling	56 Houses x $80.75 per house	4,522.00		
		Soil Sampling	21 properties x $204.57 per property	4,295.97		
		Per House Lab Dust Analysis (6 samples per house on average)	215 Houses x $156 per house	33,540.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	202 properties x $50 per property	10,100		
		Invoice Total			52,457.97	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
4 (CORE Invoice 10932)	Weeks 7 + 8 (Dec. 11 - 24)	House Sampling	89 Houses x $80.75 per house	7,186.75		
		Soil Sampling	7 properties x $204.57 per property	1,431.99		
		Per House Lab Dust Analysis (6 samples per house on average)	89 Houses x $156 per house	13,884.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	7 properties x $50 per property	350		
		Invoice Total			22,852.74	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
5 (CORE Invoice 11070)	Weeks 9 + 10 (Dec. 25 - Jan. 7, 2012)	House Sampling	144 Houses x $80.75 per house	11,628.00		
		Soil Sampling	0 properties x $204.57 per property	0.00		
		Per House Lab Dust Analysis (6 samples per house on average)	144 Houses x $156 per house	22,464.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	0 properties x $50 per property	0		
		Invoice Total			34,092.00	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
6 (CORE Invoice 11101)	Weeks 11 + 12 (Jan. 8-21 2012)	House Sampling	156 Houses x $80.75 per house	12,597.00		
		Soil Sampling	8 properties x $204.57 per property	1,636.56		
		Per House Lab Dust Analysis (6 samples per house on average)	156 Houses x $156 per house	24,336.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	8 properties x $50 per property	400		
		Invoice Total			38,969.56	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
7 (CORE Invoice 11160)	Weeks 13 + 14 (Jan. 22, 2012 to Feb. 4)	House Sampling	130 Houses x $80.75 per house	10,497.5		
		Soil Sampling	5 properties x $204.57 per property	1,022.85		
		Per House Lab Dust Analysis (6 samples per house on average)	130 Houses x $156 per house	20,280.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	5 properties x $50 per property	250		
		Invoice Total			32,050.35	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
8 (CORE Invoice 11244)	Weeks 15 + 16 (Feb. 5-18, 2012)	House Sampling	95 Houses x $80.75 per house	7,671.25		
		Soil Sampling	0 properties x $204.57 per property	0.00		
		Per House Lab Dust Analysis (6 samples per house on average)	95 Houses x $156 per house	14,820.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	0 properties x $50 per property	0		
		Invoice Total			22,491.25	

Invoice	Weeks/ Dates Covered	Items Charged	Quantity	Amount	Invoice Total	
9 (CORE Invoice 11320)	Weeks 17 + 18 (Feb. 19 to March 3, 2012)	House Sampling	25 Houses x $80.75 per house	2,018.75		
		Soil Sampling	2 properties x $204.57 per property	409.19		
		Per House Lab Dust Analysis (6 samples per house on average)	25 Houses x $156 per house	3,900.00		
		Per Soil Property Lab Analysis (2 samples per soil property on average)	2 properties x $50 per property	100		
		Invoice Total			6,427.89	

	Summary of All Invoices			Total Dollar Amount of All Invoices	273,628.18	
			Total Houses Sampled, Per		854	
			Total House Laboratory		224	
			Total Soil Properties Sampled,		224	
			Total Soil Property Laboratory		854	

EXHIBIT E

PERRINE DUPONT SETTLEMENT
SPELTER VOLUNTEER FIRE DEPARTMENT CLAIMS OFFICE
55 B. STREET
P.O. BOX 257
SPELTER, WV 26438
304-622-7443
Fax: 304-622-7447
1-800-345-0837
www.perrinedupont.com
perrinedupont@gtandslaw.com

April 11, 2012

CONFIDENTIAL
[CLAIMANT NAME]
[CLAIMANT ADDRESS]
[CLAIMANT ADDRESS]

Re: ***Perrine et al. v. DuPont et al.*** **(04-C-296-2) - Property Clean-Up Program (the "Program") - Invitation to May 1 and 2 Property Clean-Up Fairness Hearing, Your Confidential Verified Property Test Results If We Have Them, and Estimated Program Timeline; Our File No. 4609-1 {DD-23}**

Dear Claimant,

The purpose of this letter is three-fold:

1. We invite you to a Fairness Hearing on the implementation of the Property Clean-Up Program, to be held on May 1 and May 2, at the Harrison County Courthouse, where you may voice your opinion to the Court.
2. If your Soil and/or House has been tested, we describe below your confidential verified property test results, and we attach them to this letter if we now have them.
3. To provide you an estimated timeline for the Program.

I.
INVITATION TO MAY 1 AND 2 FAIRNESS HEARING

The Court will hold a two-day Property Clean-Up Program Fairness Hearing on May 1 and 2, 2012, during which any potential Property Class Members ("Claimants") may offer their opinions on the implementation of the Property Clean-Up Program. Here is the Hearing schedule:

DATE	LOCATION	TIME	SUGGESTED CLAIMANTS
Tuesday May 1, 2012	**Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor**	**Register to speak from 9:30 to 10:00am. Hearing begins at 10:00am.**	**Last Names beginning with letters A through L.**
Wednesday May 2, 2012	**Harrison County Courthouse Judge Bedell's Courtroom (Division 2) Fourth Floor**	**Register to speak from 8:30 to 9:00am. Hearing begins at 9:00am.**	**Last Names beginning with letters M through Z.**

A detailed April 9, 2012 Report respecting the Fairness Hearing issues is on our website in the Remediation Program section.

A major issue to be addressed at the Fairness Hearing is the appropriate heavy metal contamination level justifying the clean-up of a property.

Settlement expert, Mr. Richard B. Adams, recommends remediation if one or more of the heavy metal contamination levels exceed these amounts:

	Soil (Zone 1A only)	House (All Zones)
Cadmium	39 ppm	144.65 ug/ft^2
Arsenic	12.5 ppm	35.95 ug/ft^2
Zinc	23,000 ppm	43,695 ug/ft^2
Lead	400 ppm	40 ug/ft^2

II.
VERIFIED TEST RESULTS

A. Your property is in Zone _____ and we (one or more checked)

☐ Sampled House or Commercial Structure

☐ Sampled Soil

☐ Have not sampled your House or Soil (if in Zone 1A) yet

B. We (one checked) if property was sampled

☐ Have your verified confidential test results and they are attached to this letter.

☐ Have not received and/or verified your test results yet.

C. If your test results are provided, according to Mr. Adams' report (one or more checked)

☐ Your House Needs to be cleaned*

☐ Your Soil Needs to be cleaned*

☐ Your House is not contaminated at levels that threaten human health.

☐ Your Soil is not contaminated at levels that threaten human health.

II.
ESTIMATED PROGRAM TIMELINE

Below is an estimated Program timeline (which may change):

April 11, 2012 -	Begin distribution of verified property results that are available. Not all test results are available.
May 1 and 2, 2012 - at 10:00 A.M Each Day	Fairness Hearing
May 15, 2012 -	Clean-Up may begin in Zone 1, including soil in Zone 1A and houses in Zone 1.
June 1, 2012 -	If Judge Bedell approves program, distribution may begin of balance of annoyance and inconvenience payment balances to non-participating claimants (i.e. house does not require clean-up). If your property requires clean-up, you get the balance of the payment only when the clean-up is finished and you sign-off on it.
November 1, 2012 -	Clean-up may begin in Zone 2.
March 1, 2013 -	Clean-up may begin in Zone 3.

* The need to clean the house is based on anticipated long term exposure. It is not a crisis.

Thanks for the opportunity to help administer this Settlement. We look forward to seeing you at the May Fairness Hearing.

Yours very truly,

_____

Ed Gentle
Claims Administrator

_____

Michael Jacks
Settlement Executive Director

EXHIBIT F

EPA United States Environmental Protection Agency | Office of Emergency and Remedial Response | OSWER 9285.7-50 August 2003

Superfund Lead-Contaminated Residential Sites Handbook

Final: August 2003

Prepared by the

Environmental Protection Agency
Lead Sites Workgroup (LSW)

NOTICE

This document has been reviewed in accordance with U.S. EPA policy and is approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation.

DISCLAIMER

This document provides guidance to EPA Regions concerning how the Agency intends to exercise its discretion in implementing one aspect of the CERCLA remedy selection process. The guidance is designed to implement national policy on these issues.

Some of the statutory provisions described in this document contain legally binding requirements. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular remedy selection will be made based on the statute and regulations, and EPA decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate.

Interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation, and the Agency welcomes public input on this document at any time. EPA may change this guidance in the future.

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ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATSDR	Agency for Toxic Substances and Disease Registry
BMPs	Best Management Practices
BRAC	Base Realignment and Closure
CAGs	Community Advisory Groups
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIC/CIS	Community Involvement Coordinator/ Specialist
DOD	Department of Defense
FOSL	Finding of Suitability to Lease
FOST`	Finding of Suitability to Transfer
FP-XRF	Field-Portable X-Ray Fluorescence
HUD	Department of Housing and Urban Development
IC	Institutional Control
LBP	Lead-Based Paint
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
LSCG	Lead Sites Consultation Group
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NLLAP	National Lead Laboratory Accreditation Program
NTCRA	Non-Time-Critical Removal Action
OSWER	EPA Office of Solid Waste and Emergency Response
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RCRA	Resource Conservation and Recovery Act
SEP	Supplemental Environmental Project
TAG	Technical Assistance Grant
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time-Critical Removal Action
TITLE X	Title X of the Housing and Community Development Act of 1992, 42 U.S.C. 4822
TRW	EPA Technical Review Workgroup
TSCA	Toxic Substances Control Act
UAO	Unilateral Administrative Order

1.0 INTRODUCTION

This Superfund Lead-Contaminated Residential Sites Handbook (subsequently called the Handbook) has been developed by the U.S. Environmental Protection Agency (EPA) to promote a nationally consistent decision-making process for assessing and managing risks associated with lead-contaminated residential sites across the country.

The primary audience for this risk management document is Superfund project managers working on the characterization and cleanup of lead-contaminated residential sites; however, Resource Conservation and Recovery Act (RCRA) project managers may also find it useful. This information was developed primarily for EPA staff, but may prove useful to others working on lead-contaminated residential sites, including states, other federal agencies, tribes, local governments, public interest groups, and private industry. While this Handbook is not intended to apply to lead-contaminated commercial or industrial properties, other non-residential areas, or sites with ecological risks, some of the concepts may be useful for such properties. Addressing lead-contaminated properties at federal facilities requires a different approach, and this Handbook provides a special section (Section 8) on addressing this universe of sites.

Generally, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions are undertaken to address a release or threat of release of a hazardous substance such as lead into the environment. Lead contamination found inside homes may be caused by deteriorating lead-based paint (LBP), plumbing, or other sources not resulting from a release into the environment, and therefore may be more appropriately addressed by authorities and programs other than CERCLA (see Appendix A and Section 6.6 of this Handbook). However, it may be appropriate to use CERCLA authorities to conduct sampling and site characterization activities to determine the source of the lead contamination and to differentiate between various site-related sources.

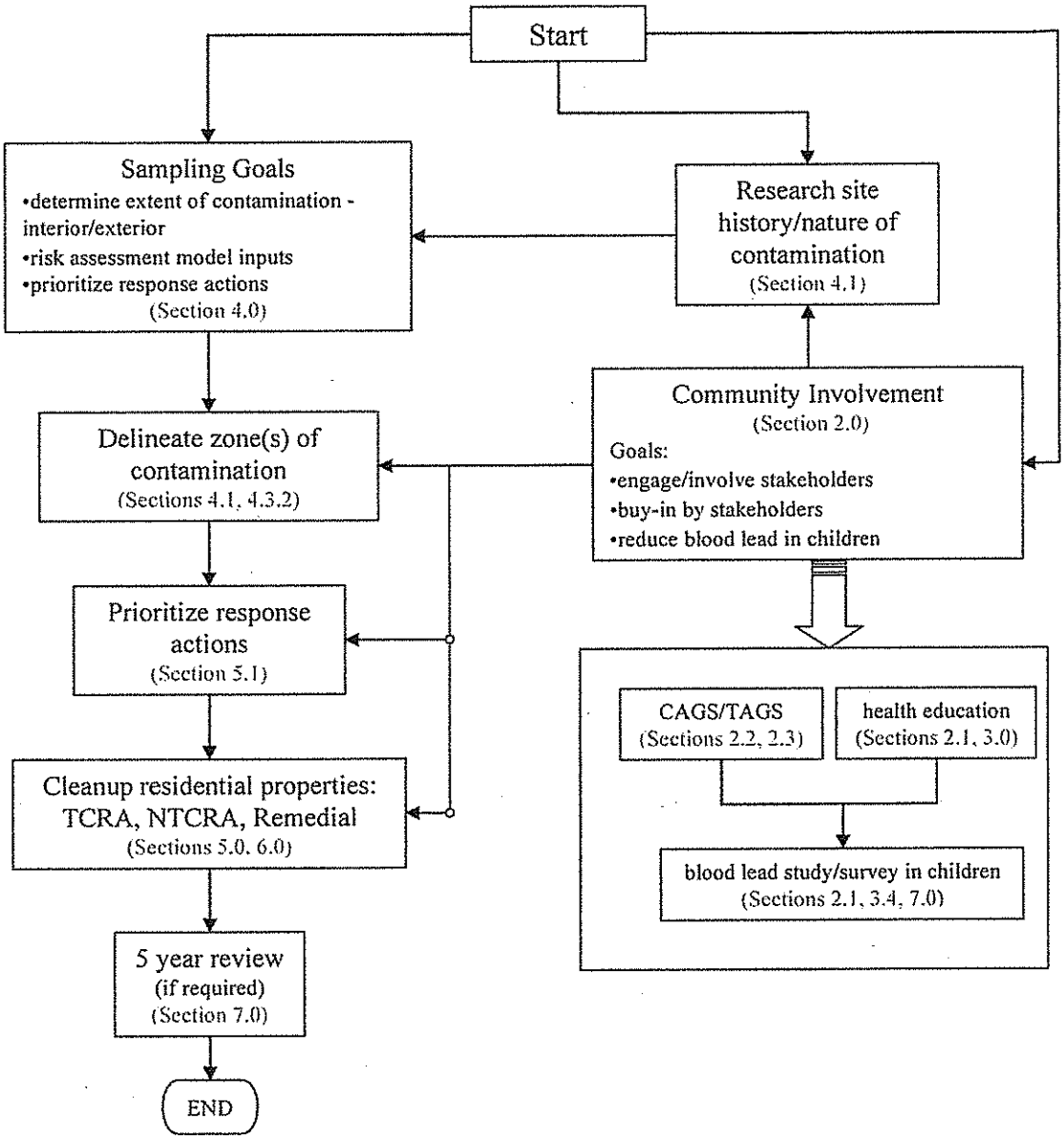
The Handbook lays out only the minimum considerations for addressing lead-contaminated residential sites and encourages users to refer to appropriate agency guidance and/or policy to conduct more stringent investigation and clean-up activities on a site-specific basis, if necessary. In addition, the site manager should determine the applicable and relevant or appropriate requirements (ARARs), including state laws and regulations, that apply to the site. It should also be noted that this Handbook does not, outside the federal facilities universe, apply to lead-contaminated residential sites addressed under Title X (HUD, 1992) procedures.

Lead site characterization and clean-up procedures are unique owing to the ubiquitous nature of lead exposures and the reliance on blood lead concentrations to describe lead exposure and toxicity. Lead

risks are characterized by predicting blood lead levels with computer models and guidance developed by EPA, which are available on the internet: http://www.epa.gov/superfund/programs/lead/products.htm. Major improvements in the removal of lead from gasoline, paint, and food packaging have significantly reduced the incidence of severe lead poisoning. The results of this progress mean that most environmental sources of lead exposure are more likely to cause subtle adverse health effects, primarily behavioral and learning impairments.

An overview to the clean-up process is provided as Figure 1-1. Section numbers are provided in the figure to help the reader locate information within this document.

Figure 1-1. An Overview to the Clean-up Process



1.1 BACKGROUND

Elevated blood lead concentrations in young children in the United States are still prevalent in many areas. Major sources of lead contamination historically included mining and milling sites, primary and secondary smelters, battery manufacturing and recycling facilities, pesticide formulators, pesticide use in orchards, and paint manufacturers (prior to 1978). Many of the source facilities are located near residential areas or have had residential areas develop around them. Fugitive emissions from the facilities have resulted in soil contamination in the yards of residences, which in turn can cause high blood lead levels in children.

Although numerous sites of this type exist, EPA has remediated, or overseen the remediation of, many of these sites and surrounding residences. Many different clean-up methods have been implemented with varying degrees of success. This document is based on the lessons learned from EPA's experience in remediating residential lead sites. It is intended to promote consistency in the characterization and cleanup of lead-contaminated residential sites, while retaining the flexibility needed to respond to different sites and communities to ensure success of the remedy and provide long-term protection of human health. The document also provides guidance on addressing lead sources and media that the Superfund does not usually remediate, such as LBP and lead plumbing. It is anticipated that this information will be periodically updated as we strive to improve our ability to respond to environmental lead hazards.

1.2 GENERAL DISCUSSION ON CERCLA'S APPLICABILITY TO LEAD SITES

This section provides a general discussion of the sections of CERCLA that address lead-contaminated sites. A description of Title X and EPA's Toxic Substances Control Act (TSCA) IV Lead Program is provided in Appendix A. The Title X discussion is provided for informational purposes and is primarily applicable to federal facilities. Section 4.2.5 also provides useful information for LBP and dust sampling.

1.2.1 Background

Historically, the CERCLA has been used as a tool to implement clean-up activities at a large number of sites across the country. CERCLA authorities have been used for cleanups ranging from the removal of drums of hazardous substances from long-abandoned sites, to major privately funded remedial actions at sites on the National Priorities List (NPL).

CERCLA may apply any time there is a release or threatened release of: (1) a hazardous substance into the environment, or (2) a pollutant or contaminant "which may present an imminent and substantial endangerment to the public health or welfare" (EPA, 2000a). The term "release" is defined broadly in the statute and includes discharging or leaking of substances into the environment. This also includes the abandonment of closed containers containing hazardous substances, pollutants, or contaminants.

The definition of hazardous substance is extremely broad, and is defined in CERCLA Section 101(14). A comprehensive list of these substances is provided in 40 CFR 302.4. In addition to general listings for "lead", "lead and compounds", and "lead compounds," the regulation lists fourteen other subcategories of lead.

Additionally, CERCLA is not media-specific. Thus, it may address releases to air, surface water, groundwater, and soils. This multi-media aspect of CERCLA makes it possible to conduct environmental assessments and design clean-up projects that address site contaminants in a comprehensive way.

The Agency has pursued a number of CERCLA response actions involving lead-contaminated soil using the abatement authority under Section 106 (which also requires a showing of imminent and substantial endangerment). CERCLA covers almost every constituent found at mining and mineral processing (primary lead and other metals smelters) sites. Exceptions include petroleum (that is not mixed with a hazardous substance) and, in some cases, responses to releases of a naturally occurring substance in its unaltered form. It should be noted, however, that the latter exception does not include any of the releases typically dealt with at mining sites, such as acid mine drainage, waste rock, or any ore exposed to the elements by man.

1.2.2 Response Authorities

CERCLA's main strength is its response authorities. EPA can either use the Superfund to perform response (removal or remedial) activities (Section 104) or require private parties to perform such activities (Section 106). CERCLA gives EPA the flexibility to clean up sites based upon site-specific circumstances. EPA's clean-up decisions generally are based upon both risk assessment and consideration of ARARs. As long as the jurisdictional prerequisites have been met, CERCLA gives EPA the ability to perform virtually any clean-up activity necessary to protect public health and the environment.

There are potential limitations in CERCLA which may be relevant to lead-contaminated sites. For example, Section 104(a)(3) limits EPA's ability to respond to releases within residential structures as follows:

> "Limitations on Response. The President (EPA) shall not provide for removal or remedial action under this section in response to a release or threat of release . . . from products which are part of the structure of , and result in exposure within, residential buildings or business or community structures . . . "

The above cited section of CERCLA generally limits EPA's authority to respond to LBP inside a structure or house as written in Section 6.6.1 of this Handbook. However as noted in Section 6.6.1 of the Handbook, EPA has the authority to conduct response actions addressing soils contaminated by a release of lead-contaminated paint chips from the exterior of homes to prevent recontamination of soils that have been remediated. In addition, Section 104(a)(4) provides an exception to the limitations in Section 104(a)(3).

CERCLA provides EPA with the authority to perform "removal" and "remedial" actions. Assessments generally are considered "removal" actions and evaluate contaminants of concern, exposure pathways, and potential receptors. The assessment process includes the review of available information, as well as sampling, to obtain other necessary information. The process is broad in its application and is a powerful tool in evaluating environmental risks posed by a site. Removal actions can be performed on mining and mineral processing (primary lead and other metals smelters) sites, and other sites with lead releases to the environment, of any size. Removal actions are subject to limits on time (12 months) and money ($2,000,000) under the statute; however, these limits are subject to exceptions.

Remedial actions are typically long-term responses performed at those sites placed on the NPL. Remedial actions also may be performed at non-NPL sites, through administrative orders on consent (AOCs) or consent decrees, if they are privately financed. Remedial actions are not subject to the time or dollar limitations imposed on removal actions, but require a more detailed and formal decision process.

1.2.3 Applicable or Relevant and Appropriate Requirements (ARARs)

Under Section 121(d) of CERCLA, remedial actions must comply with substantive provisions of federal environmental laws and more stringent, timely identified state environmental or facility siting laws. Removal actions should comply with ARARs to the extent practicable. "Applicable" requirements are those federal or state laws or regulations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. "Relevant and appropriate" requirements are not "applicable," but address problems or situations similar enough to those at the CERCLA site that their use is well suited to the site.

State requirements are not considered ARARs unless they are identified in a timely manner and are more stringent than federal requirements. The recently published TSCA §403 Soil Hazard Rule, which establishes a soil-lead hazard of 400 ppm for bare soil in play areas and 1,200 ppm for bare soil in non-play areas of the yard, should not be treated as an ARAR. As recognized in the TSCA §403 Rule, lead contamination at levels equal to or exceeding the 400 ppm and 1,200 ppm standards may pose serious health risks based upon a site-specific evaluation and may warrant timely response actions. However, the soil-lead hazard levels under the TSCA §403 Rule should not be used to modify approaches to addressing brownfields, NPL sites, state Superfund sites, federal CERCLA removal actions and CERCLA non-NPL facilities.

EPA has published a manual outlining potential federal ARARs that may be requirements at Superfund sites. Published in two parts, the manual is entitled *CERCLA Compliance with Other Laws Manual*, Part I, August 1988, and Part II, August 1989, and is available at EPA libraries (EPA, 1988).

1.3 DEFINITION AND PURPOSE

Residential properties are defined in the Handbook as any area with high accessibility to sensitive populations, and includes properties containing single- and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, community centers, playgrounds, parks, green ways, and any other areas where children may be exposed to site-related contaminated media (EPA, 1996a, 1997a, 1998a). This document defines sensitive populations as young children (those under 7 years of age, who are most vulnerable to lead poisoning) and pregnant women. Focus is put on children less than 7 years old because blood lead levels typically peak in this age range (EPA, 1986, 1990a; CDC, 1991). Unfortunately, this age range is also when children are most vulnerable to adverse cognitive effects of lead (Rodder, 1995). Pregnant women are included due to the effects of lead on the fetus (Gayer, 1990; Graziano et al., 1990; Carbone et al., 1998). Other EPA guidance (EPA, 1995a, 2001b) and local zoning regulations should also be consulted prior to determining which properties will be treated as residential.

Lead-contaminated residential sites are defined, for the purposes of this document, as sites where lead is the primary contaminant of concern in residential soils. Generally, lead-contaminated sites contain other metals of concern, such as cadmium and arsenic. This document, while addressing primarily lead contamination, may also be appropriate for use in the remediation of sites contaminated by other metals. In all cases, looking at the site history (type of lead site, depositional environment for the lead contamination, fill activities, previous epidemiological studies, etc.) is important in the use of the Handbook. Typically, the types of sites addressed by the Handbook are sites where the lead contamination has resulted primarily from primary or secondary lead smelting, battery cracking, or

mining and milling operations. Lead paint and dust, along with other sources of lead and other toxic metals, may also be present at these sites.

The Handbook is primarily based on a compilation of the Superfund program knowledge and experiences, as well as existing technical and scientific literature addressing lead-contaminated residential sites. The Handbook has undergone broad review by the Agency for Toxic Substances and Disease Registry (ATSDR), the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), and national and regional EPA offices. Because the Handbook is written for use by CERCLA program staff, there are frequent references to guidance or other documents developed under the Superfund auspices. The Handbook does not supersede or modify any existing EPA guidance or policy. This guidance does not suggest that CERCLA authorities are to be applied at all lead-contaminated residential sites. Rather, these references are provided to the reader as resources to be considered in developing site characterization and clean-up strategies under whatever regulatory or non-regulatory approach is appropriate at a particular site. However, the NCP should be followed and other applicable guidance consulted when addressing lead-contaminated residential sites under CERCLA. The Handbook does not address ecological risks from lead and lead sites.

2.0 COMMUNITY INVOLVEMENT

The sustainability of a residential clean-up project in many ways is contingent upon support from affected residents, elected officials, local public health agencies, municipal and public works staff, state government personnel, and other stakeholders. Few sites impact more citizens of a community than large residential clean-up projects, with many projects exceeding a thousand homes and several thousand residents. If the residents recognize the risks posed to their community and feel involved in the decision-making process, they are more likely to accept the need for cleanup. House-to-house personal interaction with residents can be useful to learn their concerns (or lack of concerns) and can also be an effective part of educating the public regarding risks posed by the site. The project manager should issue bulletins and/or fact sheets to help keep the community informed of site activities and should consider establishing a toll free number for residents to contact her/him with questions about the site. Likewise, without the support of local governments, portions, if not all, of the selected remedy may be more difficult to implement. Many remedies rely in part on health education and institutional controls (ICs) as part of the actions taken to protect human health, both of which may rely on the active participation of local governments and health departments. The following sub-sections provide information on involving the community.

2.1 EDUCATION ACTIVITIES

This section discusses how to involve the local health departments and community in the education activities and the overall benefits and limitations of health education. Section 3 addresses health education activities in detail.

Several studies have shown that a significant short-term reduction in blood lead concentrations can be achieved through the education of the public on the dangers of lead exposure and on methods they can take to limit their exposure (Kimbrough et al., 1994; Hilts et al., 1998; Schultz et al., 1999). However, EPA does not consider health education, as the only action, to be an effective, permanent remedy for Superfund sites (Appendix B). Often, in-home education activities have been combined with regular house cleaning. One key to begin reduction of elevated blood lead concentrations in children is to initiate health education activities, and where appropriate, blood lead screening, as early as possible in the process. These activities should be started as soon as elevated blood lead levels or elevated soil levels are detected at a site. Education should be sustained throughout the project. If residual contamination, such as encapsulated wastes, LBP, or other such potential sources are left on site after completion of the remedy, then education activities should be sustained in perpetuity.

Generally, EPA does not directly conduct the majority of education activities. One of the responsibilities of the project manager is to educate the community on the risks of lead exposure and to coordinate with various health agencies in establishing lead education programs. These programs are often implemented by local health districts that, in turn, typically coordinate with schools and other community groups working with families and children. Initial tasks include educating the community regarding their lead exposure and associated health risks. Typically, a significant amount of effort will be required to explain the rationale and procedures of the EPA risk assessment method for lead, using the Integrated Exposure Uptake Biokinetic Model (IEUBK), and the need to collect data to estimate site-specific values for model parameters. It is advisable to obtain input on exposure parameters specific to the community (e.g., how often they frequent locations that are not residential). Community input into the risk assessment is not relevant to those parameters that require site-specific studies to generate empirical data (e.g., an animal feeding study to determine bioavailability). Often, local health officials will be unfamiliar with EPA's risk assessment process and will benefit from education along with the general public. The need for community education is heightened by the subtle nature of the low-dose adverse health effects of lead, which cannot be diagnosed in an individual because the scientific basis for cognitive impairments caused by low to moderate exposures relies on carefully controlled comparisons of large numbers of children exhibiting a range of blood lead levels (NRC, 1993; Needleman and Bellinger, 2001). Once the public and local health officials are made aware of the potential risks presented by the site, specific programs, discussed in detail in Section 3 (Health Education), can be implemented. Education and clean-up activities should be easier to implement, more effective, and more widely accepted by the community when the citizens understand the risks and believe that the community is at risk.

> Integrated Exposure Uptake Biokinetic Model (IEUBK) – Predicts blood-lead concentrations (PbBs) for an individual child, or group of similarly exposed children (6 months to 7 years old), who are exposed to lead in the environment. More information is available from the Technical Review Workgroup for Lead (TRW) web site: http://www.epa.gov/superfund/programs/lead/ieubk.htm

2.2 COMMUNITY ADVISORY GROUPS

Community Advisory Groups (CAGs) can be invaluable in assuring the success of the project (EPA, 1995b). A supporting and active CAG, comprised of a wide cross section of the community, has been demonstrated on several projects to greatly contribute to the success of meeting the remedial goal. Establishing an open dialogue with the CAG

> Community Advisory Group (CAG) – Members of the community make up a CAG, which serves as the focal point for the exchange of information among the local community, EPA, the state regulatory agency, and other pertinent federal agencies involved in cleanup of the Superfund site. Additional information is available online: http://www.epa.gov/superfund/tools/cag/index.htm

and understanding and addressing its concerns, leads to increased satisfaction in the community at the completion of the project. Concurrent with the establishment of health education activities, formation of citizens groups should be encouraged at the very onset of the project. Delay in forming the groups until significant progress has occurred may lead to mistrust by the community, as well as delay or loss of the valuable contributions they can make in assisting EPA.

Citizens groups should be representative of the community. Examples include residents, workers, and business owners from affected neighborhoods, as well as minority leaders, realtors, bankers or lending institution officers, school board members, health officials, elected officials, city public works staff, local environmental group members, and other groups in the community. Additionally, the project manager should coordinate with other federal and state agencies to attend citizen group meetings. Relevant agencies may include the ATSDR, HUD, and state health and environmental departments.

Citizens groups can create a feeling of ownership that facilitates the long-term success of the remedy. They can contribute significantly to education activities in numerous ways. A few examples of the successful programs and activities accomplished by citizens groups at sites include: general education and awareness of the segment of the community they individually represent; creating site-specific education material such as coloring/story books; hosting health fairs; creating health education programs for local school districts; establishing lead poisoning prevention merit badges for girl and boy scout organizations; developing instructional videos; and establishing pre- and post-natal education programs at local hospitals.

2.3 EPA'S TECHNICAL ASSISTANCE GRANT PROGRAM

EPA provides assistance grants to communities to help citizens understand site-related information. By regulation, EPA must inform communities about the availability of Technical Assistance Grants (TAGs) and assist them in applying for these grants (EPA, 1992). EPA also informs citizens about obtaining assistance through other programs such as the university-based Technical Outreach Services for Communities program and the Department of Defense's Technical Assistance for Public Participation (TAPP) program.

Under the TAG program, initial grants of up to $50,000 are available to qualified groups affected by a response action. Additional funding is available for unusually large or complex sites. A group applying for a TAG need not be incorporated as a non-profit organization at the time it submits its application, but must incorporate as a non-profit organization before EPA can award the grant.

The group must contribute 20 percent of the total project costs to be supported by the TAG grant. This requirement can be met in a number of ways, including with cash, donated supplies, and volunteered services. TAG groups must prepare a budget and work plan for using the funds. There may be only one TAG award per NPL site. If more than one group applies for the same TAG, they are encouraged to form a coalition to apply for the grant.

TAGs are used to hire a technical advisor, who is an independent expert who can review site-related documents, interpret them, and explain technical or health-related information to community members. A TAG advisor will often make site visits to gain a better understanding of the clean-up activities. A technical advisor can also help communicate the community's concerns to EPA. TAG funds may not be used to generate new data (e.g., to conduct additional sampling) or for lawsuits or other legal actions. For further information on TAGs, see the recently revised TAG regulation (EPA, 2000b), which is available from the EPA TAG web site.

2.4 INFORMATIONAL MEETINGS

As important as the health education activities and the establishment of citizens groups are, the project manager should consider holding frequent public meetings to inform the community of current and planned EPA activities and to collect feedback and concerns from citizens. If a CAG has been formed at the site, meetings with the group should be frequent and open to the general public. It is recommended that in the early phases of the project, information sessions should be held at least monthly. Once the community becomes aware of the site risks, current site activities, and becomes relatively involved in the process, the frequency of the meetings can be reduced. However, it is recommended that public informational meetings, separate from the citizens task force meetings, be conducted at least once every six months. This frequency can help ensure that the public stays informed of site progress and has an opportunity to provide meaningful input to the process.

In addition to the meetings pursuant to CERCLA (e.g., prior to release of the Record of Decision) meetings are helpful at the following points in the process: (1) before sampling is conducted, to explain the reason that lead contamination is suspected, how residents can reduce exposure as a safety precaution while awaiting sampling results, and the overall goals of the project (e.g., if the goal of the project is to reduce exposure by remediating only surface soils and therefore the sampling is designed to evaluate only surface soils, the issue of ICs for any contaminated soils remaining at depth should be discussed with the property owners early in the process); (2) after sampling is conducted, to explain results, reiterate how residents can reduce exposure (if results show elevated levels), explain plans and the schedule for conducting remediation, discuss plans for re-landscaping the property, and discuss what sort of ICs may be appropriate; and (3) after remediation is completed, to explain what was done, provide documentation

of the results of the remediation, discuss any problems with the landscaping, and discuss any applicable ICs.

2.5 COMMUNITY INVOLVEMENT SPECIALIST/COORDINATOR

When the site is large and cleanup is expected to last several years, consideration should be given to housing a full time community involvement specialist/coordinator (CIS/CIC) at the site. The roles of the CIS/CIC are (1) to coordinate community involvement activities, and (2) to be readily accessible to the public to provide information and answer questions concerning site activities. The CIS/CIC should be intimately familiar with all activities at the site, as well as the documented health risks, and should maintain an office with business hours convenient to the public. Additionally, the CIS/CIC can use information gained from their constant contact with the local community to brief project staff on issues important to the successful remediation of the site.

> Community Involvement Specialist/ Coordinator - is the primary point of contact for a community and a Community Advisory Group (CAG), if one was formed for the site. He or she answers questions and provides other assistance directly as well as sees that a CAG's concerns and other issues are transmitted to other Regional Office staff who can help.

3.0 HEALTH EDUCATION

Health education provides information to the public about the risks associated with exposure to contamination and, in turn, how to reduce the exposures. Health education may be considered one of many tools the project manager can use at lead-contaminated sites to reduce exposure to humans.

3.1 APPROPRIATE USES FOR HEALTH EDUCATION

Health education is an informational device and this type of instrument is largely unenforceable. Furthermore, health education has not been demonstrated to be effective over the longer term. Health education may be effective when combined with other measures as an overall remedy for a site. Health education is not a stand-alone remedy. EPA's policy is that health education is only appropriate as a supplemental component of the permanent, health protective remedy selected at a contaminated lead site.

For these reasons, EPA advocates that health education be layered or implemented in series with ICs and engineered remedies. Layering means using different types of ICs and engineered remedies at the same time to enhance the protectiveness of the remedy. Using ICs in series is the use of ICs at different points in the investigation and remediation process to ensure the short- and long-term protection of human health and the environment.

3.2 PLANNING FOR HEALTH EDUCATION

Generally, the specific goals of the health education program should be described in a site-specific decision document. A plan that clearly defines the goals and how they should be achieved is also more likely to succeed. Health education at large lead sites may have a performance period of several years and cost hundreds of thousands of dollars. For these large projects, a clearly defined health education program is even more important.

An early step in any health education planning process includes conducting a community profile and assessing the educational needs of the community. A comprehensive health education program for a typical large lead site would normally attempt to focus on reaching the general public, with special emphasis on schools and other groups involved with young children. Also, it is important to coordinate with city, county, and other local governmental entities. The most important target population, though, is parents, particularly young parents, and parents with a child whose blood lead tested high. Other means of targeted education may include those homes with children that have high dust lead concentrations or lead loadings, which have been shown to be highly predictive of homes where a child is likely to have an elevated blood lead level during the summer peak (EPA, 1996b; von Lindern and Spalinger, 2001).

The response plan should describe what actions and activities are necessary to reach the community-at-large and the targeted groups. It is very important to consider that there are costs associated with the development, implementation, and follow up of health education and that these factors should be thoroughly understood and estimated. Other key points to consider are that the responsibilities for conducting this work should be clear and agreements should be made in writing in the planning stages of site response process.

3.3 Evaluation of Health Education Activities

It is important to monitor the effectiveness of health education projects that have been implemented at lead-contaminated sites. Many sites may include health education activities as a major component of the remedy, especially in the early phases of the cleanup. Failure to establish the education part of the remedy may trigger reconsideration and imposition of additional requirements, or more extensive and costly clean-up efforts.

The project manager should monitor the organization(s) performing the educational activities for proper implementation of the health education program and assess the effectiveness of the program. Project managers should ensure that the objectives of the program are being met to protect children's health. If health education is included as part of the final remedy, it should be carefully scrutinized during the Five-Year Review process.

3.4 Agency for Toxic Substances and Disease Registry (ATSDR) Involvement

Health education is often implemented through grants from ATSDR to its partners in state health departments or directly through agreements with local health departments. When health education is specified as a major part of EPA's clean-up activities, strong consideration should be given to establishing an interagency agreement with ATSDR to assist in funding the required activities. ATSDR as a federal health agency is well positioned in terms of health education resources to administer such grants. ATSDR can provide expertise not only with the CAGs but also with public health assessments, health consultations, and health surveillance. An emphasis should be placed on developing the collaborative partnerships between EPA, ATSDR, and other federal, state, and local health departments for health education activities at contaminated lead sites.

Health education at lead sites is often accompanied with blood lead screening. Centers for Disease Control and Prevention (CDC) has issued guidelines for increasing intensity of health intervention activities based on blood lead test results (CDC, 1991). Increased collaboration among the involved

agencies is important to properly implement a health education/blood lead screening project. Additionally, ATSDR and many state and local health departments have ongoing lead screening and health education programs. Information from targeted screening is valuable for (1) targeting follow-up education to individual families with children identified with elevated blood lead levels; (2) determining the areal and demographic extent of the problem; and (3) effectively evaluating the impact of health education.

3.5 OUTREACH

EPA has had success in health education activities at several sites because the programs were tailored specifically for the site by the site team (i.e., project manager, toxicologist, on-scene coordinator, CIS/CIC, etc.). These programs have included significant amounts of outreach activities in the communities. The success of any health education program generally can be attributed to the amount of community outreach that is conducted at the site. As discussed in Section 2, the outreach can consist of a wide variety of activities. A few examples include the following: site specific coloring books distributed to the parents of young children, scouting merit badges on lead-poisoning prevention, school curriculums developed to inform student of the hazards of lead and good hygiene, health and environmental fairs conducted in the community, and blood lead testing events held at community celebrations. Consultation with local health officials and community groups can provide numerous ideas for outreach, which can be incorporated into specific programs to best meet the needs of the community. Typically, the local health officials should lead the outreach efforts. Funding should be provided by EPA when other funds, such as from ATSDR, are unavailable to support the outreach activities.

4.0 SITE CHARACTERIZATION

EPA has reviewed various sampling designs historically employed at lead-contaminated residential sites and assessed the ability of these sampling designs to meet risk assessment needs and support the development of clean-up levels. Over a 20-year period, several large area lead sites (e.g., Bunker Hill, Shoshone County, Idaho; Joplin, Missouri; NL Industries/Taracorp-Granite City, Illinois; Tar Creek, Ottawa County, Oklahoma) have used a variety of sampling techniques to characterize residential properties. Additionally, many different approaches to applying selected clean-up levels have been taken. As stated, this document was developed to promote consistent procedures, criteria and goals in the investigation and clean-up activities at Superfund lead-contaminated residential sites. However, a level of flexibility is needed to best respond to different site conditions, communities, and uncertainties.

The overall goals of the sampling effort are to estimate an average soil lead concentration for risk assessment purposes and to provide information to determine the scope of any required clean-up actions. This information can also be used for public education and intervention. The sampling designs discussed in this section are intended to provide, within one sampling effort, the necessary data for all phases of a clean-up project so that residents are not inconvenienced by repeated sampling of the same property. Project managers should carefully choose the sampling points needed to estimate the average lead concentration in a cost-effective manner. Some uncertainty is acceptable to reduce the overall cost of sampling at large lead sites. The selection of sample locations within areas with potential for exposure has been the subject of recent articles which describe methods to manage decision uncertainty by balancing sampling and clean-up costs (Englund & Heravi, 1994; Crumbling et al., 2001). Table C-1 (Appendix C) lists contacts within the agency who can provide assistance in various aspects of sample planning and design, and also lists software that may be used for sample planning and decision support.

Section 4.0 discusses: (1) delineating the contamination zones; (2) residential property sampling locations; (3) sampling method; (4) sampling requirements for backfill material and excavated soil for off-site disposal.

4.1 CONTAMINANT ZONE DELINEATION

Historical information on site operations and use is crucial for the design of sampling plans that are intended to delineate contaminant zone(s), and for the interpretation of data generated from the sampling effort. In addition to gathering data on the nature of the source of contamination, information should be gathered to identify areas where soils may have been moved or where fill or topsoil may have been placed. Guidance on how to gather historical site data is available (EPA, 2001f, 2001g). Sites that have been contaminated primarily by airborne-derived lead, such as smelter areas, can initially be sampled in a

grid pattern. This will usually allow concentration contours to be defined across the community and to establish the extent of horizontal contamination for cleanup and costing purposes. If grid sampling is used for initial characterization to define the horizontal extent of contamination, follow-up sampling of each yard located within the identified clean-up zone should be used to characterize each individual property for clean-up requirements. For other sites where the variability is expected to be higher, such as mining sites with discrete individual tailings piles located throughout the area, delineating the contaminant zones by establishing concentration contours will be more uncertain and consideration should be given to sampling every home in the potentially affected area, moving laterally away from the source until clean areas of the community have been identified.

Delineating the zone of contamination generally amounts to distinguishing soil with "background" lead concentration from soil that has been impacted by site-related activities. There are basically two types of background: naturally occurring and anthropogenic (see insert for definitions) (EPA, 1989, 1995c, 2002). EPA guidance defines background for inorganics as *"...the concentration of inorganics found in soils or sediments surrounding a waste site, but which are not influenced by site activities or releases"* (EPA, 1995c). Natural background concentrations of lead vary widely with the local geology, and can be as high as 250 ppm or more in mining areas (SRC, 1999). Local background concentrations, which include natural and non-site-related anthropogenic sources (e.g., historic automobile emissions) can be substantially higher. Background samples should be collected from areas near the site that are not influenced by site contamination, but that have the same basic characteristics (e.g., soil type, land use).

Types of Background

naturally occurring: ambient concentrations of lead present in the environment that have not been influenced by humans

anthropogenic: lead concentrations that are present in the environment due to human-made, non-site sources (e.g., automobile exhaust)

Statistical approaches to delineating contaminant zones are useful for some sites. In these cases, the project manager should consult with a statistician to design an efficient sampling plan. The Agency is developing guidance on characterizing background chemicals in soil that includes statistical methods for delineating contaminated areas (EPA, 2001i). Geostatistics is widely recognized for offering graphical methods that are ideally suited for delineating contaminant zones (Gilbert and Simpson, 1983; Flatman and Yfantis, 1984; Journel, 1984; Englund and Heravi, 1994; Goovaerts, 1997). Geostatistics also provides powerful methods for detecting contaminated areas from background when sample locations have not been randomly selected (e.g., Quimby, 1986; Borgman and Quimby, 1996), for sampling plan design (e.g., Flatman and Yfantis, 1984; Borgman et al., 1996), and for aiding in the design of remedial

responses (e.g., Ryti, 1993). For smaller sites, rigorous statistical analyses may be unnecessary because site-related and non-site-related contamination clearly differ. For these sites, the sampling plan should focus on establishing a reliable representation of the extent (in two or three dimensions) of a contaminated area (EPA, 1989) .

4.2 RESIDENTIAL PROPERTIES

For the purposes of this document, a residential property includes properties that contain single and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, playgrounds, parks, and green ways (EPA, 1996a, 1997a). In all cases, historical site information (type of lead site, fill activities, previous epidemiological studies, etc.) is important in the application of this Handbook.

Rationale for collecting yard soil samples and water samples on a residential property is provided in Table 4-1. The collection of other types of media are important to determine overall risk, however CERCLA has limited authority to address these media (e.g., interior paint, dust, and potable water).

4.2.1 Sampling Access

Prior to conducting any sampling or clean-up activities at a residential property, access must be obtained from the property owner; access obtained from tenants or renters is not sufficient. It is essential to begin access procurement as early as possible in the remedial process to avoid potentially lengthy delays. It is recommended that access be obtained by going door-to-door. If residents are not home, a blank access agreement with instructions for signature and submission to EPA, along with relevant contact information should be left at the residence (but not in the mailbox). Examples of access agreements are presented in Appendix D, pages D-2 and D-3. If possible, access for remediation should be obtained at the same time access for sampling is sought. Examples of combined sampling/remediation access agreements are included on pages D-4 and D-5 of Appendix D. Combining sampling and clean-up access will avoid potentially lengthy delays. Additionally, access should be obtained for any interior dust sampling and/or cleaning that will be performed at the residence (Section 6.6.2). Sample access agreements for dust cleanup are presented in Appendix E.

Table 4-1.
Rationale for Sampling Residential Properties

Sample Location	Rationale for Sample Collection
Residential yard soils	Residential soil may present a direct exposure pathway to persons working, playing, or conducting other recreational activities on the property. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Residential soils may also present an indirect exposure pathway via house dust exposure (see below).
Gravel driveways	Fine-grained driveway material may present a direct exposure pathway to persons working or engaged in recreational activities on driveways. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Gravel driveways with elevated soil concentrations may also contribute to the transport of contaminants throughout the community.
Drip zones and soils below roof gutter downspouts	Rooftops may collect fine-grained sediments that contain high concentrations of lead. In yard areas where downspouts discharge during a storm event, the fine-grained material washed from a roof may accumulate and result in a localized increase in soil lead concentrations. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Drip zone areas may also contain LBP influences and are important to characterize for health intervention purposes, as drip zones are often used as play areas.
Soils in play areas	Play area soils may present a direct exposure pathway to children under the age of seven. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations.
Garden soils	Garden soils may present a direct exposure pathway to persons who actively maintain a garden. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations.
Interior lead dust	Lead in household dust may be a significant contributor to elevated blood lead levels, especially in younger children. Dust samples should be collected and quantitatively analyzed to estimate lead concentrations. Lead-contaminated interior dust can be derived from multiple sources; dust mat samples and speciation can be used to identify lead sources.
Lead-based paint	Deteriorating LBP may contribute lead to household dust, which can be a significant source of lead exposure, particularly for young children. If elevated concentrations of lead are found in interior dust, samples of interior paint should be collected and quantitatively analyzed to estimate lead concentrations. Exterior LBP may contribute to the recontamination of remediated properties. Samples of exterior LBP should be collected and quantitatively analyzed to estimate lead concentrations.
First run and purged tap water	Groundwater and surface water near the site may contain elevated lead concentrations. Some residences located within the site may use local groundwater or nearby surface water as a source of drinking, cooking, bathing, or irrigation water. The water may represent a direct exposure or ingestion pathway. Samples of both water standing in the pipes (first run sample) and water discharged after the system has been flushed (purged sample) should be collected and quantitatively analyzed to estimate lead concentrations. These results can also be used to help determine if the drinking water is contaminated with site-related contamination (exceedance in purged), or to determine if there is lead in the home's plumbing (exceedance in first run), or both, which may be used for remediation or intervention purposes, respectively.
Crawl Spaces	Crawl space sampling is recommended if the crawl space is accessible to children or pets. At some sites (e.g., Bunker Hill) this has been found to be a significant pathway (IDHW, 2000; TerraGraphics, 2000). Even when spaces are too small for children, pets have been found to access these spaces and move significant amounts of fine dust containing elevated lead levels into the child's bedroom (e.g., where a pet may sleep on the child's bed at night). Information on concentrations of lead beneath the structure may be used to document the need to preclude access or take other remedial measures.
Other areas	During field work, other potential sources of lead contamination may be identified. If the sources appear to represent a potential exposure pathway to occupants of a residence, sampling may be recommended. Other areas should be evaluated on a case-by-case basis and could include sediment, surface water, or secondary play areas. If deemed appropriate, samples should be collected and quantitatively analyzed to estimate lead concentrations.

4.2.2 Residential Yards

It is recommended that when sampling residential lots with a total surface area less than 5,000 square feet (a typical urban lot size), five-point composite samples should, at a minimum, be collected from each of the following locations: the front yard, the back yard, and the side yard (if the size of the latter is substantial). The front, back, and side (if needed) yard composites should be equally spaced within the respective portion of the yard, and should be outside of the drip zone and away from influences of any other painted surfaces (Figures 4-1a and 4-1b). Composites should consist of aliquots collected from the same depth interval.

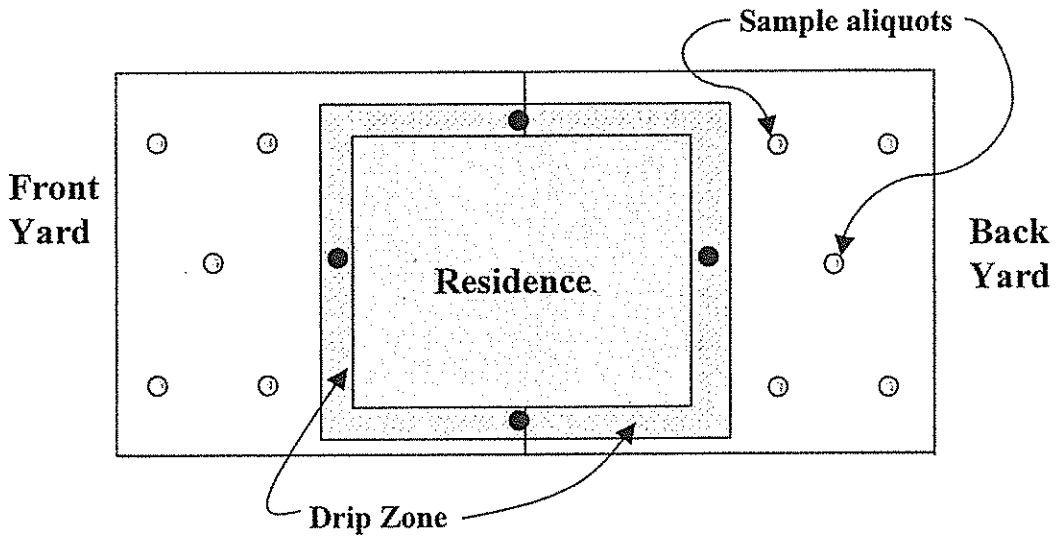


Figure 4-1a. Recommended minimum soil sampling in yards less than or equal to 5,000 square feet with small side yard. Five point composite samples should be collected from each of the front and back yards. Four point composites should be collected from the drip zone; each aliquot should generally be collected from the midpoint along each side of the residence. Aliquots for a single composite sample should be collected from the same depth interval. Soil samples should also be collected from distinct play areas and gardens if they are present, as well as unpaved driveways and minimal use areas such as areas under porches and crawl spaces. The locations of the aliquots should be equally spaced within the area of the yard the composite is collected from. The figure illustrates one possible arrangement of the sample aliquots. Please refer to Section 4.2.2 for further explanation.

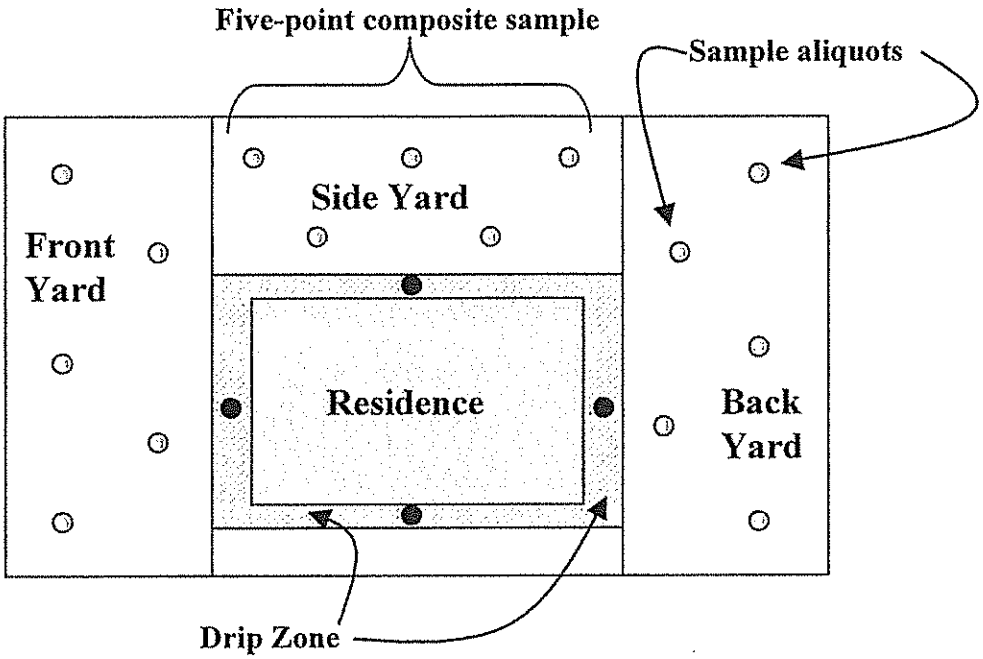


Figure 4-1b. Recommended minimum soil sampling in yards less than or equal to 5,000 square feet with substantial side yard. Five point composite samples should be collected from each of the front, back, and side yards, along with other areas as described in Figure 4-1a. The locations of the aliquots should be equally spaced within the area of the yard the composite is collected from. The figure illustrates one possible arrangement of the sample aliquots Aliquots for a single composite sample should be collected from the same depth interval. Please refer to Section 4.2.2 for further explanation.

For residential lots with a total surface area greater than 5,000 square feet, it is advisable that the property be divided into four quadrants of roughly equal surface area. The two quadrants in the front yard should encompass one half of the side yard; likewise for the two quadrants in the back yard. One five-point composite of aliquots collected at equal spacing and from the same depth interval should be obtained from each quadrant. Each aliquot should be collected away from influences of the drip zone and any other painted surfaces (Figure 4-2).

Properties over one acre in size should be divided into 1/4 acre sections. One five-point composite sample should be collected from each section. For large properties, consideration should be given to whether elevated concentrations trigger partial removal of soils or access restriction (see Section 6.5).

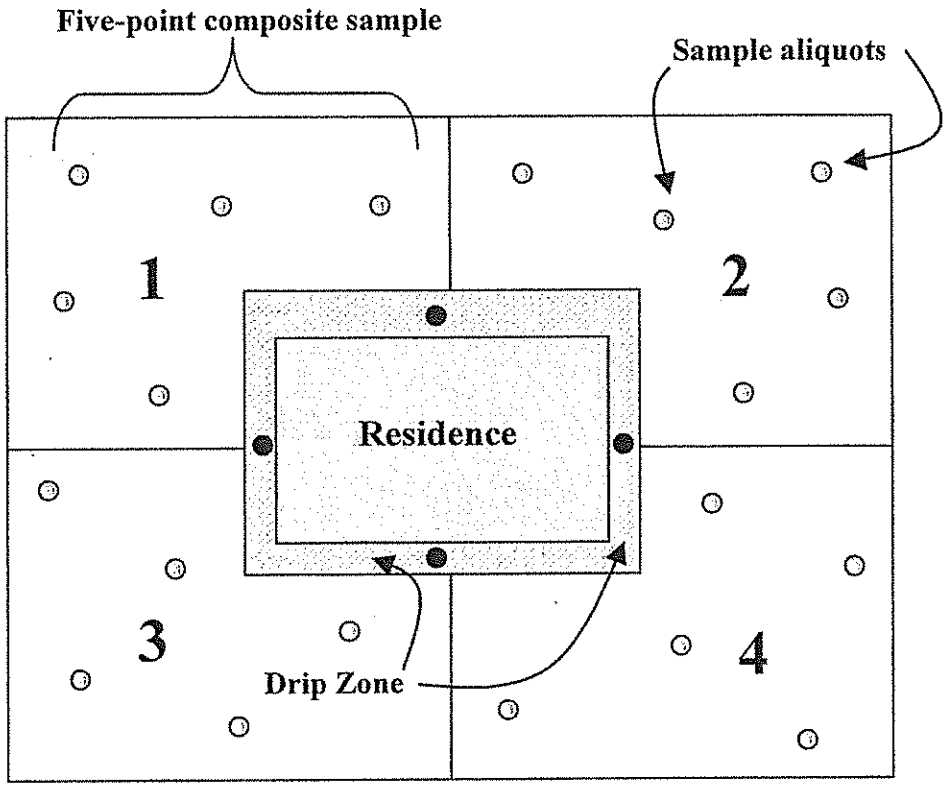


Figure 4-2. Recommended minimum soil sampling in yards greater than 5,000 square feet. Five point composite samples should be collected from each of the four quadrants as indicated above. The locations of the aliquots should be equally spaced within each of the quadrants. The figure illustrates one possible arrangement of the sample aliquots. Four point composites should be collected from the drip zone; each aliquot should generally be collected from the midpoint along each side of the residence. Aliquots for a single composite sample should be collected from the same depth interval. Additional samples should be collected from distinct play areas and gardens if they are present, as well as unpaved driveways and minimal use areas such as areas under porches and crawl spaces. Please refer to Section 4.2.2 for further explanation.

4.2.3 Drip Zones

Lead-contaminated soils are frequently found within the drip zone of houses. It is recommended that a four-point composite sample be collected from the drip zone of each residential property (Figures 4-1a, 4-1b, and 4-2). The composite sample (taken from any size lot) should consist of a minimum of four aliquots collected between 6 and 30 inches from the exterior walls of the house. Each aliquot should generally be collected from the midpoint of each side of the house. Collection of additional aliquots should be considered if other factors exist, such as bare spots, distinct differences in the house exterior, and areas where runoff collects. Rooftops may collect fine-grained sediments that contain high concentrations of lead. In yard areas where downspouts discharge during a storm event, the fine-grained material washed from a roof may accumulate and result in a localized increase in soil lead

concentrations. Samples of the soil from the downspout discharge area should also be sampled if present.

4.2.4 Play Areas, Gardens, and Driveways

Distinct play areas and gardens, if present, should generally be sampled separately as discrete areas of the yard. At some sites, collection of a right-of-way/easement composite may also be appropriate, such as residential areas with unpaved streets and alleys. Paved surfaces such as asphalt/concrete driveways, patios, alleys, and parking lots should, in most cases, not be sampled. Samples should also be collected in other locations depending upon the potential for exposure or recontamination, for example, under porches and crawl spaces and areas with incomplete barriers such as gravel driveways.

4.2.5 Potable Water, Lead-Based Paint and Interior Dust

Drinking water supply samples should be collected to determine if exposure to lead in drinking water is occurring. First-run and purged samples of potable water should be collected to differentiate site-related sources of lead from lead derived from plumbing that is located within the residence. CERCLA authority for remedial action may be limited with regard to lead derived from plumbing that is located within the residence.

Deteriorating LBP may contribute lead to household dust. If elevated concentrations of lead are found in interior dust, samples of interior paint should be collected. Exterior LBP may contribute to the recontamination of remediated properties (Section 6.7). Samples of exterior LBP should be collected and analyzed to estimate lead concentrations. Lead in household dust may be a significant contributor to elevated blood lead levels, especially in younger children. Lead-contaminated interior dust can be derived from multiple sources; dust mat samples and speciation can be used to identify lead sources. Dust samples should be collected and analyzed to estimate its potential contribution to lead exposure. Guidance on LBP and dust sampling is available from HUD (HUD, 1995).

4.2.6 Backfill and Waste Soil

Backfill soil should be sampled to ensure that uncontaminated material is being placed on the site. The list of analytes and the frequency of sampling should be based on site-specific factors including the location of the source for the backfill material relative to potential sources of contamination, the geology of the borrow area, and the heterogeneity of the material. For example, on the Bunker Hill Superfund Site, four-point composite samples were collected for each 200 yd^3 of soil (TerraGraphics, 1997a). Gravel for driveway backfill was also sampled every 200 yd^3 (TerraGraphics, 1997b). Samples of excavated soil should be analyzed by the toxicity characteristic leaching procedure (TCLP) method to

determine the appropriate method of disposal. The frequency required for TCLP sampling should be based on the heterogeneity of the lead and other contaminant(s), if any, on the site.

4.3 SAMPLING METHOD AND ANALYSIS

4.3.1 Sample Collection

Composite samples should consist of discrete aliquots of equal amounts of soil. The soil from each aliquot should be collected into one clean container, such as a stainless steel bowl or plastic bag, and thoroughly mixed. After mixing, the sample can then be analyzed by X-Ray Fluorescence (XRF) (see Section 4.3.4) or sent to the laboratory. Remaining sample volume can then be disposed in the general location from where it was collected, or archived, depending on the requirements of the project. In some cases, material other than grass and/or soil will be encountered at a sample location, e.g., wood chips and sand are often found in recreational areas of day-care and school playgrounds. Samples of the soil below the cover material should be collected.

The use of a dynamic sampling and analysis strategy should be considered (EPA, 2001d). A dynamic sampling and analysis strategy takes full advantage of the real-time that data field analytical methods provide, which can limit the sampling effort and minimize cost (EPA, 2001d). This document suggests the use of field portable X-Ray Fluorescence (FP-XRF) analysis.

4.3.2 Sample Depth

The following sampling design is based on the assumption that removal of surficial contaminated soils and placement of a cover of clean soil will be protective of human health and the environment (see Section 4.0). Furthermore, the sampling design outlined below is based on the assumption that a minimum of 12 inch soil cover is adequate.

Initial sampling for lead contamination in residential soils should be conducted to a depth of at least 18 inches, but does not need to exceed 24 inches to define the vertical extent of contamination for clean-up purposes. Composite samples should be collected at 6 inch depth intervals, i.e., 0–6 inches, 6–12 inches, 12–18 inches, and 18–24 inches. Additional sampling may be required at lead sites in cold weather regions when contamination is associated with coarse grained material. Stone-sized material, such as tailings and crushed battery casings, will, over time, migrate upward through the soil via freeze/thaw effects. At such sites, composite sampling should be conducted at 6 inch intervals to the approximate maximum frost depth for the region. In all cases, composites should consist of aliquots collected from the same depth interval.

In site-specific situations, deeper sampling may be conducted to determine the total vertical extent of contamination for groundwater issues or ICs, and to determine if complete removal of contaminated soil is possible. Depth sampling should be conducted until the vertical extent of contamination has been adequately defined, but does not need to be conducted on every property.

In addition to the composite samples collected to define the vertical extent of contamination, five-point composite surface soil samples should be collected from 0 to 1 inch for human health risk assessment purposes (EPA, 1989, 1996c). The samples should be collected using the procedure described in Section 4.3.1. These surface soil samples should be collected from every property within the identified zone of contamination; however, after collecting a statistically valid number of both 0–1" and 1–6" samples, the project manager may want to compare both sample horizons (e.g., paired-sample t-test; Wilcoxon Rank Sum test) (Gilbert, 1987; Snedecor and Cochran, 1989) to determine if the 0–1" depth can be eliminated (i.e., sample from 0–6"), to further decrease sampling costs. This may be particularly useful at mine waste sites where contamination often extends to depth or at sites where lead-contaminated soil has been used as fill material; in such cases, the lead concentration may increase with depth. Conversely, the 0–1" horizon may be far more contaminated than the 1–6" at smelter sites, making individual horizon sampling crucial to remedial decision-making.

Collection of samples from specified depth intervals serves two primary purposes: risk assessment and remedial decision-making. With respect to risk assessment, the top inch of soil best represents current exposure to contaminants (EPA, 1989, 1996c) and is the source of data used in the IEUBK model to represent exposure from soil. The various depth intervals are used in remedial decision-making to determine if a residential yard requires cleanup by evaluating if any of the horizons exceed the site-specific action level. The lower soil horizons represent possible future exposures, such as homeowner projects, children's play areas, and other home activities that periodically go beneath the top inch of vegetation/soil (EPA, 1989). All soil horizons should be used for clean-up decision-making. The 6 inch depth intervals recommended in this document are based on the performance that may be reasonably expected of operators of small equipment working in relatively small spaces around homes. Specifically, a "bobcat" is most efficiently used for soil removal on a property if the soil is removed in 6 inch intervals, rather than in smaller increments, which would be far more difficult to achieve in a consistent or cost-effective manner. This approach has been developed to ensure a residential yard is cleaned up if it poses an immediate or long-term risk to human health in a manner that relates the sampling methodology closely to reasonable and cost-effective construction equipment performance.

A secondary goal of the sample collection effort is to facilitate the implementation of ICs for sites where contamination at depth is left in place.

4.3.3 Sample Preparation

Residential soil lead samples should represent the exposure potential of young children who are most vulnerable to adverse effects of exposure. Children inadvertently ingest lead in soil and dust that adheres to their hands (Succop et al., 1998). The smaller particles are more representative of this type of exposure (Duggan et al., 1985; Kissel et al., 1996; Mielke et al., 1997). Additionally, smaller particles are preferentially brought into the home. Sieving is conducted to better represent the soil fraction that is ingested by the typical child. Sieving has also been used in soil ingestion and bioavailability studies (Calabrese et al., 1996; Casteel et al., 1997; Stanek et al., 1999). Samples collected from all depth intervals should be sieved. Samples should not be ground prior to sieving, as this changes the physical structure of the soil and may bias the analytical results. To reduce sampling costs, it may be desirable to develop a correlation between sieved and unsieved data, to eliminate the need to sieve all samples. The correlation can be used to predict sieved results from unsieved samples. The EPA Technical Review Workgroup (TRW) and American Society for Testing and Materials (ASTM) have issued guidance on sieving (ASTM, 1998; EPA, 2000c). The EPA TRW guidance addresses appropriate sieve size (No. 60) and a method for predicting the concentration in the fine fraction using concentrations measured in unsieved samples.

> Technical Review Workgroup (TRW) – The TRW is an interoffice workgroup that consists of key scientific experts from various EPA regions, labs, and headquarters that supports and promotes consistent application of the best science in the field of lead (Pb) risk assessment at contaminated sites nationwide.

The presence of paint chips in a soil sample can represent a large proportion of the total lead concentration that is measured. On this issue, the Handbook directs the reader to existing HUD guidance, which states "If paint chips are present in the soil, they should be included as part of the sample. However, there should be no special attempt to over-sample paint chips. The laboratory should be instructed to disaggregate ('break up') paint chips by forcing them through a sieve in the laboratory. Although paint chips should not be oversampled, they should not be excluded from the soil sample, since they are part of the soil matrix." (HUD, 1995). The TRW website should be checked periodically for additional sampling guidance.

4.3.4 Sample Analysis

EPA's experience in sample analyses at large residential contamination sites (with several thousand homes on a site) shows that both FP-XRF or fixed-site laboratory analyses (acid digestion/Inductively Coupled Spectroscopy) provide reliable information (EPA, 1996d, 1998b, 2001c, 2001d; Crumbling et al., 2001). The objective of using a FP-XRF is to predict Contract Laboratory Program (CLP) values with

less expensive real-time data. A sufficient amount of data should be collected to develop a site-specific relationship (i.e., correlation) between FP-XRF and CLP lab data.

The comparison should consider sample preparation (drying and sieving) and analytical methods. Typically, a large number of laboratory confirmation samples should be analyzed at the beginning of the project to estimate the correlation between the FP-XRF and the CLP results and the FP-XRF precision and accuracy. Additional confirmatory samples should then be analyzed at key decision points when the FP-XRF results are close to action levels or when the reliability of the FP-XRF unit is in question (EPA, 2001d). For example, initial sample analyses using an FP-XRF instrument could include 20 percent laboratory confirmatory samples to assess the accuracy and precision of the FP-XRF. Once the accuracy and precision of the FP-XRF results have been determined (and assuming they satisfy the requirements of the project), the number of laboratory confirmatory samples could be reduced (e.g., to 5 percent). Additional information on analyzing soil (and other media) in the field with FP-XRF is available on the EPA web site: http://www.epa.gov/superfund/programs/dfa/ (EPA, 2001e).

Proper calibration of the FP-XRF unit is important to obtaining reliable results (EPA, 1996d). Correlation between the FP-XRF and laboratory analyses is best achieved with small sample volume. Laboratory confirmatory samples should be collected in the specimen cup available from the FP-XRF manufacturer. The sample is first analyzed with the FP-XRF and then sent to the laboratory for wet chemistry analysis. Soil moisture can introduce error in FP-XRF results to varying degrees, depending on the instrument being used (EPA, 1996d). The correlation between the FP-XRF measurements on dried and undried samples should be estimated. The correlation analysis should then be used to establish a cutoff or 'soil moisture ceiling'. The 'soil moisture ceiling' represents the maximum moisture content at which useful results (i.e., of sufficient precision and accuracy) can be obtained with the FP-XRF. Field portable instruments capable of measuring moisture content are available and should be used to compare sample moisture content to the 'soil moisture ceiling'. Samples with moisture contents greater than the 'soil moisture ceiling' should be dried prior to analysis with the FP-XRF.

5.0 CLEAN-UP LEVEL SELECTION

Generally, the approach to human health risk assessment for lead differs from that of other metals and contaminants. Typically, risks from lead exposures are estimated from long-term exposures, although elevated blood lead concentrations also result from short-term exposures (CDC, 1991). EPA has developed the IEUBK model to predict blood lead (PbB) concentrations in children exposed to lead. The model considers several different media through which children can be exposed to lead.

EPA and the CDC have determined that childhood PbB concentrations at or above 10 micrograms of lead per deciliter of blood (μg Pb/dL) present risks to children's health (CDC, 1991). Accordingly, EPA seeks to limit the risk that children will have Pb concentrations above 10 μg Pb/dL. The IEUBK model predicts the geometric mean PbB for a child exposed to lead in various media (or a group of similarly exposed children). The model also calculates the probability that the child's PbB exceeds 10 μg Pb/dL (P_{10}). Preliminary remediation goals (PRGs) generally are determined with the model by adjusting the soil concentration term until the P_{10} is below 5%. Final clean-up level selection for Superfund sites generally is based on the IEUBK model results and the nine criteria analysis per the National Contingency Plan (NCP) (EPA, 1990b), which includes an analysis of ARARs. More information on the IEUBK model is available from the EPA TRW web site.

Typically at large lead sites, early actions taken to mitigate the identified site risks consist of time-critical removal actions (TCRAs), most often taken as an interim action. These actions are usually followed by long-term remedial actions. The following sections describe the different approaches that should be used for prioritizing response actions and selecting clean-up levels for both early (interim) and long-term (permanent) response actions.

5.1 PRIORITIZING RESPONSE ACTIONS

For early, interim actions, a tiered approach should be used for prioritizing clean-up actions. A tiered-response approach is recommended when sufficient resources are not available to fully address lead risks. The size and complexity of many lead sites often requires implementation of response actions over an extended period of time; therefore, it is often necessary to implement interim clean-up actions to manage short-term health risk concerns while response actions to address long-term risk are planned and implemented. Early removal actions at residential lead sites should contribute to the performance of the long-term permanent remedy.

The tiered approach is depicted in Figure 5-1. Figure 5-1 is a flowchart that provides a roadmap of the recommended clean-up process for lead-contaminated residential sites. An overview to the clean-up process is provided in Figure 1-1. The first page of Figure 5-1 provides a more detailed overview; the subsequent pages provide additional details of the process.

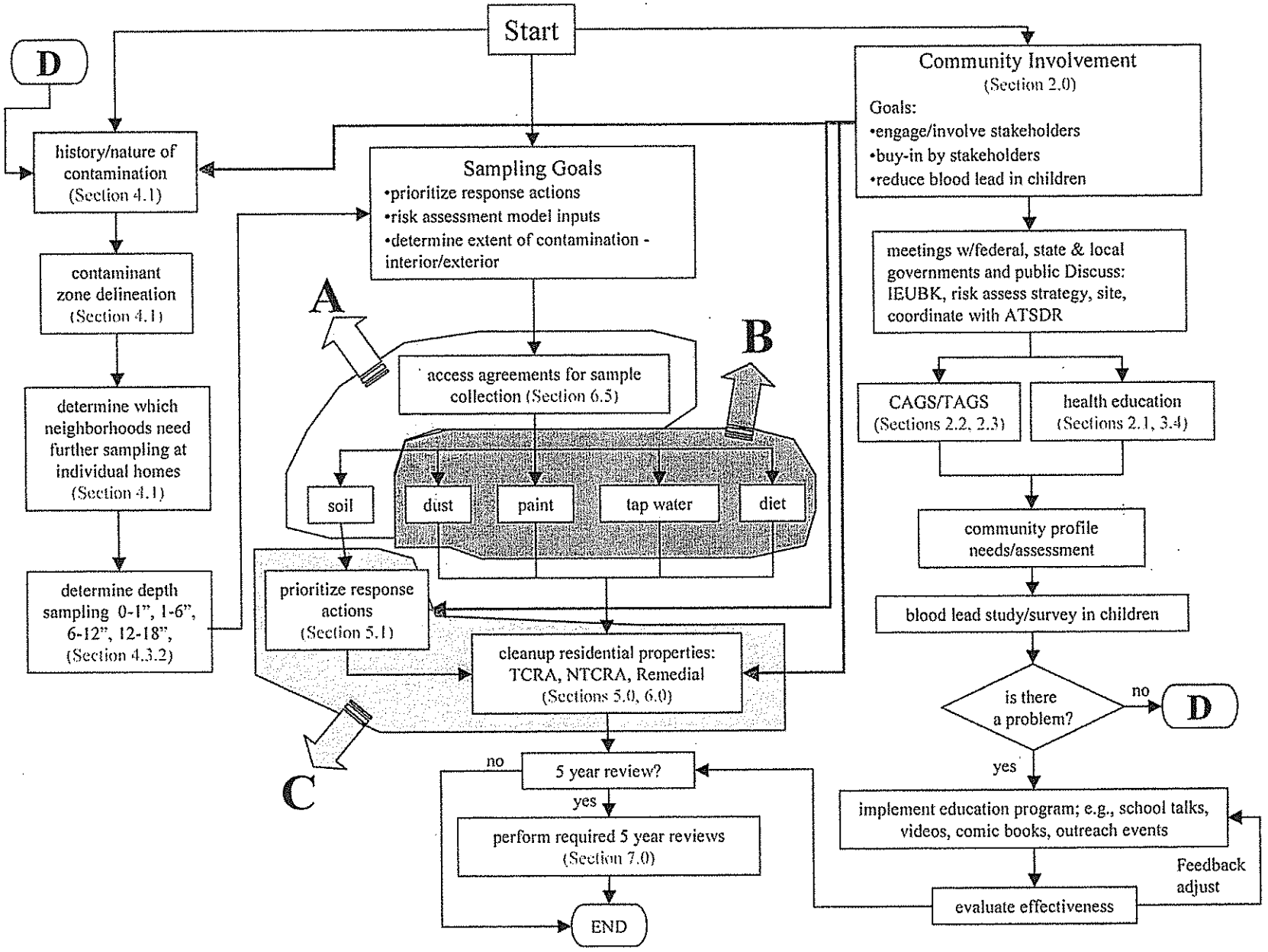


Figure 5-1. Recommended clean-up process for lead-contaminated residential sites. Refer to Figure 1-1 for an overview of the process. The shaded portions of the figure, labeled A-C, are expanded on the second through the fourth pages of the flowchart.

Figure 5-1. (continued)

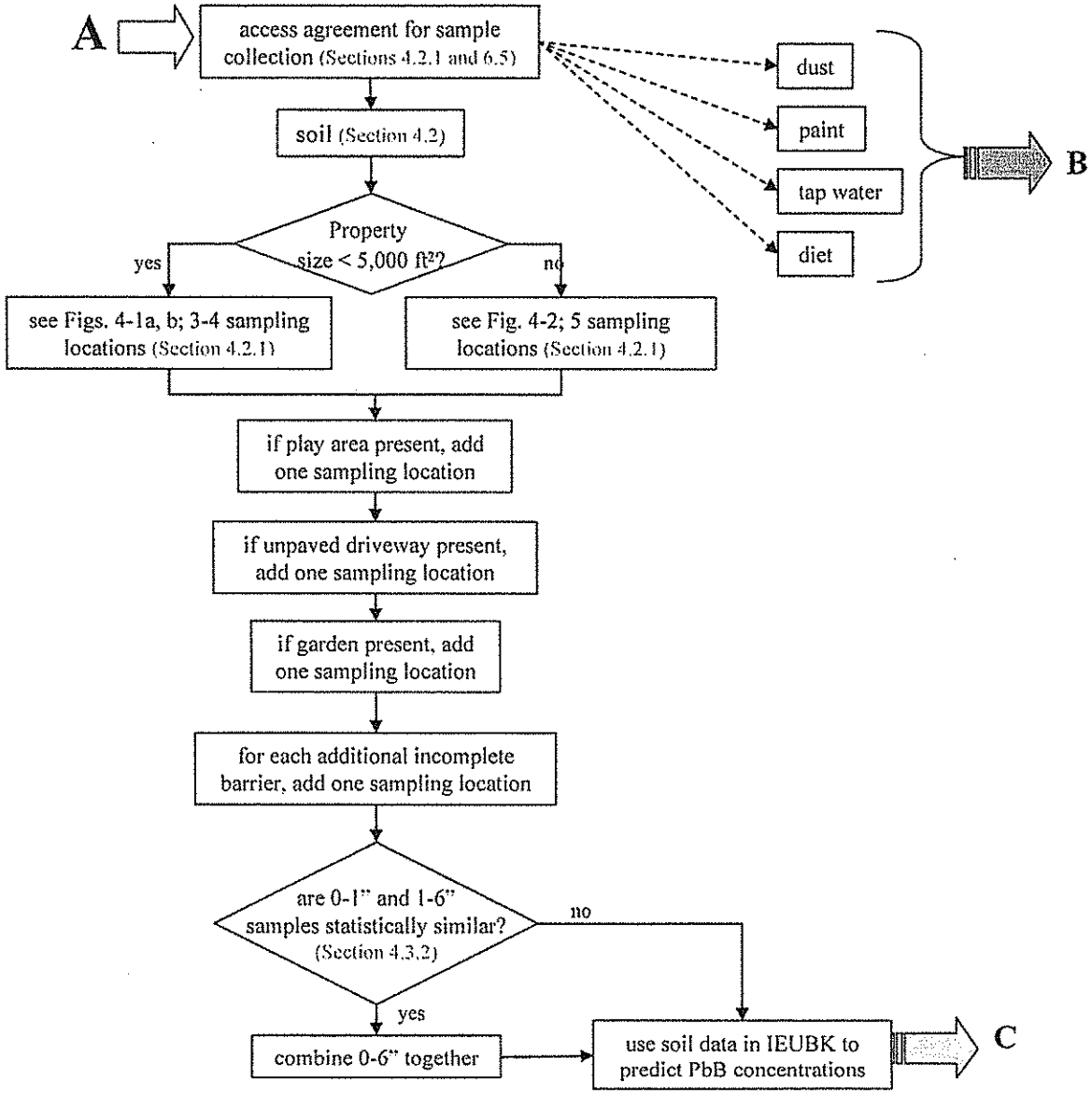


Figure 5-1. (continued)

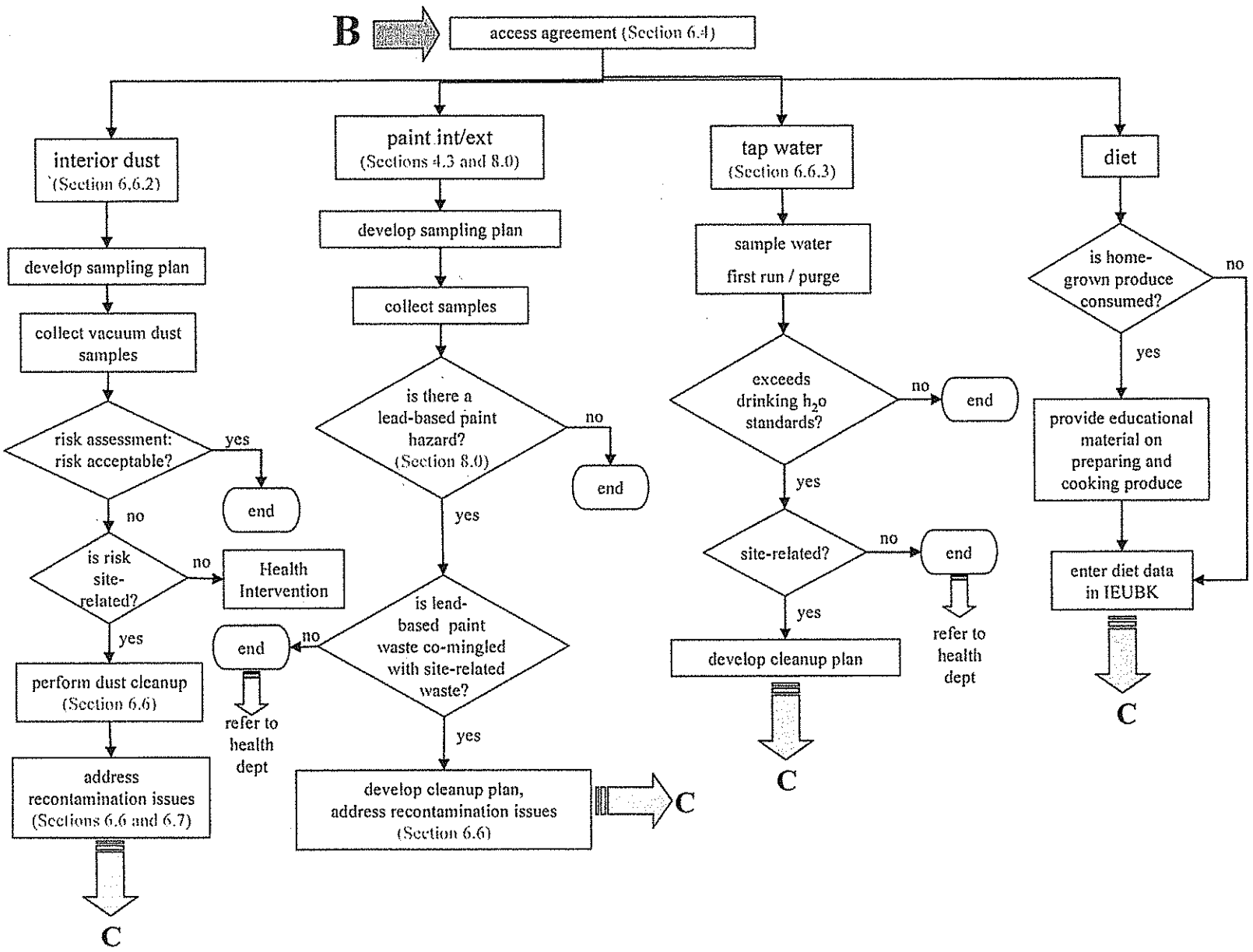
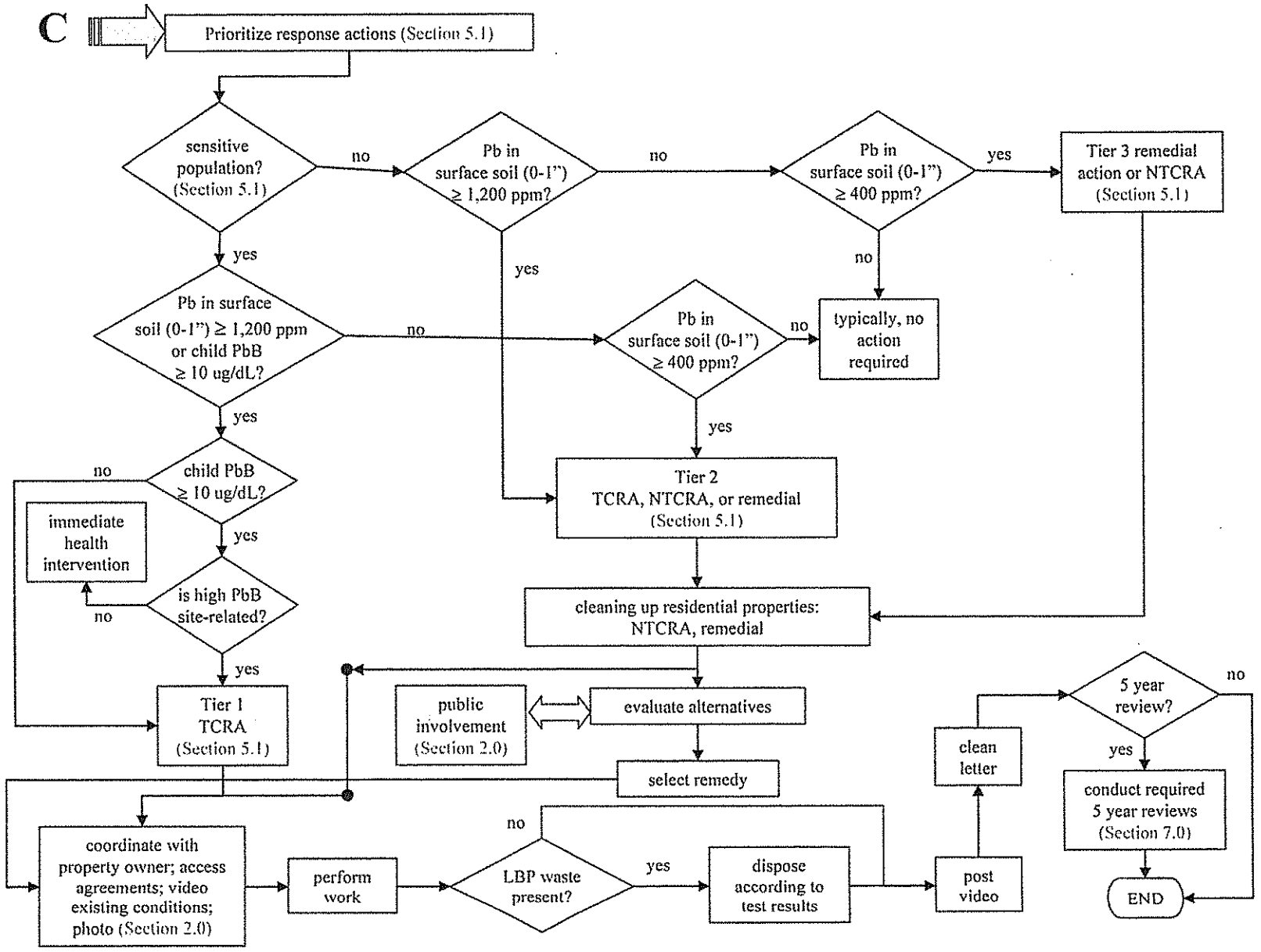


Figure 5-1. (continued)



The concentrations that are used to define tiers should not be confused with clean-up numbers, which are based on the PRG determined with the IEUBK model and an analysis that includes the nine criteria listed in the NCP (EPA, 1990b). The 1,200 ppm concentration is not an action level for TCRAs, but is intended to provide an alternative to running the IEUBK model if the project manager believes the site poses an urgent threat (EPA, 1997b, 1997c). Certainly, a TCRA could be justified above or below this concentration depending on the conditions at the site. The tiers, for the purposes of this guidance, are defined below (see also Figure 5-1). (Please note the Agency is considering developing new guidance for removal actions.)

- Tier 1 properties have both sensitive populations (children up to 7 years old or pregnant women) and soil concentrations in the surface soils (0–1" depth) at or above 1,200 ppm (EPA, 1997b, 1997c). Also, Tier 1 sites can be identified based upon a demonstration of children's blood lead levels at or above 10 µg/dL. Generally, TCRAs would be taken at Tier 1 properties.

- Tier 2 properties have either sensitive populations and soil lead concentrations in surface soils between 400 ppm and 1,200 ppm, or no sensitive populations and surface soil lead concentrations above 1,200 ppm, but not both. Tier 2 properties can be addressed through TCRAs, or non-time-critical removal actions (NTCRAs), or long-term remedial actions.

- Tier 3 properties have surface soil concentrations below 1,200 ppm, but above 400 ppm, and no sensitive populations present. Tier 3 sites would typically be addressed through long-term remedial actions or NTCRAs.

Tier 1 should be the highest priority for immediate action and Tier 3 should be the lowest priority for immediate action. Residential properties can move into a different tier if conditions change (e.g., small children or pregnant women move into a house). A typical residential lead site will contain a combination of properties that fit into different tiers. The project manager should use judgement to determine whether or not to perform a complete cleanup of contaminated residential properties (as defined in Section 1.3).

As discussed below, remedial actions for residential lead sites should use the IEUBK model. The IEUBK model should be used to assess risks posed by contaminated soils and to determine PRGs for soils at residential lead sites. In order to facilitate TCRAs, a demonstration of elevated blood lead levels or elevated soil-lead levels at or above 1,200 ppm will usually be sufficient. If elevated blood lead levels are the basis for concern, occupational contributions of lead, elevated lead levels in drinking water, lead from LBP, and lead dust in the homes of children or adults with elevated blood lead should be investigated first because these sources of lead can be significant (Appendix B). At this stage, consultation with Regional

risk assessors and public health officials (such as ATSDR) to better understand health impacts is encouraged.

The Agency plans on publishing a future lead removal directive which includes further information on site-tier approaches.

5.2 LONG-TERM REMEDIAL ACTION

The 1994 Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12 states OSWER's risk reduction goal for residential lead sites: "... generally, OSWER will attempt to limit exposure to soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% exceeding the 10 µg lead/dL blood lead level." (P_{10}<5%) (EPA, 1994b). It is important to note that this recommendation (i.e., P_{10}<5%) is meant to apply to a single residential property or another discrete exposure area, not on an area- or community-wide basis (i.e., 5 children out of every 100 actually exceed 10 µg/dL). It is also important to note that selecting a soil lead concentration in this manner will not guarantee that a given child will not exceed a blood lead level of 10 µg/dL. Many factors other than soil concentration cause variance in blood lead levels: pica behavior, or other sources of lead not included in the exposure unit, such as paint, diet, etc. (e.g., this could include soil at a camping site or other remote site frequented by the child).

The 1998 OSWER Directive 9200.4-27P ('Clarification') (EPA, 1998a) recommends that the IEUBK Model be used as the primary tool to generate risk-based soil clean-up levels at lead sites for current and future residential use (Appendix B). Additionally, the 1998 Clarification states that response actions can be taken using IEUBK predictions alone, and that blood lead studies, while providing useful information, should not be used for establishing long-term remedial or non-time-critical removal clean-up levels at lead sites. Regarding exposure units at residential lead sites, the 1998 Clarification states: "... it is recommended that risk assessments conducted at lead-contaminated residential sites use the individual residence as the primary exposure unit of concern" (EPA, 1998a; Appendix B). This document clarifies the definition of exposure unit provided in the 1998 Clarification. In addition to the individual residence, accessible site-related lead sources outside the residential setting should also be evaluated to understand how these other potential exposures contribute to the overall risk to children. When the evaluation indicates a significant contribution to risk, clean-up measures should be determined for those areas.

Empirical blood lead data occasionally deviates significantly from IEUBK Model predictions. This can be due to numerous factors, including the implementation of lead exposure-reduction and health education programs, and uncertainties in the exposure parameters of the Model as well as uncertainties in the blood lead data (Mushak, 1998). Regarding this issue, the 1998 Clarification states: "Where actual

blood lead data varies significantly from IEUBK Model predictions, the model parameters should not automatically be changed. In such a case, the issue should be raised to the TRW to further identify the source of those differences" (Appendix B). Basically, model inputs should be changed only when defensible, site-specific information that is specifically applicable to the parameters is collected. Moreover, these changes should also ensure that model outputs are protective of future residents. Examples of such information are dust lead concentration, drinking water concentration, bioavailability data (e.g., *in vivo* pig studies), and soil-to-dust ratio. The predictive capacity of the IEUBK Model depends upon the representativeness of the inputs. Section 4 discusses the collection of the data used to estimate some of these inputs.

In summary, there is no national clean-up standard for lead in residential soil on a Superfund site; however, there is a consistent process by which residential soil lead clean-up levels are selected. One step is to gather site-specific data as recommended in Section 4 of this Handbook and review other guidance on the use of the IEUBK Model (EPA, 1994b; TRW web site: http://www.epa.gov/superfund/programs/lead/ieubk.htm). Risk assessors (and other data users) should be consulted early to assist with data collection and planning (EPA, 2000d). Another step is to get assistance from the regional risk assessor(s) to run the IEUBK Model with applicable site-specific inputs. Running the model should allow the determination of a site-specific PRG that corresponds to a P_{10} for a typical child, or group of similarly exposed children, that is no more than 5%. Another step is to select a site-specific residential soil lead clean-up level that is based on the model-derived soil lead PRG and an analysis of the nine criteria consistent with the NCP (Superfund sites only) (EPA, 1990b). If the proposed clean-up level is outside of the range of 400 ppm to 1,200 ppm lead, then the draft decision document for the site is sent to the Lead Sites Consultation Group (LSCG) for review (EPA, 1997b).

Lead Sites Consultation Group (LSCG) – The Lead Sites Consultation Group (LSCG) was created in 1997 to promote national consistency in decision-making at lead sites across the country (EPA, 1997b). The main purpose of the group is to review key response decisions at lead sites. The LSCG is comprised of senior management representatives from the Waste Management Divisions in all 10 EPA regions along with senior representatives from the Office of Emergency and Remedial Response in EPA headquarters.

The LSCG is supported by EPA's Technical Review Workgroup for Lead (TRW) and the national Lead Sites Workgroup (LSW). According to Agency policy, there are three triggers that cause the review of lead-related proposed plans by the LSCG (EPA, 1997b):

1) Residential contaminated lead sites with proposed cleanup levels outside a 400 to 1,200 ppm soil-lead level;
2) Sites that envision actions to address non-soil lead-contaminated media;
3) Routine LSW deliberations that identify a unique or precedent setting site issue(s).

6.0 APPLICATION OF CLEAN-UP NUMBERS/REMEDIATION

The following section provides a detailed discussion of recommended minimum considerations to remediate residential soil and other sources of lead in residential settings. The guidelines stated below apply to early/interim actions and long-term remedial actions. However, due to statutory funding limitations that apply to time-critical removal actions, site-specific determinations regarding yard size limitations, and whether to clean up empty lots and other sources of lead (paint, dust, tap water), should be made by the project manager on a site-by-site basis.

6.1 MINIMUM EXCAVATION DEPTH/SOIL COVER THICKNESS

Based on Agency experience, it is strongly recommended that a minimum of twelve (12) inches of clean soil be used to establish an adequate barrier from contaminated soil in a residential yard for the protection of human health. Cover soil can either be placed after excavation as backfill or placed on top of the contaminated yard soil. The rationale for establishing a minimum cover thickness of 12 inches is that the top 12 inches of soil in a residential yard can be considered to be available for direct human contact. With the exception of gardening, the typical activities of children and adults in residential properties do not extend below a 12-inch depth. Thus, placement of a barrier of at least 12 inches of clean soil will generally prevent direct human contact and exposure to contaminated soil left at depth.

Removal of lead-contaminated soil to depths greater than 12 inches should be considered at sites in cold regions with non-soil lead-contamination sources, such as tailings and crushed battery casings, and whenever it is cost-effective. The additional response cost should be compared to future IC and monitoring costs associated with leaving the material in place. Full vertical removal of residential soil has many advantages, such as reducing or avoiding the costs of maintaining the soil cover, the placement of subsurface barriers/markers, and obtaining environmental easements. Full removal of contaminated soil also satisfies EPA's preference for permanent remedies and normally allows the remediated yard to return to unrestricted use.

Twenty-four (24) inches of clean soil cover is generally considered to be adequate for gardening areas; however, site specific conditions that may require more soil cover (e.g., presence of burrowing animals) should be considered. A 24-inch barrier normally is necessary to prevent contact of contaminated soil at depth with plant roots, root vegetables, and clean soil that is mixed via deep rototilling. Raised garden beds may be built to obtain 24 inches of clean soil, and may be more cost effective than excavating to 24 inches in depth, e.g., excavate 12 inches of contaminated soil, then add 24 inches of soil to create a 12" raised bed.

6.2 SOIL CLEAN-UP OPTIONS

Currently, there are only two remedial actions that generally are considered to be protective, long-term (not interim) remedial actions at residential properties: (1) excavation of contaminated soil followed by the placement of a soil cover barrier and (2) placement of a soil cover barrier without any excavation of contaminated soils. Excavation followed by the placement of a soil cover is the preferred method and is strongly recommended at sites with relatively shallow contamination, such as many smelter sites. In most cases, excavation and placement of a soil cover should be performed whenever the specific conditions of a site do not preclude it. For example, it may not be feasible to fully excavate a very large site cost-effectively, therefore capping, also considered to be protective, may be more appropriate. The advantage of the preferred method is that it is a permanent remedy in terms of removal of lead from areas where children may be exposed.

Several treatment technologies are currently under development to reduce the bioavailability of soil lead, but have not yet been proven to be protective in the long-term. These include amending the soil with phosphorus or high iron biosolids composts. Preliminary results have shown phosphate treatment to reduce the bioavailability of lead in soil by as much as 50 percent. This would mean that soil with lead concentrations in the range between clean-up levels calculated with the pre- and post-treatment bioavailability values could be treated instead of removed (e.g., if the IEUBK model-derived clean-up number using the pre-treatment bioavailability were 400 ppm lead, and the calculated post-treatment clean-up level were 800 ppm lead, then the yards with lead concentrations between 400 ppm and 800 ppm could be treated rather than excavated or capped).

Over time, the efficacy of the phosphorous treatments appears to increase. This is consistent with what is predicted using thermodynamics. To date, the treatability studies have been monitored for 3–5 years. Additional monitoring will be necessary to assure the long-term stability of the observed reduction in bioavailability.

Some other existing technologies for soil remediation that are not currently considered acceptable for residential lead cleanups are rototilling, phytoremediation, and interim controls, such as mulching, seeding, and sodding (without prior removal of contaminated soil). Rototilling is not considered a permanent, protective remedy in that no lead removal occurs, and adequate mixing of soil is difficult, if not impossible, to achieve; additionally, rototilling may increase the volume of soil, which ultimately requires remediation. Mulch, sod, or other vegetative covers are generally not considered permanent, protective remedies in that no lead removal occurs, and there is no guarantee that grass, mulch, or other vegetative cover will be maintained in good condition over time.

Additionally, land use changes that may occur within a yard, such as starting a garden or putting in a swing set, are not precluded in any way by mulch, sod, or other vegetative cover. Lastly, phytoremediation is not currently an appropriate technology for residential lead cleanups due to several factors: (1) the lead concentrations at many residential sites are not within the optimal performance range for the plants; (2) the plants may concentrate lower level lead contamination and present an increased disposal cost if the plants fail the TCLP test, but the unremediated yard soil does not fail; (3) the length of time required for remediation; (4) the potential conflicts with local regulations pertaining to yard maintenance; and (5) the depth of remediation achieved may be inadequate.

6.3 INTERPRETING SAMPLING RESULTS

Based upon the results of the sampling efforts (Section 4.0), this section describes the implementation of two clean-up options: (1) excavation and backfill (and placement of a visible barrier if applicable); or (2) soil cover placement (and placement of a visible barrier if applicable). The options should be performed as described below (see also Figure 6-1). The goal should be to remove all contaminated soil or provide a minimum 12" clean soil barrier. The following describes the implementation of option 1:

- If the 0–1" horizon exceeds the clean-up level, a 6 or 12" excavation is recommended, depending on the 6–12" sample horizon results;
- If the 1–6" or 0–6" horizon exceeds the clean-up level, a 6 or 12" excavation is recommended, depending on the 6–12" sample horizon results;
- If the 6–12" horizon exceeds the clean-up level, a 12" excavation is recommended. A visual barrier is required if the 12–18" horizon exceeds the clean-up level;
- If the 0–1, 0–6 or 1–6" horizons exceed the clean-up level and the 6–12" horizon does not exceed the clean-up level, a 6" excavation is recommended; a visual barrier is not needed.

	Depth	Soil Concentration Exceed Action Level?							
	0-1"	Yes	Yes	Yes	Yes	No	No	No	No
	1-6" (or 0-6")	Yes	Yes	No	No	No	Yes	No	Yes
Remedial Action Options	6-12"	Yes	No	Yes	No	No	No	Yes	Yes
Option 1: Excavation (& Backfill)	Depth of excavation	12"	6"	12"	6"	No action	6"	12"	12"
Option 2: Capping	Soil cover thickness	12"	12"	12"	12"	No action	12"	6"	12"

Figure 6-1. Interpreting Sampling Results. The figure suggests remedial actions based on the results of composite soil samples collected for each of the depth intervals shown. The figure includes two remedial action options: (1) excavation followed by backfilling, and (2) placement of a clean soil cover without removal of soil that exceeds the action level. To use the figure, find the column of the table that agrees with the soil sample results for your site, then read down the table to determine the depth of soil to remove (option 1: excavation remedies) or the thickness of the soil cover recommended (option 2: capping remedies). For example, the heavy border around the third column of the table corresponds to a situation where the average lead concentration in the 0–1" and 1–6" depth intervals exceed the action level, but the 6–12" interval does not. In this example, it is recommended to remove the top 6" of contaminated soil and replace it with clean soil, or to place a 12" clean soil cover (cap). The goal is to provide a minimum 12" barrier of clean soil when the underlying soil exceeds the action level. Please refer to Section 6.3 for further explanation.

The following describes the implementation of option 2:

- If the 0–1" horizon exceeds the clean-up level, a 12" soil cover and visual barrier should be used;
- If the 0–6" or 1–6" horizon exceeds the clean-up level, a 12" soil cover and visual barrier should be used;
- If the 6–12" horizon exceeds the clean-up level (but not the 0–1", 1–6", or 0–6" intervals), a 6" soil cover should be used;
- If only the 12–18" horizon exceeds the clean-up level, no capping is needed.

The decision to perform soil cleanup to depths greater than 12 inches should be considered on a site-by-site basis. Some advantages to full vertical soil cleanup are listed in Section 6.1. However, there are many sites where lead contamination is located at depth. Full vertical soil cleanup may not be cost-effective and/or feasible at such sites. The depth of excavation and soil cover thickness is an important factor to be considered during the analysis of the nine criteria per the NCP (for Superfund sites) (EPA, 1990b). Potential for freeze/thaw upward migration, groundwater contamination, and the cost, extent, and effectiveness of ICs are some of the factors to be considered in this analysis.

Sampling results obtained for residential lots may indicate that only a portion of the lot contains soil that exceeds the selected clean-up level. For properties less than 5,000 square feet, the spatial scale for the remedial decision should be one-half of the yard. For properties greater than 5,000 square feet, the property should be divided into four quadrants and a remedial decision should be made for each quadrant. It is usually protective to excavate only the portion(s) of the lot that exceed the clean-up level (Figures 6-2a and 6-2b). However, removal of the sod layer and resodding/reseeding the unexcavated portion(s) of the lot is strongly recommended to promote consistency in the vegetative cover of the yard for homeowner satisfaction. When interpreting sampling results for a property, the sampling results of surrounding properties should also be considered to lessen the probability of mislabeling the property as being below the clean-up level, when it is actually above, and to avoid "patchwork clean-up" patterns, which are prone to recontamination.

If the only portion of the yard that exceeds the selected clean-up level is the drip zone, the exterior paint should be checked for lead content. If the drip zone contamination does not appear to be paint-related, the drip zone should generally be cleaned up. If the drip zone contamination appears to be solely paint-related, EPA should promote the remediation of the exterior LBP by local health agencies, other local government agencies, state health agencies, and/or the homeowner. At a minimum, the resident should be notified and informed of the disclosure requirements (Appendix A). Consideration should be given to also notifying the relevant local government agencies and informing them about available remedies, such as HUD grants.

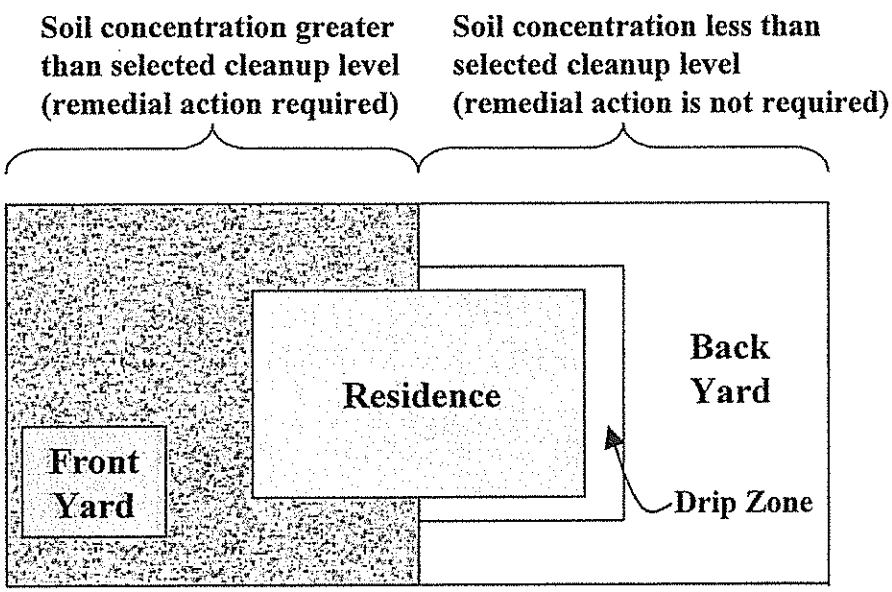


Figure 6-2a. Partial cleanup of residential lot less than or equal to 5,000 square feet in size. In this example, the lead concentration measured in the front yard exceeds the selected clean-up level while the concentration measured in the backyard does not. Cleanup may be limited to the front yard although it is recommended that the sod layer in the entire lot be removed to promote consistency in the vegetative cover on the property for homeowner satisfaction. The entire drip zone should be cleaned up if the average lead concentration exceeds the clean-up level. For example, in the above figure, the drip zone in the back yard (as well as the front yard) should be cleaned up if the average concentration in the drip zone exceeds the clean-up level. Please refer to Section 6.3 for further explanation.

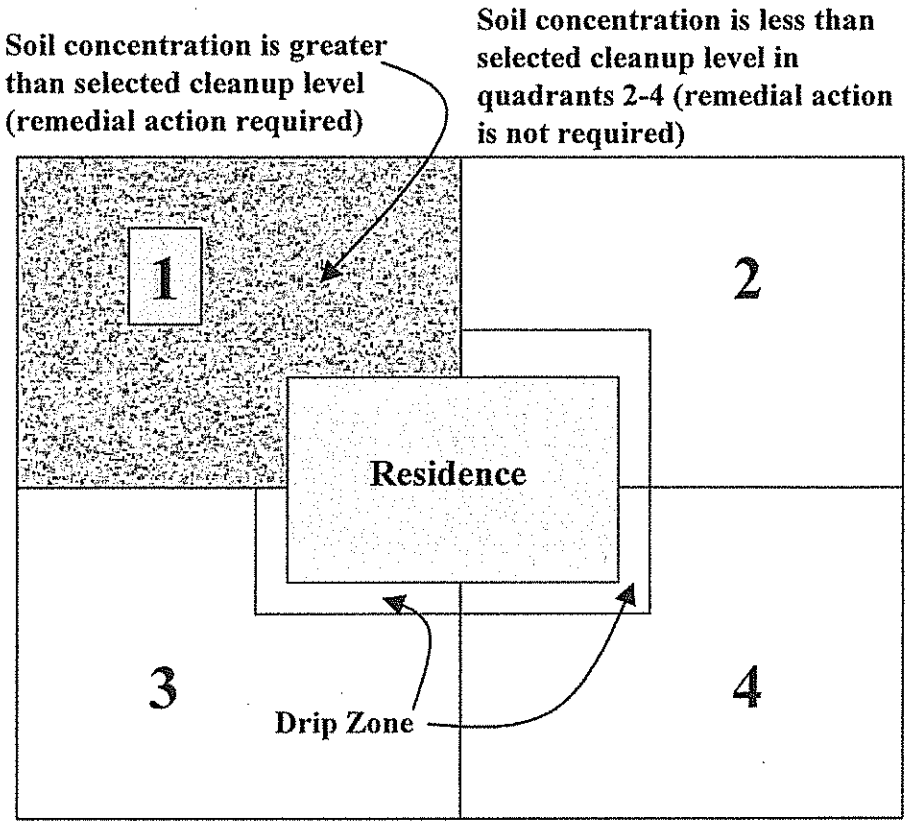


Figure 6-2b. Partial cleanup of residential lot greater than 5,000 square feet in size. In this example, the lead concentration measured in quadrant 1 exceeds the selected clean-up level while the concentration measured in quadrants 2–4 do not. Cleanup may be limited to quadrant 1 although it is recommended that the sod layer in the entire lot be removed to promote consistency in the vegetative cover on the property for homeowner satisfaction. The entire drip zone should be cleaned up if the average lead concentration exceeds the clean-up level. For example, in the above figure, the drip zone in quadrants 2–4 (as well as quadrant 1) should be cleaned up if the average concentration in the drip zone exceeds the clean-up level. Please refer to Section 6.3 for further explanation.

6.4 OTHER CLEANUP CONSIDERATIONS

The area remediated on a single property normally should not exceed one acre. This limitation is based on three factors: (1) typical lot sizes in residential areas throughout the country generally do not exceed one acre; (2) the portion of a property where the majority of exposure to contaminated soil occurs generally does not exceed one acre; and (3) EPA should generally not excavate/cover with soil the entirety of very large yards due to cost-effectiveness considerations.

The goal for cleanup of a yard that exceeds one acre is to excavate or cap the portion of the yard that is in frequent use and continue to limit exposure in the unremediated portion of the yard. To this end, it is recommended that the unremediated portion of such a yard be fenced to clearly delineate the remediated and unremediated areas and to limit the potential for off-site migration of contaminants (e.g., vehicle tracking). Exceptions to this general approach may include areas outside the one-acre area that are used for recreation and gardening, areas with the potential for residential development, and areas in close proximity to other residential areas. As stated in Section 6.5, any unremediated areas of a property should be documented on the clean-up documentation letter for such property, and consideration should be given to implementing ICs for those areas.

If contaminated soil is not removed to the full depth of contamination (i.e., where soil concentration is greater than clean-up level) on a property, a permanent barrier/marker that is permeable, easily visible and not prone to frost heave, should be placed to separate the clean fill from the contamination. This applies to both incomplete vertical excavation with placement of a soil cover and placement of a soil cover without excavating contaminated soil. Selection of an appropriate permanent barrier/marker should be based on the type of contamination left in place, the chemical/physical characteristics of the soil (e.g., pH), the potential for upward migration of the contamination, and/or the types of ICs developed for the site. Examples of suitable barriers/markers include snow fencing (usually orange), a clean, crushed limestone layer, and geofabric.

Empty lots that are zoned residential and contain soils with lead concentrations greater than the clean-up level should be cleaned up when in close proximity to other residential lots. Examples of this are lots between two houses and lots that are near occupied lots. A site-specific determination should be made for these situations. Also, unpaved lots used for vehicle parking should be sampled, and cleaned up if necessary, or access restrictions put in place to prevent recontamination (e.g., vehicle tracking of contaminants) even if no current direct exposure exists. However, it is not the intent of EPA to clean up tracts of remote, undeveloped, lead-contaminated land that may be developed into residential lots in the future. This clean-up responsibility should be borne by the land developer. Institutional controls should

be developed to ensure safe development in these areas, since under CERCLA developers could be held liable for improper cleanup.

6.4.1 Background Lead Concentrations

Many of the "Lead Sites" on the NPL are located in areas with high natural background lead concentration. Often this problem is exacerbated by the presence of high background concentrations of lead in various media (such as soil and groundwater) from anthropogenic sources such as automobile emissions, mining, and smelting (the latter two sources would be considered 'background' if they are not associated with the site). It should be noted that CERCLA 104 (a)(3) limits the Agency from taking response actions to address "... naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found" (EPA, 2000a). Generally, under CERCLA, clean-up levels are not set below natural or anthropogenic background concentrations (EPA, 1996c, 1997d, 2002). Cleanup below natural or anthropogenic background concentrations is normally not performed because it is not cost-effective, it is technically infeasible and there is a high likelihood of recontamination by surrounding areas that have not been remediated (EPA, 2002).

Public education about ubiquitous risks should be incorporated early in the process to help the community understand that Superfund actions are designed to address risks from specific releases to the environment (EPA, 2002). In situations like these, it may be appropriate to examine land uses that limit exposures through implementation of ICs. For more information on this approach, please refer to the 1998 Clarification to the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (Appendix B). Site-specific factors should determine what range of alternatives and what clean-up levels will achieve a protective remedy satisfying the nine criteria specified in the NCP.

Remedial decisions often involve a comprehensive response coordinated with other responsible authorities, such as a local public health district, state departments of environmental protection, housing agencies, and private parties. An effort should be made to identify other programs or regulations that may have the authority and capability of addressing risks associated with high natural or anthropogenic background (EPA, 2002). Additional guidance is available for developing a risk management-based response strategy that is protective of human health and the environment (EPA, 1988).

6.5 YARD CLEANUP SPECIFICS

It is important to define the limits of the properties that will be remediated. The use of property lines rather than temporary features, such as fence lines, to delineate boundaries is recommended. The use of temporary features may result in partial cleanup of some properties.

Whether remediation consists of excavation and placement of soil cover or just the placement of a soil cover, consultation with the property owners is important to the development and implementation of response actions and may necessitate property-specific deviations to the guidelines listed in this section. Flexibility is essential to a successful residential lead clean-up program. Some residents may want to pay for upgrades during the cleanup of their yard, such as paving a driveway after excavation, or to have some yard features removed, such as taking out a damaged patio. Within reasonable limits, such requests should be entertained on a yard-by-yard basis. Granting such requests can greatly contribute to building public trust and satisfaction with the clean-up program. All additional costs associated with special requests and considerations must be borne by the homeowner.

Prior to cleanup of a residential yard, access from the property owner should be obtained; access obtained from tenants or renters is not sufficient. It is recommended that access be obtained by going door-to-door. If residents are not home, a blank access agreement with instructions for signature and submission to EPA, along with relevant contact information should be left at the residence (but not in the mailbox). An example access agreement form is presented on page D-6 of Appendix D. As stated in Section 4.2.1, it is suggested that access for remediation be obtained at the time access for sampling is sought. Examples of combined sampling/remediation access agreements are presented on pages D-4 and D-5. An example of a dust cleanup access agreement form is presented on page E-2 of Appendix E. Many residents may refuse access for dust cleanup while granting access for yard-soil cleanup. Combining dust access agreements with other access agreements is not recommended.

Prior to initiating clean-up activity, the condition of each property should be documented and recorded on videotape. 'Clean-up activity' includes any disturbance of the property, including the removal of debris and dilapidated structures that may be required prior to initiating the excavation of contaminated soil. An example of a property inspection form is provided in Appendix F. EPA should enter into a written agreement with the resident regarding any special requests or considerations in cleaning up the yard, e.g., replacing concrete walkway with brick. All additional costs associated with special requests and considerations must be borne by the homeowner. Any contaminated yard areas that will not be cleaned up, special resident concerns, and any deviations from strict soil excavation or capping should be noted on this agreement.

Other possibilities for cleanup-related agreements include sod/lawn watering agreements. A sod-watering agreement basically allows for payment to residents for watering the sod that is placed by the remediation contractor. A payment is made before watering is required to cover the water bill and some of the time involved. A second payment is made if, at the end of one month, the sod is in good condition. A similar agreement should be established for maintaining lawns that have been initiated by hydroseeding. This can be a useful incentive program that can also save money. The contract with the remediation contractor should require the contractor to establish vegetation on each property, restore the pre-construction drainage patterns on each property, and perform repairs for damages to the property.

Relocation of residents during yard soil remediation is rarely needed and is generally not recommended (EPA, 1999b). (Guidance is available online at: http://www.epa.gov/oerrpage/superfund/tools/topics/relocation/index.htm.)

Specific safety issues during residential yard cleanup, including ingress and egress to the home, should be coordinated with the property owner/residents and spelled out in the Health and Safety Plan.

Incomplete barriers (such as rock or gravel) or minimal use areas (such as areas under porches), which exceed the applicable clean-up level, should be cleaned up to the extent practical. Although removal is preferred, if it is not feasible to clean up the area, a barrier, which effectively limits access, should be constructed. For example, for areas underneath porches, typically the preferred barrier would be shot-crete (sprayed concrete that can easily be placed in tight or confined areas). It may be preferable to place asphalt rather than gravel on heavily-trafficked roads or driveways, especially those that experience severe erosion.

In all cases, every attempt should be made to clean up the entire yard (subject to cost limitations discussed below), however, any residential yard areas without permanent barriers that the resident requests to leave unremediated, such as gardens or patios, should be sampled separately to determine if the selected clean-up level is exceeded. If the clean-up level is exceeded and the owner refuses to allow cleanup of that portion of the yard, then the clean-up documentation letter issued to the owner should note the unremediated area.

The steps of a typical soil cleanup are shown in the text box below.

Steps of a Typical Soil Response Action

Step 1 (Access Agreement) - Collect access agreement(s) from each owner and/or tenant before any work is conducted.

Step 2 (Initial Survey) - Interview the resident(s) to determine if there are any specific problems that need attention, and if there are any structures or property the owner wants to have disposed, stored, or left untouched. The contractor will conduct a thorough documentation of the property using drawings, digital photographs, and videotapes. Once documented, the owner is required to sign a property agreement which documents any special requests or considerations in cleaning up the yard, any contaminated yard areas that will not be cleaned up, provisions for structural concrete and fence restoration, and deviations from strict soil excavation and capping.

Step 3 (Excavation) - Each tract is excavated by the contractor(s), who will also complete documentation and provide depth confirmations.

Step 4 (Backfill) - After excavation of properties where full excavation to depth has been performed, the excavated area is backfilled and compacted. After excavation of properties with a vertical excavation limit, a permanent, permeable barrier/marker is placed in the excavated area. After placement of the barrier/marker, the excavation area is backfilled and compacted.

Step 5 (Restoration) - Restoration of the property, including landscaping, sod/seeding, fencing, and concrete (if needed) is conducted.

Step 6 (Final Inspection) - After restoration activities are complete, the EPA, PRP, or its agent (e.g., Corps of Engineers) will conduct a final inspection.

Step 7 (Closeout Form) - A property closeout form should be signed by the property owner, which documents the owner is satisfied with the remediation of the property. Any outstanding issues between the EPA and the homeowner that have not been fully resolved should be documented in the closeout form.

Step 8 (Clean Letter) - After the homeowner signs at property closeout form, the EPA issues a "clean" letter, which documents the property has been remediated. Any areas that are not cleaned up via the owner's request, such as gardens, should be noted in the "clean" letter. For properties where contamination is not completely removed, the clean letter should also document the presence of contamination at depth, and should describe the protective measures that were taken to prevent exposure to the remaining contamination (i.e., barriers/markers).

6.6 CLEANUP OF OTHER SOURCES OF LEAD

Lead in the environment can originate from many sources. In addition to soil, the main sources to consider when performing clean-up activities are interior and exterior LBP, lead-contaminated interior dust, drinking water, and occupational exposure resulting in subsequent contamination of homes. Generally, sources other than soil, exterior paint, dust, and tap water cannot be remediated by EPA in the course of residential lead cleanups.

Ultimately, the project managers should strive to address any unacceptable lead-exposure risks at the residence. Sampling and the establishment of clean-up mechanisms needed to take action, such as HUD grants for paint abatement, should be completed as early in the remedial process as possible. Even so, it may not be possible to address all sources of lead in the ideal sequence. When this occurs, other measures should be taken to minimize the potential for recontamination (i.e., to protect the remedy). For example, if deteriorating exterior LBP is present, it is recommended that it be removed prior to initiating any soil clean-up activities in the yard.

Due to transport of lead among media, the preferred sequence of lead clean-up activities at a residence with LBP and lead-contaminated soil would be to clean up the paint first, then the yard soil, and then the interior dust. Clean-up activities performed counter to this sequence increase the risk of recontamination. For example, performing a soil cleanup first at a residence with exterior paint problems increases the potential for recontamination of the soil from the exterior paint. Similarly, interior dust can be recontaminated by interior LBP. Exterior sources have been shown to cause recontamination of the interior when cleaned before community-wide yard cleanup is completed (EPA, 2000e). Accordingly, project managers should make every effort to coordinate the sequence of clean-up activities to prevent recontamination.

CERCLA and the NCP limit Superfund authority to address interior LBP (see Section 1.2) (EPA, 1990b). If a mechanism exists for addressing the paint, such as a HUD grant or a Supplemental Environmental Project (SEP), then the timing of the paint encapsulation or abatement activities may not coincide with the soil cleanup. Additionally, residents may be more reluctant to grant access for dust remediation since it is more intrusive. On the other hand, EPA actions taken to address lead in drinking water from site sources usually can be taken independently from any soil, dust, or paint cleanups, and should be done as soon as practical.

> Supplemental Environment Project (SEP) – Environmentally beneficial projects which a defendant/respondent agree to undertake in settlement of an enforcement action, but which the defendant/respondent is not otherwise legally required to perform.

6.6.1 Lead-Based Paint

The 1998 Clarification presents OSWER's policy with respect to remediation of interior paint, exterior paint, interior dust, and lead plumbing. Regarding interior LBP, the 1998 Clarification states:

> "EPA has limited legal authority to use Superfund to address exposure from interior lead-based paint. As a policy matter, OSWER recommends that such exposures not be addressed through actual abatement activities. However, EPA Regions should promote addressing interior paint risks through actions by others, such as HUD, local governments and health authorities, or individual homeowners as a component of an overall site management strategy. Any activities to clean up interior lead-based paint by potentially responsible parties (PRPs) or other parties should not result in an increase of the risk-based soil clean-up levels" (EPA, 1998a; Appendix B).

Regarding exterior LBP, the 1998 Clarification indicates that the Regions should avoid using the Superfund trust money for removing exterior LBP and soil contaminated from LBP. However, Superfund dollars may be used to respond to exterior LBP to prevent recontamination of soils that have been remediated, but only after determining that other funding sources are not available (EPA, 1998a; Appendix B). The 1998 Clarification states: "As with interior lead-based paint abatement, EPA Regions should promote remediation of exterior lead-based paint by others, such as PRPs, local governments, or individual homeowners. Clean-up activities of exterior paint conducted by PRPs or other parties should not result in an increase of the risk-based soil clean-up levels" (EPA, 1998a; Appendix B).

As a practical matter, project managers should inform each resident regarding the presence or absence of LBP in their home, and options for encapsulation and abatement. The local health agency and/or the state health agency should be informed regarding the availability of HUD grants for paint assessment and abatement. Additionally, regarding PRP-funded cleanups, if any penalties are being considered for non-compliance (Section 6.9), consideration should be given to allowing the PRPs to perform a SEP for paint assessment and abatement in lieu of some or all of the penalty amount.

6.6.2 Interior Dust

Lead-contaminated interior dust can be derived from multiple sources, including exterior soil, interior and exterior paint, homeowner hobbies, workplace, and other exterior sources; thus, it may be difficult to differentiate between sources of dust contamination. Household lead dust contamination may be a significant contributor to elevated blood lead levels, especially for younger children (under the age of three), and may need to be evaluated in determining risks and clean-up actions at residential lead sites. However, as pointed out previously, there are limitations on EPA's authority to abate these sources of contamination to the extent they are not related to releases or threatened releases to the environment (Appendix B).

Based on the 1998 Clarification, OSWER recommends that Superfund monies should generally not be used to take CERCLA response actions for addressing residential dust exposures due solely to interior paint or other interior sources. However, Superfund monies can be used to address interior dust if it can be shown to be derived from an exterior pollution source (e.g., air lead concentration caused by lead smelter, mining, or mineral processing). Dust mat sampling, which was done at the Bunker Hill Site in Idaho (EPA, 2000e), is one possible method of lead source identification; speciation, which is costly, is another method. (Dust mats are used to measure dust lead concentration and loading rates in residences and other structures.) Where interior dust is being addressed by other authorities, the recommendations presented here may be helpful to guide the dust cleanup.

If the lead in interior dust is solely derived from interior paint, EPA should promote addressing interior dust risks through the actions of others, such as HUD, state and local governments, PRPs, or individual homeowners, as a component of an overall site management strategy. The overall site strategy, as outlined below, should also consider the proper phasing/sequencing of actions to address the multiple sources of lead risks at residential lead sites, as discussed at the beginning of Section 6.6.

The baseline risk assessment should document the relative contributions of lead uptake from all relevant media including direct soil exposures and secondary exposures to soil in indoor dust. Replacement of defaults with a site-specific value for the interior dust concentration, or the soil-to-dust relationship (M_{sd}), should be justified through the use of high quality, compelling, site-specific data (EPA, 1994b, 1998c). Dust sampling is preferred for risk assessment and remedial decisions, but dust modeling may be needed to develop or refine soil action levels.

Lead-contaminated interior residential dust presents a significant exposure pathway that can readily be addressed. Consequently, significant health benefit is gained by removal of contaminated interior dust as early in clean-up activities as possible. However, exterior contamination sources present a threat of recontamination to interior of residences (EPA, 2000e; TerraGraphics, 2001). Therefore, any interior dust clean-up actions should be periodic throughout the project and should culminate in a final cleaning of all residences exceeding an action level after the exterior sources have been remediated. As a practical matter, risk management and reduction may need a phased strategy as recommended below:

Early-Phase Actions: Public awareness and health education efforts should be initiated immediately. Entry way dust mats should be provided to residents. HEPA-filter vacuum cleaners should be provided for use by residents. If warranted, a program to abate interior lead-contaminated dust in homes with acute levels should be initiated to provide temporary risk reduction.

Establish appropriate public health partnerships with state and local health departments, ATSDR, and HUD as early as practical.

Mid-Phase Actions: The source of the interior dust lead contamination should be identified. Monitoring of the changes in lead-contaminated dust (e.g., lead loading in dust, lead concentration in dust, exterior-to-interior lead transport) should be initiated. The public awareness/health education efforts and availability of HEPA-filter vacuum cleaners for use by residents should be continued. Assistance to remove and dispose of old carpets should be provided to residents after yard cleanup has occurred.

Final-Phase Actions: Once the exterior lead sources that were found to contribute to interior dust have been addressed, the final step should consider the active remediation of interior lead-contaminated dust. Actions may include: removal of carpeting, cleaning heat and ventilation ducts, wet wiping hard surfaces and soft surfaces (furniture, draperies, bedding, clothing, etc.). Most of these actions should be limited to living spaces. Areas such as attics, crawl spaces, and other non-living spaces need not be addressed unless they are shown to be a continued source of contamination to the living areas . It is important for dust remediation to be performed as the last phase in the site clean-up process to minimize the risk of recontamination.

6.6.3 Lead Plumbing/Tap Water

The 1998 Clarification states: "Generally CERCLA does not provide legal authority to respond to risks posed by lead plumbing within residential dwellings. It should be noted that the water utility is responsible for providing clean water to the residences. As with interior dust, OSWER recommends that EPA Regions coordinate with local agencies to establish a health education program to inform residents of the hazards associated with lead plumbing and how to protect themselves by regularly flushing, or preferably, replacing lead pipes. Soil clean-up levels should not be adjusted to account for possible remediation of lead plumbing" (EPA, 1998a; Appendix B).

With regard to tap water, it should be sampled, and lead levels in the purged sample in excess of the maximum contaminant level (MCL) established by the Safe Drinking Water Act should be addressed. In general, lead concentrations in the purged sample greater than a removal action level (RAL) of 30 µg/L should be addressed through TCRAs; concentrations between the MCL and RAL should be addressed through NTCRAs or long-term remedial actions. Actions that could be taken include provision of bottled

water, connection to a municipal water supply, tap filtration, and installation of deep wells (in remote areas and where shallow groundwater is contaminated). Regarding first run exceedance for lead, the homeowners should be notified that they may need to address a plumbing or corrosion problem, which is outside of the scope of Superfund.

6.7 PREVENTION OF RECONTAMINATION

Project managers should take steps to mitigate recontamination. During site closeout and five-year reviews, the project manager should also check for recontamination at levels which may threaten the remedy.

At many large-area lead sites, cleanup occurs over a long period of time and through multiple phases, throughout which the potential for recontamination exists. During each of these phases, windblown dust sources, vehicle tracking, flooding, and other mechanisms can recontaminate previously cleaned areas. Although best management practices (BMPs) should minimize the movement of contaminated material from each residence being cleaned, vehicle tracking of contamination from areas yet to be cleaned up can significantly raise concentrations of contaminants in cleaned areas. During the early phase, typically an emergency response action, cleanup is focused towards Tier 1 properties, and cleanup favors a "hop scotch" approach to address the worst risks first. This method of remediation can result in recontamination of clean properties. Confirmation samples should be collected in any areas that have been potentially recontaminated.

Another aspect of large-area lead sites is that complete cleanup of residential properties does not always take place for a variety of reasons (see Sections 6.2 and 6.4); instead a barrier or soil cover is put in place over contaminated soils. Flooding can pose a serious problem for these areas in that flood waters can erode away clean materials leaving subsurface contamination exposed, and entrained sediments bearing contamination may be left on top of newly remediated properties. Inadequate drainage of runoff can move lead into cleaned areas (e.g., lead particles on a crowned road with no curb and gutter may be rinsed onto adjacent residential properties with normal rainfall). Additionally, the activities of burrowing animals can bring contaminated soils to the surface.

> Best Management Practice (BMP) – In general, BMPs are a combination of practices that are determined to be the most effective and practicable means of controlling point and nonpoint pollutants at levels compatible with environmental quality goals. In this document, BMPs specifically refer to measures taken during construction activities on properties where contamination has been left at depth to prevent the transfer of those contaminants to other media.

Recontamination of clean soil cover can be caused by ongoing homeowner projects, such as digging a hole through a clean barrier to install fence posts or a new tree or shrub, if preventative measures are not taken. Education and licensing of contractors who work on clean barriers/markers should generally be required (e.g., as part of a local ordinance) to ensure the longevity of the remedy. Also, at many sites (e.g., Bunker Hill), ICs have been most effective when linked to the "call before you dig" program typically operated by many counties to avoid disruption of utility service. In addition, large scale residential development projects that may raze old housing in favor of new will frequently recontaminate areas where lead-contaminated soil was left at depth, without appropriate BMPs in place. BMPs include silt fences, hay bales, etc., to limit movement of contamination off a project site, and stockpiling of contaminated soil on a tarp to prevent contamination of underlying soil (Figure 6-3). EPA provides guidance on the implementation of BMPs in construction activities at sites where contamination is present (EPA, 1997e). Best management practices typically add about 5 percent to project cost (TerraGraphics, 2000). Periodic inspections of residential areas should be performed by the local government to ensure that projects within the site are implementing BMPs.

Wind blown dust can pose a significant threat to the health of individuals at a site and can cause recontamination. Tailings impoundments that have dried can be large sources of windblown lead dust. Most tailings impoundments are large; a wind sweeping across the face of one can carry substantial amounts of contaminated dust and then deposit these particles on a downwind residential area, both causing increased exposure to contaminants, and recontaminating clean areas. Wind blown dust sources are typically a key issue to be addressed early in the sequencing of site activities to minimize this migration.

These are but a few examples of how recontamination can be an ongoing problem that needs to be considered at every site during each phase of cleanup. Although mechanisms vary from site to site, the types of response actions put in place and the sequence in which these actions take place can play a significant role in enhancing the permanence and effectiveness of a remedy.

A disposal area may be needed to dispose of contaminated soil from the site to support typical homeowner projects, as some municipal landfills may not accept contaminated soil. Without free or low cost disposal for contaminated soil available to each homeowner and renter, improper disposal is more likely, which would result in recontamination. In addition, a disposal area may be needed if certain materials at a site, such as carpets, fail TCLP and cannot be commingled with solid waste. It may even be appropriate for the remedy to provide free removal of contaminated soil and provision of clean soil to homeowners (but contractors may be required to pay for these services, or obtain material from approved sources) to encourage maximum compliance and further ensure the longevity of the remedy. The

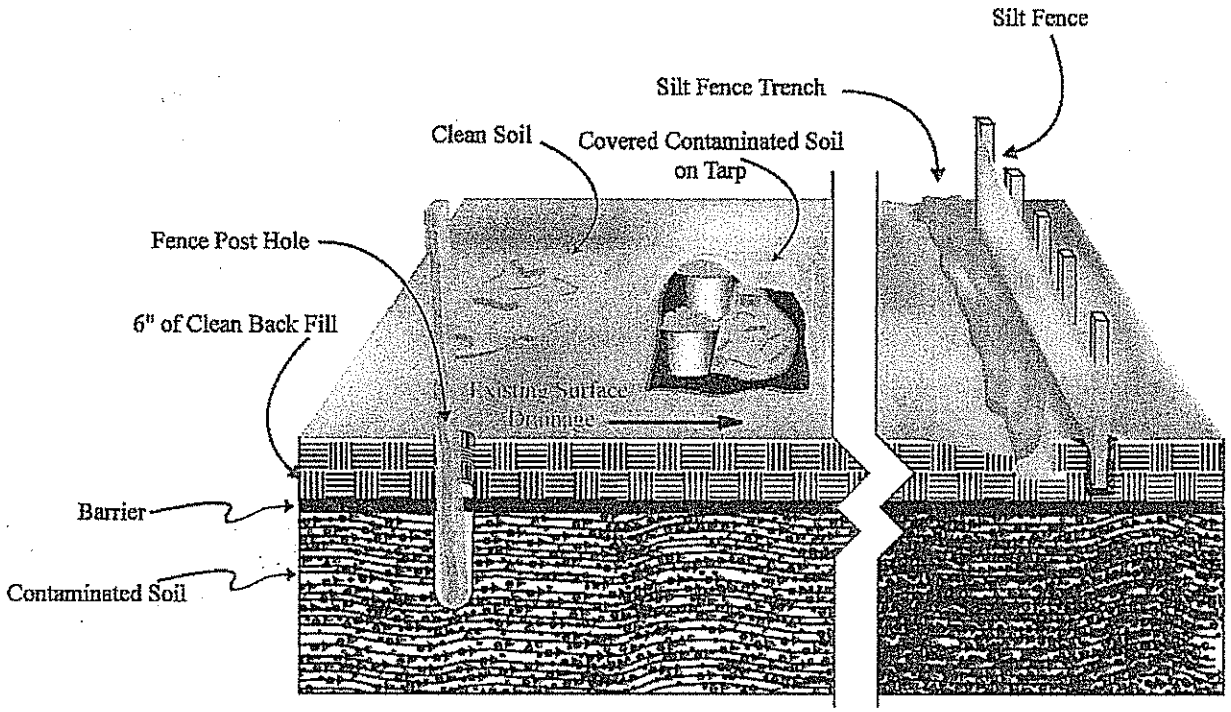


Figure 6-3. Implementing Best Management Practices (BMPs) during construction work. The best management practices (BMPs) shown in the above figure (e.g., a clean soil barrier) represent one component of the ICs which may be put in place by local ordinance to ensure the long-term protectiveness of the remedy and to prevent recontamination. The purpose of BMPs is to minimize the potential for accidental exposure of humans during construction and maintenance activities on sites where wastes have been left in place. The staging of contaminated soil on tarps and/or in small buckets, and the installation of silt fences downgradient of the construction area are examples of BMPs intended to prevent the migration of contaminated material from the construction site. Please refer to Section 6.7.3 for further explanation.

maximum concentration of lead (and perhaps other constituents) allowed in "clean" soil, and the required sampling frequency, should be specified in an IC.

Over the long term, cleanups may not be possible at every property at the same time. A trust fund should be established for the site for the cleanup of properties that are deferred for various reasons, which should be implemented by the local government. In this manner, changes in property ownership over time may be more closely monitored to determine when cleanup at deferred properties might be appropriate (see Section 6.9). Local implementation of the trust fund will ensure that cleanup of these properties occurs as soon as possible, further ensuring the protectiveness of the remedy, further ensuring the protectiveness of the remedy by minimizing the potential for recontamination to the extent possible.

6.7.1 Early Actions

Early response actions (including cleanups for sensitive subpopulations) can be an essential aspect of the response action at a site, as discussed above. These actions should be conducted simultaneously with source area control. The following are considerations that may reduce the potential for recontamination when scoping an early action.

- Seek permanence in selecting the clean-up alternative(s), if possible, such as complete removal to depth of soil contamination at properties where there is an acute risk.

- Consider cleanup of adjacent properties simultaneously that may threaten the permanence or effectiveness of the early action.

- Control fugitive dust sources, access, tracking, and erosion of contaminants to the extent possible.

- Perform HEPA street sweeping to minimize tracking of contaminants throughout a community.

- Evaluate the feasibility of conducting the cleanup of residential areas in their entirety during the early removal phase if contamination is widespread. If this is not possible, limit the early removal actions to immediate risks (Tier 1 and Tier 2 residential properties, including residences with elevated blood lead levels) in order to minimize the potential area where recontamination might occur.

- Provide informational fact sheets to homeowners on how to minimize recontamination on their property.

- Establish an IC to manage cleaned areas. This could involve local and state government agencies, and PRPs that are available to recommend best management practices for homeowner projects and provide education to the homeowner, as well as utility districts and companies likely to breach the barriers/markers put in place.

- Provide site plans or other documentation of areas that have been cleaned up, as well as information on areas that are still contaminated, to the local governmental entity responsible for the maintenance of the remedy, i.e., for monitoring ICs and for tracking properties over time.

- Establish a geographic information system (GIS) for monitoring ICs and properties.

6.7.2 Long-term Remedial Action

Some or all of the following measures may be useful to address the risk of recontamination during the remedial action (Tiers 2 and 3, if a tiered approach is used) and post-design phase:

- Evaluate the permanence and effectiveness of the various remedial actions under consideration. Consider the economic feasibility of complete contaminated soil removal to minimize reliance on ICs.

- Conduct a cost analysis comparing the cost of long term ICs to those of complete removal (EPA, 2000f). For example, property depreciation, tax base impact, additional procedures/cost of utility work, flooding complications/costs, and long term IC administration cost should be taken into account when comparing the cost of a partial removal of contaminants to a complete removal. Property depreciation, while possibly subtle for each property, may add up to substantial losses for the entire community in reference to a county tax base. Also, losses for an individual property over a lifetime of sales could add up to a significant cost. Following cleanup, increases in property valuation from source removal or drainage/infrastructure enhancements (and savings/in-kind services to municipalities) should be considered.

- Remedial action should strive to remediate the contamination in the community by segregable areas, such as a town, or a divisible segment of town. Each segregable area should be cleaned up as quickly as possible (e.g., within one construction season) to minimize recontamination of cleaned properties and to compound the protection to human health (EPA, 2000e). Each community should be cleaned up block by block within these segregable areas, utilizing BMPs to mitigate tracking of contaminants. Site experience suggests that cleanup of up to 800 properties per site per year is possible.

- Fugitive dust that may be a source for recontamination, and access to such sources should be controlled. Air monitoring along with depositional modeling may be necessary to determine if windblown dust presents a significant threat of recontamination. Significant sources of windblown dust should be controlled prior to or simultaneously with cleanup of adjacent residential areas. Consider HEPA street sweeping during remediation and immediately following completion of cleanup to minimize tracking of contaminants throughout a community.

- Complete removal of contaminants should be considered in flood prone areas or areas with a high groundwater level due to the inherent difficulty in maintaining a soil cover remedy in a flood prone area. Drainage-ways containing contamination within their 100-year floodplain, which are

not addressed in the remedy could also lead to remedy failure if the contaminants are eroded to other areas.

- Remediation of contaminated rights-of-way should occur within segregable areas simultaneously, if possible, or as close together in time as possible to minimize vehicle tracking and recontamination of driveways from the rights-of-way.

- Control measures for all remaining sources, such as mining waste piles surrounding the community, should be developed to ensure the remediated neighborhoods are kept clean. ICs should be established to ensure the control, or proper use and disposal of any wastes remaining on site.

- If the residential remedy includes replacement of soils, removal of deteriorating exterior LBP (e.g., by pressure washing) should be considered to minimize the soil recontamination potential.

- Other sources of residential property recontamination should also be considered. For example, homeowners may bring in contaminated soil for fill or other uses on their property.

- Establish permanent funding for ICs. Unless all contaminants are removed, some level of ICs may be necessary. Early establishment of a program is the key to success of a remedy that consists of a partial removal of contaminants.

6.7.3 Institutional Controls (ICs)

EPA defines ICs as administrative and/or legal mechanisms that: (1) help minimize the potential for human exposure to contamination, and (2) protect the integrity of the remedy. ICs accomplish these objectives by directly limiting land or resource use, and/or by providing information that modifies behavior. ICs are used throughout the remedy pipeline, including (1) when contamination is first discovered (i.e., prohibition of excavation of newly discovered soil contamination), (2) when the remedy is ongoing (i.e., restrictions on property use until clean-up levels are met), and (3) when hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

At sites where minimizing exposure is the primary purpose of the IC, it is EPA's policy that if a site cannot support "unlimited use and unrestricted exposure" (EPA, 2000f), ICs are generally required. The "unlimited use and unrestricted exposure" threshold is a site-specific determination similar to that of a five-year review. Essentially, if contamination could result in an unacceptable exposure, ICs would be

required. This is often the case at lead cleanups because residual contamination is frequently managed onsite. Note that the term "residential" is often used interchangeably with the "unlimited use and unrestricted exposure" threshold but these are not synonymous terms. For example, a lead cleanup where the top layer of soil has been removed and replaced can result in a residential use at a site that includes restrictions (e.g., restrictions on digging, requirements for elevated gardens, and an information/outreach program, etc.).

The second common purpose of an IC is to protect the integrity of a remedy. In the lead clean-up context this may mean using institutional controls to prevent penetration of a cap or damage to monitoring equipment. An important consideration in this context is what type of IC will provide the required remedy protection. For example, the primary concern for protecting a remedy in a lead clean-up scenario is typically uncontrolled excavation. For this reason it is important to select ICs that will be relevant to excavators. Examples of potentially effective ICs are local digging or drilling permits and "One-Call" or "Miss Utility" systems. Examples of potentially ineffective ICs are deed notices, because excavators seldom check land records prior to digging.

To better understand the correct IC approach, it is important to understand what tools are available. In general, there are four categories of ICs commonly used in cleanups: governmental controls, proprietary controls, enforcement and permit tools with IC components, and informational devices. The definitions provided below were taken in large part from the current EPA guidance (EPA, 2000f).

Governmental controls are usually implemented and enforced by a state or local government. Some of the more common examples include things like zoning restrictions, building/excavation permits, groundwater drilling and use permits, ordinances, or other provisions that restrict land or resource use at a site. These types of mechanisms are popular in remedies because the administrative processes are in place and are typically well understood within a particular jurisdiction. The greatest concern with this type of control is that it is often implemented, monitored, and enforced by an agency other than EPA or the state.

Proprietary controls are unique in that they have their basis in real property law and that they generally create legal property interests. An example of this type of control is an easement that provides access rights to a property so that an agency may inspect and monitor a cover system. A proprietary control may also be used to restrict certain activities on the property, such as excavating below a certain depth. These are powerful tools in that they can be made to "run-with-the-land" (i.e., effective if ownership changes), but they provide significant challenges because property interests are often transferred. EPA is limited by CERCLA §104(j) with regard to acquiring interests in real property. Prior to acquiring an interest in real property the state must provide an assurance that it will accept transfer of

that interest at completion of the remedial action. This requirement applies at both Fund-lead and enforcement-lead sites. Therefore, if a proprietary control involves the transfer of an interest in real property, EPA must obtain this assurance and find an appropriate entity to hold the interest following the remedial action. At Fund-lead sites this will most likely be the state. At enforcement sites, it may be the state, a PRP, or some other interested and qualified party. In addition, proprietary controls are based on state law, and EPA and many state environmental agencies have limited real estate or common law experience. This can complicate proprietary control enforcement.

Enforcement and permit tools with IC components under CERCLA Sections 104 and 106(a) include unilateral administrative orders (UAOs) and AOCs, which can be issued or negotiated to compel the land owner to limit certain site activities at both federal and private sites. In addition, CERCLA 122(d) authorizes the use of consent decrees at privately-owned sites. Enforcement devices are some of the more common ICs. The strength of these types of tools is that EPA or states can directly enforce them (rather than relying on a local agency for governmental controls or using real estate common law for proprietary controls). The major weakness is that they may be enforceable only against the signatory, recipient, or permitee (i.e., may not run with the land to bind future property owners).

> Unilateral Administrative Order (UAO) – When EPA negotiates with a Potentially Responsible Party (PRP) to do cleanup work at a Superfund site, the agreement may be documented in an administrative order on consent (AOC). If the negotiations fail, EPA has the authority to compel the PRP to do the cleanup by issuing a unilateral administrative order (UAO). Administrative orders are issued under CERCLA sections 104 and 106.

Informational devices are types of devices that only provide information or notification that residual or capped contamination may remain on-site. These types of tools are common at lead cleanups to both provide notification of residual contamination and to provide information that may modify behavior to minimize the potential for unacceptable exposure. Examples include placing a property on a state contaminated properties registry, developing deed notices, and providing periodic lead-education advisories to residents. Due to the nature of informational devices and their non-enforceability, it is important to carefully consider the objective of this category of ICs. Informational devices are most likely to be used as a secondary "layer" to help ensure the overall reliability of other ICs.

There is typically an inverse relationship between the amount of cleanup and the degree of reliance on ICs (i.e., the more cleanup, the less reliance on ICs). EPA tends to focus on a number of considerations when evaluating the long-term viability and amount of redundancy required for ICs at a particular site. EPA guidance strongly advocates the use of ICs in "layers" and/or in "series" (EPA, 2000f). Layering ICs means using multiple ICs concurrently (e.g., a consent decree, deed notice, educational/informational devices and a covenant). Using ICs in series is appropriate when IC

mechanisms are removed or changed as site circumstances change, such as reduction in restrictions during the clean-up life-cycle. As illustrated in the descriptions of the different categories of ICs, there are inherent strengths and weaknesses with each type. The goal is to obtain the best mixture of ICs to manage the risk at a site over the long-term. There are many important factors to consider when determining how many ICs are required at a site. The following is not intended to be a comprehensive list, but rather illustrative of the site-specific nature of these types of decisions. A few common considerations include: (1) the type of enforcement mechanism used (consent decree, order, permit, ordinance); (2) who will enforce the mechanism (i.e., EPA, the state, local agency, third party, etc.); (3) who the intended IC will effect and how; (4) the level of sophistication of the party implementing the cleanup and those remaining on the property; (5) the expected property use (likelihood of redevelopment and/or resale); and (6) the degree of cooperation exhibited by the parties to the cleanup. Since ICs can impact future development at sites, it is important to work cooperatively to determine the appropriate mix of ICs. The objective is not to use as many layers of ICs as possible, but rather to strike a balance that gives the regulators the certainty that the site remedy will be protective over time while maximizing the site's future beneficial use.

At many large lead sites, GIS systems are used to track the cleanup status of properties located on the site. The tracking system facilitates the monitoring of ICs and the maintenance of the remedy. GIS systems can be operated by local governments, state governments or PRPs.

6.8 CLEAN-UP DOCUMENTATION

Upon confirmation that initial yard sampling indicates a given residential yard does not exceed the lead clean-up level for the site, or upon the completion of the cleanup of a residential yard, a letter ("clean" letter) should be sent to the property owner documenting that EPA considers the lead level in the yard to be below the level of human health concern. Prior to issuing a "clean" letter, a property closeout form should be signed by the property owner, which documents the owner is satisfied with the remediation of the property. Examples of property closeout forms are proved in Appendix G. Any areas that are not cleaned up via the owner's request, such as gardens, should be noted in the "clean" letter. If contamination is not cleaned up to depth, this fact, along with protections (i.e., barriers/markers) that are put in place, should be stated in the "clean" letter. The "clean" letter provides official documentation to the property owner for use in future property sales or transactions. Sample "clean" letters are provided in Appendix H.

6.9 ENFORCEMENT

The project manager should strive to characterize all residences within the identified zone of contamination, and achieve cleanup at all residences where lead concentrations exceed the clean-up level. At all residential clean-up sites, a percentage of homeowners typically will refuse to grant access to EPA for sampling and/or for cleanup. In order to meet remedial goals of protecting a community, all residences suspected of being located within a zone of contamination should be sampled. It is important to work with the landowner and be sensitive to a landowner's concerns regarding property access. The project manager should educate the landowner of the dangers that lead contamination may pose. If a landowner still refuses to grant access, the Region should consider issuing an access order for sampling (EPA, 1990c).

An owner of residential property on a Superfund site may be potentially liable under CERCLA § 107(a)(1). However, EPA, as an exercise of enforcement discretion, generally will not take CERCLA enforcement actions against an owner of residential property unless the residential homeowner's activities lead to a release or threat of release of hazardous substances resulting in the taking of a response action at a site. (See Policy Towards Owners of Residential Property at Superfund Sites (July 3, 1991)). Additionally, under CERCLA a residential property owner may qualify for protection from CERCLA liability as a contiguous property owner, bona fide prospective purchaser, or innocent landowner. Under both the statute and EPA's policy, a residential property owner is expected to cooperate with EPA and the person taking the response action. This obligation includes providing access and information as requested, agreeing to comply with land use restrictions relied on in connection with the remedy, and not impeding the effectiveness the effectiveness or integrity of institutional controls. (See CERCLA §§ 101(40)(B)-(H), 107(q)(1)(a), 101(35)(A)-(B)). The project manager should work to inform and educate an owner of EPA's expectations for cooperation in connection with the remedy. If necessary, to meet the commitments of the remedy, EPA should consider taking appropriate steps, such as issuing a UAO, to secure the cooperation of an uncooperative landowner.

If some properties are not addressed under site response actions (e.g., current homeowners with no young children or women of child-bearing age), then consideration should be given to establishing a trust fund (under state authority or local law), to be administered by a local government, for the cleanup of the property at a future date, when the property is transferred (e.g., by sale) to a new owner (see text box). Buyers of contaminated properties could make use of the fund to have the property cleaned up at their discretion.

Example Trust Fund – At the Bunker Hill Superfund Site, a number of property owners refused to have their residential yards cleaned up. Without any obvious need to cleanup the property right away, e.g. an unpaved, contaminated driveway that threatens to recontaminate the neighborhood or a child living at the residence or next door, the PRPs for the site were willing to give the State funds to set aside in an interest bearing account to clean up the properties in the future, when the property changes hands. Property status is then monitored by the local Health District as part of the institutional controls program. The State then manages the funds to ensure maximum interest accrual in an irrevocable trust and disbursement according to the limitations set up in the trust -- for residential property cleanup. Cleanup then occurs under State oversight at the time new owners buy the property thereby ensuring families with children that move into the community are protected.

In the case of rental properties, EPA should order access for cleanup by UAO to all owners of contaminated rental property who refuse access. To ensure the protection of occupants, enforcement of the UAO may be necessary to clean up all rental properties with contamination greater than the clean-up level.

7.0 FIVE-YEAR REVIEW

> Five-Year Review – Pursuant to section 121 of CERCLA and the NCP, remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure need to be reviewed every five years to ensure protection of human health and the environment.

CERCLA §121(c) requires an assessment of certain remedial actions every five years on sites where contamination has been left on site (EPA, 2000a). Guidance for conducting five-year reviews has been issued (EPA, 2001h). The purpose of a five-year review is to evaluate the performance of a remedy to determine if the remedy continues to be protective of human health and the environment. Typically, at large lead sites, such as mining and smelting sites, the volume and areal extent of contamination is such that total removal of all contamination above the health-based risk level is economically impractical. Contaminated wastes are generally left on site and covered with soil. The remedy for these types of sites typically includes some type of IC to address residual or encapsulated contamination. A five-year review can determine whether the remedy is stable (i.e., soil covers are undisturbed, and clean areas are not being recontaminated from sources remaining on the site). The review should also assess the ICs that were established for residual source control to determine their effectiveness in protecting human health. As described below, the five-year reviews at large lead sites may involve the collection and evaluation of substantial quantities of data and require significant up-front planning. Much of the following discussion may not apply to small sites.

At many sites, an exposure study has been performed prior to any clean-up activities to determine blood lead concentrations of children in the community. A follow-up exposure study of residents should be conducted during the five-year review to determine if the concentrations have decreased below levels of concern. If the blood lead concentrations have not decreased to acceptable levels, additional environmental studies and individualized, follow-up exposure investigations should be conducted to determine the pathways of exposure that may need to be addressed. Long-term exposure studies can be very useful in understanding exposure trends at a site. They also can be useful to ensure that no pathways of exposure have been missed and to help identify areas of the site that have been recontaminated. In this manner, the project manager can use health data as a means to "double check" the effectiveness of the remedy and to corroborate environmental data. However, blood lead data from limited sampling should not be used as the only metric for gauging the success of a remedy, even if it can be used to identify specific problems. The project manager should coordinate with ATSDR and the local health district with respect to planning and funding such a program.

The five-year review should include resampling at a percentage of each type of property that was remediated during the clean-up actions. A baseline level of resampling should be designed to achieve a

pre-specified level of statistical significance and power. This sampling should assess the potential for recontamination that may be occurring, and may help identify any pathways that may have been missed during remediation. Any sampling that indicates widespread or clusters of soil levels above clean backfill concentrations should be monitored over time to determine if an upward trend exists that may jeopardize the remedy.

Additionally, some level of house dust sampling should occur to determine if levels are rising or falling. House dust, being a primary exposure pathway, should be used as one indicator of remedy effectiveness and also used to detect the presence of recontamination. Lead concentrations in house dust levels often correlate to interior LBP, which is not usually addressed by Superfund (Appendix B). Therefore, interior paint sampling should also be conducted as a component of the risk assessment to aid in determining the source of the lead loading to dust.

At large lead sites, remedy protectiveness issues will often relate to the implementation and management of ICs and recontamination of areas previously cleaned. The five-year review should evaluate the effectiveness of the site ICs and recommend corrections to address any deficiencies that are identified. In order for a five-year review to be effective at sites where ICs are a component in ensuring the effectiveness of the remedy, there should be: (1) clear documentation of the specific type of ICs that were to be implemented, and (2) accurate and complete tracking of subsequent activities and changes in property use following completion of the Superfund remedy.

The following are possible deficiencies for several types of commonly-used ICs and other control measures taken to ensure the protectiveness of the remedy:

- HEPA vacuum loan program not being broadly used.
- Information on interior home cleaning not being widely distributed.
- Lack of access control along rights-of-way, and in unremediated areas.
- Inadequate decontamination of vehicles leaving areas of existing contamination.
- Erosion of unremediated areas onto remediated properties.
- Lack of or inadequate disposal area for snow (that contains contaminated soil).
- Lack of drainage infrastructure and maintenance by local entities.
- Uncontrolled utility excavation in areas with contamination at depth.
- Inadequate road maintenance in areas where contamination exists at depth.
- Inadequate disposal capacity to handle IC-generated wastes.
- Discontinuation of, or diminishing, health education program.
- Decrease of blood lead monitoring.
- Complicated/unfounded ICs and/or change in local government acceptance of ICs.

8.0 FEDERAL FACILITIES

The purpose of this section includes the following: (1) to provide direction to EPA federal facility project managers who oversee response actions involving lead contamination of soils from LBP in residential areas of federal facilities; (2) to build and elaborate on the joint March 1999 EPA and DOD Principles Memorandum (DOD/EPA, 1999a) and the December 1999 Lead-Based Paint Interim Field Guide (DOD/EPA, 1999b); (3) to address situations where the DOD service component will conduct the response actions and the regulatory agencies will provide oversight; and (4) to address the unique considerations that arise when the federal government transfers LBP-contaminated property that is subject to CERCLA §120(h) to non-federal parties (e.g., states, local governments, local reuse authorities [LRAs], and private entities, etc.).

While existing policy, guidance, and directives on lead contamination are applicable at federal facilities, property transfer issues present unique requirements that necessitate this section. This section applies to properties that will be transferred for residential use which are contaminated with lead due to LBP or to properties/parcels whose use would expose sensitive populations (e.g., infants, toddlers, small children, nursing mothers) to unacceptable exposure to lead after the properties are transferred to non-Federal entities.

Beginning in 1995, EPA and DOD began to address policy differences on the clean-up levels for lead in soils from LBP. In 1998, Sherri Goodman, then Deputy Under Secretary of Defense (Environmental Security) and Tim Fields, Assistant Administrator for OSWER, reached agreement on the management of LBP at residential and non-residential areas at BRAC properties. In March 1999, this agreement was formalized as the 'Principles Memorandum' (DOD/EPA, 1999a). The Principles Memorandum stated that for residential areas located on BRAC sites, Title X procedures provide an efficient, effective, and legally adequate framework for addressing LBP in residential areas, and that as a matter of policy, CERCLA/RCRA would apply in limited circumstances. EPA and DOD agreed that generally for residential areas that were being transferred, Title X regulations would apply and that CERCLA/RCRA would apply in limited circumstances. Residential real property is defined by Title X as real property on which there is situated one or more residential dwellings used or occupied, in whole or in part, as the home or residence of one or more persons. It is important to note that Title X defines residential property differently than the Handbook.

For federal property transfers subject to CERCLA where there is a concern about lead contamination to soils from LBP, EPA Regions, where they are involved, will need to make a determination whether the property meets the requirements of CERCLA §120(h)(3). This section of CERCLA outlines deed requirements for transferring property and requires covenants indicating that all

remedial actions have been taken at the site. Federal property contaminated with lead from LBP should be evaluated based on its use, or its intended reuse, before the property has been sold or transferred to another private entity. EPA's evaluation of the transfer should be based on an evaluation of lead contamination by either relying on existing and available information gathered through a combination of file searches and a review of existing data and/or a site risk assessment, which may require the collection and analysis of additional soil samples.

The soil sampling design should be specific to the site. The actual or suspected presence of lead contamination in soil does not necessarily require sampling. Factors to be considered before designing a sampling plan include, but are not limited to, the nature of the facility's operations, its operating records, the age of the buildings/structures under consideration, the maintenance schedule for the buildings/structure, visual inspection, and future use. Based on these factors, it may be reasonable to conclude that the potential risks posed by lead may be acceptable and no further evaluation is needed. It may also be important to consider the ultimate disposition of the property once it leaves federal control. For example, the structures may be scheduled to be demolished, so that the abatement of the hazard may be addressed in the demolition process and may negate the need to conduct clean-up activities.

The EPA project manager and, as appropriate, an EPA risk assessor should work with their federal, state, and local government counterparts to develop a sampling design, where required, that would be scientifically appropriate, minimize the cost of sampling, and provide the information required for risk management decisions. As appropriate, the local redevelopment or reuse authority should be consulted as well. Information from the sampling effort could result in different outcomes: a "no further action decision", a conclusion that more extensive sampling is necessary, or, in some cases, a response action. All of these potential outcomes should be discussed with the lead federal agency, and others as appropriate, prior to the initiation of sampling.

If there is insufficient knowledge to make a conclusion about the risk at the site or if the initial sample results indicate an unacceptable risk from lead, data may be collected by a focused sampling of an environmental media to develop an improved understanding of the risk that may be posed by the lead exposure. It may be appropriate to determine that after visual inspection and/or focused sampling, and after consultation with an EPA risk assessor, the lead from the area may not pose a significant risk that requires further evaluation. Risk evaluations should be based upon a number of factors including the reasonably anticipated future land use, exposure potential, ICs proposed or in place, and bioavailability. The Handbook user is encouraged to obtain detailed information on ICs for federal facilities in the document "Institutional Controls and Transfer of Real Property under CERCLA Section 120(h)3(A), (B), or (C)" (EPA, 2000g).

If the property has been used or will be reused as residential real property after transfer, the EPA project manager should verify that the lead federal agency has followed the Title X regulations and policies regarding sampling and risk assessment. As a guide to assist site managers in understanding Title X regulations and policies, EPA and DOD jointly issued a Field Guide (DOD/EPA, 1999b) that is used by EPA and DOD field personnel when assessing hazards due to LBP. The field guide contains information on performing a Title X paint inspection and risk assessment and outlines the requirements for abating soil contaminated by LBP

The Title X program, through the implementation of the new Title IV of TSCA, establishes certification programs and work practice standards to regulate LBP hazard evaluation and abatement in target housing and child-occupied facilities. There are two types of evaluations covered by Title X. The first evaluation is a paint inspection that includes a surface-by-surface inspection to determine the presence of LBP. All painted surfaces with distinct painting histories are sampled. Usually the paint inspection is done by a combination of portable XRF devices and paint chip sampling.

The second evaluation is a risk assessment to determine if LBP hazards exist. A risk assessment includes taking samples of all deteriorating paint, dust, and soil. The final report recommends methods to deal with all LBP hazards that were found, which could include interim controls or abatement. A comprehensive evaluation consists of a combination of a paint inspection and risk assessment. Paint inspections and risk assessment conducted in accordance with Title X must be performed by certified personnel. All results, whether positive or negative, must be disclosed at the time of sale or rental.

The final TSCA 403 regulation (EPA/HUD, 2001), defines a soil-lead hazard as bare soil on residential real property, or on property of a child-occupied facility, that contains concentrations of lead equal to or exceeding 400 ppm in the play area or an average of 1,200 ppm in the rest of the yard. EPA and DOD have agreed that as a matter of policy, for bare soil with lead concentration between 400 ppm and 1,200 ppm, the Service, in consultation with the EPA, has the option of abatement or interim controls. Based on the final HUD 1012/1013 regulations (24 CFR Part 35) (HUD, 2001), federal agencies can transfer the control and abatement requirements to the purchaser, but by law the federal agency is responsible for performing the LBP inspection and risk assessment and must assure that through contractual mechanisms, the purchaser has performed the abatement of the soil in accordance with Title X.

In cases where the EPA project manager makes a determination that actions taken to address LBP hazards are sufficient (following the requirements outlined in the Field Guide), EPA should agree with the federal agency on the transfer documents and the covenant that all remedial action necessary to protect human health and the environment with respect to any such substances remaining on the property has been taken before the date of such transfer . In the case of BRAC sites, the EPA project manager can agree on the Findings of Suitability to Transfer (FOST) or Findings of Suitability to Lease (FOSL) language, and/or the operating properly and successfully (OPS) determination as required by CERCLA. When an EPA project manager has unresolved questions as to whether actions at residential areas meet the requirements of CERCLA, she/he should raise these issues to the federal agency and provide an opportunity for response. In the case of BRAC sites, it is proper to highlight these concerns in EPA's comments on the FOST/FOSL. Efforts should be made to determine that the purchaser is fully aware that EPA has questions about the condition of the property.

Finding of Suitability to Transfer (FOST) – A process that has been established to identify and prepare property for transfer by deed. Such transfers are usually undertaken at a property where environmental response is not needed or has been taken. However, under certain conditions, new authority now permits earlier transfer. The FOST process also looks at the compatibility of an anticipated reuse with completed restoration activities and identifies restrictions necessary to protect human health and the environment.

Finding of Suitability to Lease (FOSL) – A process that has been established for leasing of property that cannot be transferred by deed because environmental restoration activities are still ongoing. The FOSL process also looks at the compatibility of a proposed reuse with ongoing restoration activities and identifies restrictions necessary to protect human health and the environment and prevent interference with the cleanup.

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APPENDIX A

TITLE X AND EPA'S TOXIC SUBSTANCES CONTROL ACT (TSCA) TITLE IV LEAD PROGRAM

TITLE X AND EPA'S TOXIC SUBSTANCES CONTROL ACT (TSCA) TITLE IV LEAD PROGRAM

Background

The Housing and Community Development Act of 1992 (PL102-550) contained Title X the "Residential Lead-Based Paint Hazard Reduction Act of 1992" (HUD, 1992). Even though this was a U.S. Department of Housing and Urban Development (HUD) authorization bill, it established a series of requirements for EPA. Title X includes a new Title IV of the Toxics Substances Control Act (TSCA). The sections that address EPA alone have section numbers in the four hundred (400) series, such as Section 403, Health Based Standards, whereas the HUD portions have numbers in the one thousand (1000) series, such as Section 1015, Task Force. There is one section, Section 1018, that Congress required both HUD and EPA to jointly issue a rule on disclosure.

Overview

Title X addresses LBP and LBP hazards and requires EPA and HUD to issue regulations to address those items. Title X's emphasis is on actual hazards such as deteriorating paint, lead in dust, or lead in soil versus potential hazards such as intact paint. Generally, Title X does not mandate inspections, risk assessments, abatements of LBP, or LBP hazards. The exceptions are HUD program related actions (Section 1012) or when a federal agency disposes of a property that will be used for residential purposes (Section 1013). However, if you choose to do an inspection, risk assessment, or abatement, Title X establishes certification requirements and work practice standards that must be followed. Title X requires disclosure at the time of sale or rental (Section 1018) and the provision of a brochure *Protect Your Family from Lead in Your Home* (EPA, 1999a), before rehabilitation (Section 406b). EPA may authorize state programs to operate in lieu of the federal program for the 400 series regulations but not Section 1018. See Appendix A for a full discussion of Title X.

Scope of Title X

Title X contains specific classes of structures that it regulates. The first category is "target housing", which is defined as "...any housing constructed prior to 1978 except housing for the elderly or persons with disabilities (unless any child who is less than 6 years of age resides or is expected to reside in such housing for the elderly or persons with disabilities) or any 0-bedroom dwelling."

The second category is "child occupied facilities", which are defined as "... a building or a portion of a building, constructed prior to 1978, visited regularly by the same child, 6 years of age or under, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visit lasts at least 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may include, but are not limited to, day-care centers, preschools and kindergarten classrooms" (EPA, 2001a).

As of December 2001 target housing and child occupied facilities are the only classes of structures for which EPA has issued final regulations.

CERCLA 121(e)(1) exempts any response action conducted entirely on-site from having to obtain a federal, state, or local permit, where the action is carried out under §121. In general, on-site actions need to comply only with the substantive aspects of ARARs and not with the corresponding administrative requirements. Therefore, the administrative requirements laid out under TSCA 402 and 403 are not considered ARARs for actions conducted entirely on-site.

More Information

Section 405 requires EPA to establish a Hot Line and Clearing House for lead. This has been done and the National Lead Information Center's toll free number is 1-(800)-424-LEAD. Additionally the EPA web site at www.epa.gov/lead has all the rules, fact sheets, and guidance documents that the EPA Office of Pollution Prevention and Toxics has developed.

Description of the Sections of Title X

Title X Final Rules in Effect for ONLY Target Housing:

Section 1012. This section establishes the requirements for those who get assistance or mortgage insurance from HUD. The requirements are HUD program specific, but only pertain to those who are involved with a particular HUD program.

Section 1013. This section establishes the requirements for federal agencies that dispose of target housing that will be used for residential purposes.

Section 1018. Section 1018 requires that sellers and landlords disclose known LBP and LBP hazards and provide available reports to buyers and renters. Sellers and landlords must also provide a copy of *Protect Your Family from Lead in Your Home* (EPA, 1999a).

This is a joint rule between EPA and HUD. Section 1018 does not include "child occupied facilities"; EPA developed the concept of "child occupied facilities" under TSCA Title IV, the term is only in effect for TSCA four hundred (400) series rules.

TSCA Final Rules in Effect for ONLY Target Housing and Child Occupied Facilities:

Section 402/404 State Certification Programs establishes a nationally consistent federal Program for the certification of individuals and firms engaged in training, paint inspections, risk assessments, and certification of abatement workers, supervisors and training providers. There are two aspects of the program. States and tribes are encouraged to establish a program that as a whole, is at least as protective as EPA's federal program. The state programs can be more protective. When a state program is approved, it becomes the federal program in that state.

If the state or tribe does not establish an acceptable certification program, EPA operates the national program in that state. Much of the work is done in the EPA Regional Office. As of December 2001, 39 states, the District of Columbia, and 2 tribes have EPA authorized programs. Two states with large populations, which do not have authorized programs, are New York and Florida.

Section 403 establishes hazard standards for lead in paint, dust, and soil. Lead-based paint is a hazard if (1) it is deteriorated; (2) it is present on a friction surface that is subject to abrasion and the dust-lead levels on the nearest horizontal surface are equal to or greater than the applicable dust hazard standard; or (3) it is present on any chewable surface on which there is evidence of teeth marks. (Lead-based paint is statutorily defined as paint containing 1.0 milligram or more lead per square centimeter or 0.5% or more lead by weight.) Dust is a hazard if it contains 40 micrograms or more lead per square foot on floors or 250 micrograms or more lead per square foot on window sills. Soil is a hazard if it contains 400 parts per million or more in play areas or 1,200 parts per million or more in the rest of the yard.

This regulation also established the following clearance levels for interior dust: 40 micrograms lead per square foot for floors, 250 micrograms lead per square foot for window sills, and 400 micrograms lead per square foot for window troughs.

EPA's Section 403 rule was intended to prioritize risks as opposed to being inclusive of situations in which risks of concern exist. Per the rule preamble, *"The hazard standard in this TSCA rule was intended as a ''worst first'' level that will aid in setting priorities to address the greatest lead risks promptly at residential and child-occupied facilities affected by lead-based paint"* (EPA, 2001a). While identification of lead hazards (as defined under TSCA) is a necessary part of the facility reuse process, a minimal approach that would insure only that the letter of the hazard standards are met may not protect against some important risks.

Section 405 establishes standards of environmental sampling laboratories. The National Lead Laboratory Accreditation Program (NLLAP) is administered by the American Industrial Hygiene Association and the American Association for Laboratory Accreditation. All laboratory samples must be analyzed by an NLLAP accredited laboratory.

Section 406b requires that the pamphlet *Protect Your Family from Lead in Your Home* (EPA, 1999a) be distributed no more than 60 days before a renovation in the home.

TSCA Rules Being Developed

Section 402. Renovation and remodeling requirements for target housing and child occupied facilities are being drafted as a proposed rule. Requirements for bridges and structures constructed prior to 1978 are being drafted for re-proposal. Both of these could include training, certification, and work practice standards.

Lead-based Paint Debris. This rule was not required by Title X, but the need was clearly there to treat portions of the debris from lead-based activities differently than the RCRA requirements. There are two categories of waste discussed. First is the paint chips and dust, sludges and filtercakes, wash water and contaminated and decontaminated protective clothing equipment that would continue to be subject to all the requirements of RCRA. Second is the "lead-based paint architectural component debris", which would be exempt from the Toxicity Characteristics rule including Toxicity Characteristic Leaching Procedure (TCLP) testing for lead only. This would allow disposal of these components at construction-demolition (CD) landfills.

Although the Pb Debris Rule is still being developed, in the interim, **EPA has issued a Memorandum that "Regulatory Status of Waste Generated by Contractors and Residents from Lead-Based Paint Activities Conducted in Households" - signed July 31, 2000.** This memo clarifies the regulatory status of waste generated as a result of LBP activities (including abatement, renovation activities, and remodeling) in homes and other residences. This memo explains why LBP generated by contractors in households is "household waste" and thus excluded from the RCRA Subtitle C hazardous waste regulations. The household exclusion applies only to waste generated by either residents or contractors conducting LBP activities in residents. As a result, LBP waste from residences can be discarded in a municipal solid waste landfill or a municipal solid waste combustor.

APPENDIX B

1998 OSWER Directive 9200.4-27P ('Clarification')

9200.4-27
EPA/540/F-98/030
PB98-963244

OSWER Directive # 9200.4-27P

MEMORANDUM

SUBJECT: Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities

FROM: Timothy Fields, Jr.
Acting Assistant Administrator

TO: Regional Administrators I-X

PURPOSE

This directive clarifies the existing 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive 9355.4-12. Specifically, this directive clarifies OSWER's policy on (1) using EPA's Science Advisory Board (SAB) reviewed Integrated Exposure Uptake Biokinetic Model (IEUBK) and blood lead studies, (2) determining the geographic area to use in evaluating human exposure to lead contamination ("exposure units"), (3) addressing multimedia lead contamination and (4) determining appropriate response actions at lead sites. The purpose for clarifying the existing 1994 directive is to promote national consistency in decision-making at CERCLA and RCRA lead sites across the country.

BACKGROUND

OSWER Directive 9355.4-12, issued on July 14, 1994 established OSWER's current approach to addressing lead in soil at CERCLA and RCRA sites. The existing directive established a streamlined approach for determining protective levels for lead in soil at CERCLA sites and RCRA facilities as follows:

- It recommends a 400 ppm screening level for lead in soil at residential properties;
- It describes how to develop site-specific preliminary remediation goals (PRGs) at CERCLA sites and media cleanup standards at RCRA Corrective Action facilities for residential land use; and,
- It describes a strategy for management of lead contamination at CERCLA sites and RCRA Corrective Action facilities that have multiple sources of lead.

The existing interim directive provides direction regarding risk assessment and risk management approaches for addressing soil lead contaminated sites. The OSWER directive states that, " ... implementation of this guidance is expected to provide more consistent decisions across the country ..." However, since that directive was released, OSWER determined that clarification of the guidance is needed. Key areas being clarified by issuance of this directive include: (1) using the IEUBK model and blood lead studies, (2) determining exposure units to be considered in evaluating risk and developing risk management strategies, (3) addressing multimedia lead contamination and (4) determining appropriate response actions at residential lead sites. The existing directive provides the following guidance on these areas:

1. The OSWER directive recommends using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (Pub. # 9285.7-15-1, PB93-963510) for setting site-specific residential preliminary risk-based remediation goals (PRGs) at CERCLA sites and media cleanup standards (MCSs) at RCRA corrective actions Facilities. The directive states that the IEUBK model is the best tool currently available for predicting the potential blood lead levels of children exposed to lead in the environment. OSWER's directive also recommends the evaluation of blood lead data, where available, and states that well-conducted blood lead studies provide useful information to site managers. The directive however recommends that "... blood lead data not be used alone to assess risk from lead exposure or to develop soil lead cleanup levels."

2. The directive describes OSWER's risk reduction goal as "...generally, OSWER will attempt to limit exposure to soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% of exceeding a 10 µg/dl blood lead level." The directive also states that "... EPA recommends that a soil lead concentration be determined so that a typical child or group of children exposed to lead at this level would have an estimated risk of no more than 5% of exceeding a blood lead of 10 µg/dl." OSWER generally defines an exposure unit as a geographic area where exposures occur to the receptor of concern during the time of interest and believes that for a child or group of similarly exposed children, this is typically the individual residence and other areas where routine exposures are occurring.

3. The directive recommends that risk managers assess the contribution of multiple environmental sources of lead to overall lead exposure (e.g., consideration of the importance of soil lead levels relative to lead from drinking water, paint, and household dust) which promotes development of risk reduction strategies that address all sources that contribute significantly to exposure.

4. The OSWER directive states that the IEUBK model is not the only factor to be considered in establishing lead cleanup goals. Rather, the IEUBK model is the primary risk assessment tool available for evaluating lead risk and the results of the model are used to guide selection of appropriate risk management strategies for each site.

Since the OSWER directive was issued in 1994, there has been a trend toward a more consistent approach to managing risk at residential lead sites, however, OSWER was interested in identifying areas requiring additional clarification to facilitate more effective implementation of the directive. As a first step in the process, meetings were held with various EPA Regions, States and local governments to discuss how the directive has been implemented nationally at lead sites since 1994. By participating in these meetings and by reviewing the decisions that are being made across the country, OSWER believed that clarification of certain aspects of the 1994 directive would be useful.

All of the documents and guidance referenced in this directive are available through the National Technical Information Service (NTIS) at 703-605-6000 or could be downloaded electronically from: http//epa.gov/superfund/oerr/ini_prod/lead/prods.htm.

OBJECTIVE

At lead contaminated residential sites, OSWER seeks assurance that the health of the most susceptible population (children and women of child bearing age) is protected and promotes a program that proactively assesses and addresses risk. OSWER believes that predictive tools should be used to evaluate the risk of lead exposure, and that cleanup actions should be designed to address both current and potential future risk.

While health studies, surveys, and monitoring can be valuable in identifying current exposures and promoting improved public health, they are not definitive tools in evaluating potential risk from exposure to environmental contaminants. In the case of lead exposure, blood lead monitoring programs can be of critical importance in identifying individuals experiencing potential negative health outcomes and

directing education and intervention resources to address those risks. However, CERCLA §121(b) requires EPA to select cleanup approaches that are protective of human health and the environment and that utilize permanent solutions to the maximum extent practicable. To comply with the requirements set forth in CERCLA §121(b), OSWER will generally require selection of cleanup programs that are proactive in mitigating risk and that do not simply rely on biological monitoring programs to determine if an exposure has already occurred.

To meet these objectives, OSWER will seek actions that limit exposure to soil lead levels such that a typical child or group of similarly exposed children would have an estimated risk of no more than 5% of exceeding a 10 μg/dl blood lead level. If lead is predicted to pose a risk to the susceptible population, OSWER recommends that actions be taken to significantly minimize or eliminate this exposure to lead.

The principles laid out in the **four attached fact sheets** (Appendix) support OSWER's goals by encouraging appropriate assessment and response actions at CERCLA and RCRA lead sites across the country.

This clarification directive emphasizes the following key messages regarding the four areas and encourages the users of this directive, be they EPA Regions, States, or other stakeholders, to adopt these principles in assessing and managing CERCLA and RCRA lead sites across the country. The critical elements of the attached papers are as follows:

I. Using Blood Lead Studies and IEUBK Model at Lead Sites:

OSWER emphasizes the use of the IEUBK Model for estimating risks for childhood lead exposure from a number of sources, such as soils, dust, air, water, and other sources to predict blood lead levels in children 6 months to 84 (7 years) months old. The 1994 directive also recommended evaluation of available blood lead data and stated that data from a well-conducted blood lead study of children could provide useful information to site managers. In summary, OSWER's clarification policy on the appropriate use of the IEUBK and blood lead studies is that:

- OSWER recommends that the IEUBK model be used as the primary tool to generate risk-based soil cleanup levels at lead sites for current or future residential land use. If Regions propose an alternative method for generating cleanup levels, they are required to submit their approach to the national Lead Sites Consultation Group (LSCG)[1] for review and comment;

- Response actions can be taken using IEUBK predictions alone; blood lead studies are not required; and

- Blood lead studies and surveys are useful tools at lead sites and can be used to identify key site-specific exposure pathways and to direct health professionals to individuals needing immediate assistance in minimizing lead exposure; however, OSWER recommends that blood lead studies not be used for establishing long-term remedial or non-time-critical removal cleanup levels at lead sites.

II. Determining Exposure and Remediation Units at Lead Sites

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[1]The Lead Sites Consultation Group (LSCG) is comprised of senior management representatives from the Waste Management Divisions in all 10 EPA regions along with senior representatives from the Office of Emergency and Remedial Response in EPA headquarters. The LSCG is supported by EPA's Technical Review Workgroup (TRW) for lead and the national Lead Sites Workgroup (LSW). The TRW consists of key scientific experts in lead risk assessment from various EPA Regions, labs and headquarters. The LSW is comprised of senior Regional Project Managers from various Regions and key representatives from headquarters who are experienced in addressing lead threats at Superfund sites.

OSWER recommends that cleanup levels at lead sites be designed to reduce risk to a typical or individual child receiving exposures at the residence to meet Agency guidelines *(i.e.*, no greaterthan a 5% chance of exceeding a 10 µg/dl blood lead level for a full-time child resident). Therefore, it is recommended that risk assessments conducted at lead-contaminated residential sites use the individual residence as the primary exposure unit of concern. This does not mean that a risk assessment should be conducted for every yard, rather that the soil lead contamination data from yards and other residential media (for example, interior dust and drinking water) should be input into the IEUBK model to provide a preliminary remediation goal (PRG) for the residential setting. When applicable, potential exposure to accessible site-related lead sources outside the residential setting should also be evaluated to understand how these other potential exposures contribute to the overall risk to children, and to suggest appropriate cleanup measures for those areas.

III. Addressing Multimedia Contamination at Lead Sites

EPA generally has limited legal authority to use Superfund to address exposure from **interior lead-based paint**. As a policy matter, OSWER recommends that such exposures not be addressed through actual abatement activities. However, EPA Regions should promote addressing interior paint risks through actions by others (*e.g.*, potentially responsible parties (PRPs), other government programs, etc.) as a component of an overall site management strategy. Because of other competing demands on the Superfund Trust Fund, OSWER recommends that EPA Regions avoid using the Superfund Trust Fund for removing **exterior lead-based paint** and soil contaminated from lead-based paint. Superfund dollars *may* however be used in limited circumstances to remediate exterior lead-based paint in order to protect the overall site remedy (*i.e.*, to avoid re-contamination of soils that have been remediated) but generally only after determining that other funding sources are unavailable. As with interior lead-based paint abatement, EPA Regions should promote remediation of exterior lead-based paint by others, such as PRPs, local governments or individual homeowners.

IV. Determining Appropriate Response Actions at Lead Sites

In selecting site management strategies, it is OSWER's preference to seek early risk reduction with a combination of engineering controls (actions which permanently remove or treat contaminants, or create reliable barriers to mitigate the risk of exposure) and non-engineering response actions. All potential lead sources should be identified in site assessment activities. Non-engineering response actions, such as education and health intervention programs, should be considered an integral part of early risk reduction efforts because of their potential to provide immediate health benefits. In addition, engineering controls should be implemented early at sites presenting the greatest risk to children and other susceptible subpopulations.

As a given project progresses, OSWER's goal should be to reduce the reliance on education and intervention programs to mitigate risk. The goal should be cleanup strategies that move away from reliance on long-term changes in community behavior to be protective since behavioral changes may be difficult to maintain over time. The actual remedy selected at each CERCLA site must be determined by application of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (55 FR 8666- 8865, March 8, 1990) remedy selection criteria to site-specific circumstances. This approach also recognizes the NCP preference for permanent remedies and emphasizes selection of engineering over non-engineering remedies for long-term response actions.

This directive clarifies OSWER's policy on four key issue areas addressed in the 1994 OSWER soil lead directive in order to promote a nationally consistent decision-making process for assessing and managing risks associated with lead contaminated sites across the country. The policy presented in these specific issue areas supersedes all existing OSWER policy and directives on these subjects. No other aspects of the existing 1994 directive are affected.

IMPLEMENTATION

The principles laid out in this directive (which includes the four attached factsheets) are meant to apply to all residential lead sites currently being evaluated through the CERCLA Remedial Investigation/Feasibility Study process and all future CERCLA Sites and RCRA Corrective Action Facilities contaminated with lead. The Regions will be required to submit their rationale for deviating from the policies laid out in this directive to the Lead Sites Consultation Group. This directive does not apply to previous remedy selection decisions.

Attachments

cc: Waste Management Policy Managers (Regions I-X)
Stephen Luftig, OERR
Elizabeth Cotsworth, OSW
James Woolford, FFRRO
Barry Breen, OSRE
Larry Reed, OERR
Tom Sheckells, OERR
Murray Newton, OERR
Betsy Shaw, OERR
John Cunningham, OERR
Paul Nadeau, OERR
Bruce Means, OERR
Earl Salo, OGC

NOTICE: This document provides guidance to EPA staff. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus it cannot impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future, as appropriate.

Factsheet: Using the IEUBK Model and Blood Lead Studies at Residential Lead Sites

Question: What is OSWER's policy on using the IEUBK model and blood lead studies in conducting risk assessments and setting cleanup standards at residential lead contamination sites?

Answer: OSWER's policy on using the IEUBK model and blood lead studies in conducting risk assessment and setting cleanup standards is as follows:

A. Use of the IEUBK Model:

1. The IEUBK model is a good predictor of potential long-term blood lead levels for children in residential settings. OSWER recommends that the IEUBK model be used as the primary tool to generate risk-based soil cleanup levels at lead sites for current or future residential land use. If Regions propose an alternative method for generating cleanup levels, they are required to submit their approach to the National Lead Sites Consultation Group (LSCG) for review and comment.

2. Blood lead distributions predicted by the IEUBK model illustrate a plausible range of variability in children's physiology, behavior, and household conditions.

3. Response actions can be taken, and remedial goals developed, using IEUBK predictions alone.

B. Use of Blood Lead Studies/Data:

1. Blood lead studies, surveys, and monitoring are useful tools at lead sites and can be used to help identify key site-specific exposure pathways and direct health professionals to individuals needing immediate assistance in minimizing lead exposure.

2. The utility of blood lead testing results and studies depends on how representative the information is of the population being evaluated, the design of the data collection, and the quality of the laboratory analysis. To this end, OSWER recommends that EPA Regions consult with ATSDR or CDC to assess or design studies according to their intended use.

3. Many blood lead screening, monitoring, or testing programs differ from blood lead studies in that they do not attempt to identify risk factors for childhood exposure to lead sources. Although these programs may be extremely beneficial in identifying children with elevated blood lead levels and identifying candidates for referral to medical professionals for evaluation, they may not provide an accurate representation of community-wide exposure.

4. Well-designed blood lead studies may be used to identify site specific factors and pathways to be considered in applying the IEUBK model at residential lead sites. However, OSWER recommends that blood lead studies not be used to determine future long-term risk where exposure conditions are expected to change over time; rather, they should be considered a snapshot of ongoing exposure under a specific set of circumstances (including community awareness and education) at a specific time. Long-term studies may be helpful in understanding exposure trends within a community and evaluating the effectiveness of cleanup strategies over time.

C. IEUBK and Blood Lead Studies/Data:

1. Blood lead data and IEUBK model predictions are expected to show a general concordance for most sites. However, some deviations between measured and predicted levels are expected. On some occasions, declines in blood lead levels have been observed in association with lead exposure-reduction and health education. However, long-term cleanup goals should be protective

in the absence of changes in community behavior as there is little evidence of the sustained effectiveness of these education/intervention programs over long periods of time.

2. Where actual blood lead data varies significantly from IEUBK Model predictions, the model parameters should not automatically be changed. In such a case, the issue should be raised to the Lead Technical Review Workgroup (TRW) to further identify the source of those differences. Site work need not be put on hold while the issue is being reviewed by the TRW; the site manager should review other elements of the lead directive and the "Removal Actions at Lead Sites" guidance to determine appropriate interim actions to be taken at the site.

The Regions will be required to submit their rationale for deviating from the policies laid out in this factsheet to the Lead Sites Consultation Group.

Factsheet: Determining Exposure and Remediation Units at Residential Lead Sites

Question: How does OSWER define an exposure unit, and subsequently apply this definition in conducting risk assessment and risk management activities at residential lead sites?

Answer: OSWER recognizes that defining and characterizing exposure unit(s) for a site is critically important in undertaking risk assessment activities and in designing protective cleanup strategies. An **exposure unit** is defined as a geographic area where exposures occur to the receptor of concern during the time of interest and that for a child, or group of similarly exposed children, this is typically the individual residence and other areas where chronic or ongoing exposures are occurring.

Various approaches to characterizing and managing risks by exposure units have been examined by OSWER. OSWER recognizes that lead ingestion can also cause adverse health effects in adults and fetuses but believes that by adequately limiting lead exposures to young children at residential sites, these other receptors will generally be likewise protected from adverse health impacts.

EPA's goal is to protect human health and the environment under current and future exposure scenarios. At lead sites, OSWER wants to assure that children's health is protected and promotes a program that proactively assesses risks rather than relying on biological monitoring to determine if an exposure has already occurred. OSWER emphasizes actions be taken at lead sites that will minimize or eliminate exposure of children to environmental lead contamination.

To achieve the above stated goal, OSWER recommends characterizing **exposure units as exposure potential at the individual residence as the primary unit of concern for evaluating potential risk at lead contaminated residential sites.** This recognizes that there are children whose domain and activities occur principally within the confines of a particular residential property. For determining exposure potential (and ultimately developing protective cleanup levels) at the individual home, OSWER recommends the scenario to be evaluated (through use of the IEUBK Model) would be a young child in full-time residence. This approach helps achieve OSWER's recommended health protection goal that an individual child or group of similarly exposed children would have <5% chance of exceeding a blood lead concentration of 10 μg/dl. In designing community wide cleanup strategies, it is essential that non-residential areas (*e.g.*, parks, day care facilities, playgrounds, etc.), where lead exposure may occur, also be characterized with respect to their contribution to soil-lead exposure, and appropriate cleanup actions implemented.

OSWER recommends that risk management decisions for response to residential lead contamination sites focus on reducing risk at residences, but also recommends that response strategies be developed for other site locations (exposure units) where children receive exposure. Flexibility in determining appropriate response actions that provide protection at the individual residence should be considered in context of the NCP remedy selection criteria. The lead exposure issues are complex and OSWER recommends that EPA Regions try to communicate clearly the risk characterization and risk management decisions to the site residents. Affected communities must clearly understand the context of risk management decisions, how these decisions affect the health of their children, and how cleanup actions will influence the future growth and development of the community.

The Regions will be required to submit their rationale for deviating from the policies laid out in this factsheet to the Lead Sites Consultation Group.

Factsheet: Addressing Multimedia Contamination at Residential Lead Sites

Question: What is OSWER's policy on addressing multimedia contamination at residential lead sites?

Answer: OSWER recognizes that several sources of lead-contamination, including soil, ground water, airborne particulates, lead plumbing, interior dust, and interior and exterior lead-based paint may be present at Superfund sites where children are at risk or have documented lead exposure. These lead sources may contribute to elevated blood lead levels and may need to be evaluated in determining risks and cleanup actions at residential lead sites. However, there are limitations on the Agency's statutory authority under CERCLA to abate some of these sources, such as indoor lead-based paint and lead plumbing because CERCLA responses may be taken only to releases or threatened releases into the environment (CERCLA §104 (a)(3) and (4)).

When EPA's resources, or authority to respond or to expend monies under Superfund is limited, OSWER recommends that EPA Regions identify and coordinate to the greatest extent possible with other authorities and funding sources (*e.g.*, other federal agencies and state or local programs). EPA Regions should coordinate with these other authorities to design a comprehensive, cost-effective response strategy that addresses as many sources of lead as practicable. These strategies should include actions to respond to lead-based paint, interior dust, and lead plumbing, as well as ground water sources and lead-contaminated soil.

Although OSWER will encourage that EPA Regions fully cooperate in the development of a comprehensive site management strategy, OSWER realizes that complete active cleanup of these other sources may be difficult to complete due to limited funding available to other authorities. Since complete cleanups of these sources is not guaranteed, and at most sites may be unlikely, OSWER recommends that the soil cleanup levels not be compromised. In other words, the soil cleanup levels should be calculated with the IEUBK model using existing pre-response action site specific data. This is due to the fact that soil cleanup levels at residential lead sites are generally established to protect individuals, from excess exposures to soils, and house dust attributable to those soils, and are not attributable to exposure to other sources such as interior lead paint which should be managed on a residence specific basis. Remediation of non-soil lead sources to mitigate overall lead exposure at individual residences should therefore not be used to modify site-wide soil lead cleanup levels.

The recommendations provided below represent OSWER's policy on addressing lead-contaminated media and/or sources for which EPA has limited or no authority to remediate.

Interior Paint: EPA has limited legal authority to use Superfund to address exposure from interior lead-based paint. As a policy matter, OSWER recommends that such exposures not be addressed through actual abatement activities. However, EPA Regions should promote addressing interior paint risks through actions by others, such as HUD, local governments, or individual home owners as a component of an overall site management strategy. Any activities to clean up interior lead-based paint by PRPs or other parties should not result in an increase of the risk-based soil cleanup levels.

Exterior Paint: Because of other competing demands on the Superfund Trust Fund, OSWER recommends that EPA Regions avoid using the Superfund Trust Fund for removing exterior lead-based paint and soil contaminated from lead-based paint. Superfund dollars *may* be used to respond to exterior lead-based paint for protecting the overall site remedy (*i.e.*, to prevent re-contamination of soils that have been remediated) but only after determining that other funding sources are unavailable. Where other sources of funding are not available, EPA may utilize the CERCLA monies to remediate exterior lead-based paint on homes/buildings, around which soil contaminated by other sources has been cleaned up to prevent recontamination of the soil. The Superfund should not be used to remediate exterior lead-based paint where no soil cleanup has occurred. As with interior lead-based paint abatement, EPA Regions

should promote remediation of exterior lead-based paint by others, such as PRPs, local governments or individual homeowners. Cleanup activities of exterior paint conducted by PRPs or other parties should not result in an increase of the risk-based soil cleanup levels.

Interior Dust: Lead contaminated interior dust can be derived from several sources, including interior paint, home owner hobbies, exterior soil, and other exterior sources. In many cases, it may be difficult to differentiate the source(s) for the lead contamination in the dust. In general, EPA Regions should refrain from using the Superfund Trust Fund to remediate interior dust. Because of the multi-source aspects of interior dust contamination, potential for recontamination, and the need for a continuing effort to manage interior dust exposure, OSWER recommends the use of an aggressive health education program to address interior dust exposure. Such programs, administered through the local health department (or other local agency), should be implemented in conjunction with actions to control the dust source. At a minimum, the program should include blood lead monitoring, and personal hygiene and good housekeeping education for the residents. OSWER believes that EPA Regions can also support the program by providing HEPA vacuums to the health agency for use in thoroughly cleaning home interiors.

Lead Plumbing: Generally CERCLA does not provide for legal authority to respond to risks posed by lead plumbing within residential dwellings. It should be noted that the water purveyor is responsible for providing clean water to the residences. As with interior dust, OSWER recommends that EPA Regions coordinate with local agencies to establish a health education program to inform residents of the hazards associated with lead plumbing and how to protect themselves by regularly flushing, or preferably, replacing lead pipes. Soil cleanup levels should not be adjusted to account for possible remediation of lead plumbing.

Factsheet: Determining Appropriate Response Actions at Residential Lead Sites

Question: What is OSWER's position on the appropriate use of engineering and non-engineering response actions in developing risk management strategies for lead sites?

Answer: One goal emphasized in the recent third round of Superfund Reforms is for EPA to take a consistent approach in selecting and implementing both long- and short-term response actions at lead sites in all regions. One obstacle to achieving this consistency has been differing degrees of reliance on non-engineering response actions in reducing risk.

Site management strategies at lead sites typically include a range of response actions. Alternatives range from engineering controls that permanently remove or treat the contaminant source to non-engineering response actions, such as educational programs and land use restrictions. This continuum represents the range of response options available to risk managers. This position paper clarifies the relationship between engineering and non-engineering response actions in developing site management strategies.

In selecting site management strategies, OSWER's policy will be to seek early risk reduction with a combination of engineering controls (actions which permanently remove or treat contaminants, or which create reliable barriers to mitigate the risk of exposure) and non-engineering response actions. All potential lead sources should be identified in site assessment activities. Non-engineering response actions, such as education and health intervention programs, should be considered an integral part of early risk reduction efforts due to their potential to provide immediate health benefits.[2] In addition, engineering controls should be implemented early at sites presenting the greatest risk to children and other susceptible subpopulations. Community concerns should receive a high priority in site decision-making; local support is vital to the success of health intervention and education programs.

As the project progresses, OSWER's goal should be to reduce reliance on education and intervention programs to mitigate risk. The goal should be cleanup strategies that move away from reliance on long-term changes in community behavior to be protective; behavioral changes may be difficult to maintain over time. The actual remedy selected at each site must be determined by application of the NCP remedy selection criteria to site-specific circumstances. However, this approach recognizes the NCP preference for permanent remedies and emphasizes the use of engineering controls for long-term response actions. This approach also recognizes that well-designed health intervention and education programs, when combined with deed restrictions and/or other institutional controls, may be appropriate for reducing future exposure potential and may supplement engineering controls.

In instances where Regions believe that the use of engineering controls is impracticable, and education, health intervention, or institutional controls are proposed as the sole remedy, Regions will be required to consult with the LSCG.

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[2]The actual effectiveness of health intervention and educational programs in reducing risk continues to be a subject of discussion. Anecdotal information suggests that such programs can provide short-term benefits in some populations. Rigorous statistical studies demonstrating the benefits of educational programs in preventing lead exposure are lacking. It is generally recognized that not all segments of the population will be influenced by such programs, and that long-term benefits are less certain. Local support for such programs is critical. The active (and long-term) participation of local and state public health agencies is needed in implementing institutional controls, including health intervention and education programs; without local implementation of such programs their success is uncertain. Additional research on the effectiveness of these programs is critical to consideration of their use in future cleanups.

APPENDIX C

Contacts and Software for Sampling Design

Table C-1
Contacts and Software for Sample Planning Design

Topic		Contact(s)
Sampling plan design/ Systematic Planning	General support	EPA HQ Quality Staff Phone: (202) 564-6830 FAX: (202) 565-2441 E-mail: quality@epa.gov
	Dynamic Field Activities	Internet: http://www.epa.gov/superfund/programs/dfa/index.htm
Software	DEFT: Data Quality Objectives Decision Error Feasibility Trials	E-mail: quality@epa.gov Internet: http://www.ornl.gov/doe_oro/dqo/resdqo.htm
	FIELDS: Fully Integrated Environmental Decision Support	Internet: http://www.epa.gov/region5fields/static/pages/index.html
	Geo-EAS: Geostatistical Environmental Assessment Software	E-mail: englund.evan@epa.gov Internet: http://www.ai-geostats.org/
	SADA: Spatial Analysis Decision Assistance	E-mail: sada@tiem.utk.edu Internet: http://www.tiem.utk.edu/~sada/
	VSP: Visual Sample Plan	E-mail: nell.cliff@pnl.gov Internet: http://dqo.pnl.gov/vsp/

APPENDIX D

Examples of Property Access Agreement Forms

CONSENT FOR ACCESS TO PROPERTY FOR SAMPLING

Name: _____ Daytime Phone Number: _____

Address(es) of Property(ies): _____

_____

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of taking [DESCRIBE NUMBER OF SAMPLING LOCATIONS AND DEPTHS] which are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me at least one week in advance before the soil samples are collected. This agreement is only for the purpose of soil sampling and no other work.

_____
Date

☐ I grant access to my property

☐ I do not grant access to my property

_____
Signature

_____
Signature

☐ I would also like EPA to have a lead expert contact me to schedule a free inspection to identify potential lead hazards in my home and provide safety tips.

United States Environmental Protection Agency Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

CONSENT FOR ENTRY AND ACCESS TO PROPERTY FOR SAMPLING

Description of property (including address) for which consent to access is granted:

Example: XXXX Street, Texarkana, Arkansas, more particularly described as a lot measuring approximately 3,000 square feet, including a two-room wood structure of approximately 300 square feet

Name of Signatory: _____

Address: _____

_____

_____ Phone: (____)_____

Relationship to property (e.g., owner, lessee, agent or employee of owner, etc.):

I HEREBY CONSENT to officers, employees and parties authorized by the U.S. Environmental Protection Agency (EPA), entering and having continued access to the property described above at reasonable times for the following purposes (List the activities to be undertaken on the property):
Example:

- Sample collection including: (1) the gathering of soil from the outside area of the property; (2) drawing water from the tap; and (3) vacuuming the inside area of any inhabitable structure in order to collect dust.

- Taking photographs to record the sampling process.

I realize that these actions are undertaken pursuant to EPA's response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601-9675. This written permission is given by me voluntarily with the knowledge of my right to refuse and without threats or promises of any kind.

This agreement expires on: _____
(Date)

I HEREBY WARRANT that I have authority to make this access agreement.

_____ _____
Date Signature

_____
Print name

CONSENT FOR ACCESS TO PROPERTY FOR SAMPLING AND TO TAKE RESPONSE ACTION

Name: _____ Daytime Phone Number: _____

Address(es) of Property(ies): _____

_____

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of sampling and taking a response action including: (1) preparing for and excavation of soil from my property; (2) backfilling the excavated area(s) with clean soil and/or backfill; and (3) restoring any grass or other vegetation or structures to their pre-excavation state. These activities are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me approximately two weeks in advance before the removal of soil begins, to discuss the steps involved in the excavation and removal program and all measures EPA will take to restore my yard. I also understand that if there is any damage to structures such as sidewalks that is caused by the work conducted by EPA or authorized representatives of EPA, then EPA or authorized representatives of EPA shall repair such damage.

_____
Date

☐ I grant access to my property

☐ I do not grant access to my property

_____
Signature

_____
Signature

XXXX TRIBE OF OKLAHOMA

PROPERTY ACCESS CONSENT AGREEMENT FOR SAMPLING AND TO TAKE RESPONSE ACTION

The Property which is the subject of this agreement is described as follows:

NE 1/4 SE 1/4, Section 6, Township 28 North, Range 24 East, Xxxx County, Oklahoma otherwise described as Beaver Springs Park and Tribal Office which includes the Pow Wow grounds (hereinafter the Property).

THIS ____ DAY OF _____, 1999, by authority of the Xxxx Tribal Business Committee, permission is hereby granted to officers, employees and parties authorized by the United States Environmental Protection Agency (EPA) entering and having continued access to the Property until 4:30 pm (CST) on _____, to conduct the following work (hereinafter the work):

(1) To perform necessary response actions (e.g., excavation of contaminated soil, backfilling with clean soil or gravel, and sodding or seeding) to address lead and other metals from mining waste contamination on the above-described lands in accordance with the EPA Record of Decision issued August 27, 1997;

(2) To take necessary samples of environmental media to identify lead and other metals that may be a threat to public health or welfare or the environment.

Nothing contained in this permit shall operate to delay or prevent a termination of Federal trust responsibilities with respect to the Property by the issuance of a fee patent or otherwise during the term of the work; however, such termination shall not serve to terminate the work. The Xxxx Tribal Business Committee shall notify EPA of any change in status or ownership of the Property.

The Xxxx Tribal Business Committee realizes that the work will be undertaken pursuant to EPA's Superfund authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601-9675.

This written permission is given by the Xxxx Tribal Business Committee voluntarily with the knowledge of its right to refuse and without threats or promises of any kind.

The Xxxx Tribal Business Committee is the property owner or a responsible representative of the property owner and I, Xx Xxxx, as Chairman of that Committee, warrant that I have authority to make this access agreement.

_____ _____

Xx Xxxx
Xxxx Tribal Chairman
Xxxx Tribe of Oklahoma

Date

_____ _____

U.S. Environmental Protection Agency

Date

CONSENT FOR ACCESS TO PROPERTY TO TAKE RESPONSE ACTION

Name: _____ Daytime Phone Number: _____

Address(es) of Property(ies): _____

_____

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of taking a response action including: (1) preparing for and excavation of soil from my property; (2) backfilling the excavated area(s) with clean soil and/or backfill; and (3) restoring any grass or other vegetation or structures to their pre-excavation state. These activities are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me approximately two weeks in advance before the removal of soil begins, to discuss the steps involved in the excavation and removal program and all measures EPA will take to restore my yard. I also understand that if there is any damage to structures such as sidewalks that is caused by the work conducted by EPA or authorized representatives of EPA, then EPA or authorized representatives of EPA shall repair such damage.

_____
Date

☐ I grant access to my property

☐ I do not grant access to my property

_____
Signature

_____
Signature

APPENDIX E

Example of Dust Abatement Access Form

CONSENT FOR ACCESS TO PROPERTY

Name: _____ Daytime Phone Number: _____

Address(es) of Property(ies): _____

_____

I hereby consent to grant officers, employees, contractors, sub-contractors and authorized representatives of the United States Environmental Protection Agency (EPA) access to the interior of my home and/or property for the purpose of interior dust abatement. The home dust abatement program being offered at this time consists of vacuuming floors and walls with a special vacuuming system. This system is portable and compact and easy to use. A team of bonded representatives will be providing the service at no charge to the homeowner.

Videotaping of the interior of the residence will be necessary to provide backup documentation in the event of any claims. It will be necessary that someone remain at the residence for one or two days while it is being vacuumed. This lead abatement program is offered only to homeowners who have or will grant access to their property for the remediation of in their yards. These activities are necessary to interrupt the movement of lead through soil dust, house dust, and paint dust.

If you want the process completed in your home and prefer to do it yourself, please note in the appropriate space and arrangements will be made to schedule the loan of a HEPA-VAC unit to you.

This written permission is given voluntarily with the knowledge of its right to refuse and without threats or promises of any kind. I understand that , if any damage to my property results from these activities or any work conducted by the USEPA or its authorized representatives, then the USEPA or its authorized representatives shall repair or replace such damage.

_____
Date

- ☐ I grant access to my property for Representatives of the EPA to video and vacuum.
- ☐ I wish to make arrangements to vacuum myself.
- ☐ I do not grant access to my property.

_____
Signature

Please return as soon as possible for scheduling of work. If you should have any questions please contact [LOCAL CONTACT NAME] at [PHONE NUMBER].

APPENDIX F

Example of Property Inspection Checklist

TAR CREEK PROJECT
PROPERTY HOME INSPECTION CHECKLIST

Address _____ Date _____

Property Group Number _____

Home Interior Access (check one, see comments):
☐ Approved by Property Owner ☐ Denied by Property Owner

Property (Yard) Access (check one, see comments):
☐ Approved by Property Owner ☐ Denied by Property Owner

	OK	NA	PROBLEM/CONDITION
YARD AREA			
1. Lawn Area			
A. Location of Flower/Plant Boxes			
B. Soil (grade) next to house			
C. Shrubbery			
D. Trees			
E. Low areas near house (that could cause ponding of water)			
F. Other: _____			
2. Utility			
A. Water Meter			
B. Gas Meter			
C. Sewer Lines			
D. Other: _____			
3. Driveway			
A. Concrete cracked, damaged			
B. Blacktop cracked, damaged			
C. Uneven Settling			
D. Other: _____			

	OK	NA	PROBLEM/CONDITION
YARD AREA (cont.)			
4. Streetwalk & Walkways			
A. Concrete cracked, eroded			
B. Tripping hazards			
C. Tree roots cracking, lifting slab			
D. Sections missing			
E. Other _____			
5. Garage			
A. Settlement cracks in walls			
B. Concrete floor slab cracked, damaged			
C. Door jambs damaged, rotted			
D. Door hard to open, close			
E. Other: _____			
6. Swimming Pool (Above Ground)			
A. Leakage			
B. Visible damage			
C. Other: _____			
7. Swimming Pool (Below Ground)			
A. Leakage			
B. Visible damage			
C. Other _____			
8. Storm Cellar			
A. Damaged			
B. Indication of Flooding			
C. Other: _____			

	OK	NA	PROBLEM/CONDITION
YARD AREA (cont.)			
9. Electrical Service			
A. Damaged circuit breaker panel box			
B. Wiring hanging outside			
C. Damaged electric meter			
D. Other:_____			
EXTERIOR AREA			
10. ☐ Brick ☐ Siding			
A. Brick bulging, spalling, cracking			
B. Mortar loose, needs repointing			
C. Lintel needs repair			
D. Stucco bulging, cracking			
E. Siding dented, damaged			
F. Finish wearing off siding			
G. Siding loose, not level, missing			
H. Siding rotted, termites			
I. Composite shingles worn, broken, missing			
J. Windows damaged			
K. Other:_____			
11. Roofing			
A. Age of covering			
B. Shingles worn, damaged, patched			
C. Brick chimney broken, leaning			
D. Joint open between chimney & exterior wall			
E. Need flashing at chimney, vents, walls			

	OK	NA	PROBLEM/CONDITION
EXTERIOR AREA (cont.)			
F. Parapet wall leaning			
G. Roof sagging			
H. Metal flashing damaged, missing			
I. Other: _____			
12. Gutters & Leaders ☐ Yes ☐ No			
A. Copper discolored, greenish, damaged			
B. Galvanized rusted, patched			
C. Fascia board rotted, damaged, patched			
D. Drain onto foundation wall			
E. Need to divert water from wall			
F. Soffit venting ☐ Yes ☐ No			
G. Concrete slab cracked, deteriorated			
H. Concrete slab/splash block need			
I. Other: _____			
13. Entrance Steps			
A. Concrete cracked			
B. Brick cracked, mortar loose			
C. Structurally sound			
D. Handrail			
E. Other: _____			
14. Exterior Doors			
A. Damaged			
B. Opens/closes freely			
C. Weatherstripping			
D. Trim rotted, missing			

	OK	NA	PROBLEM/CONDITION
EXTERIOR AREA (cont.)			
E. Jambs rotted, damaged			
F. Frame separation from walls			
G. Other:_____			
INTERIOR AREA			
15. Windows			
A. Trim/sills rotted			
B. Broken glass			
C. Open freely			
E. Frame separation from walls			
F. Other: _____			
16. Kitchen			
A. Cracked walls, ceiling			
B. Loose nails, tape on drywall			
C. Soft, springy floors			
D. Wood, tiles on floor damaged			
E. Faucet leaks			
F. Doors don't close			
G. Cabinets don't close			
H. Moisture in cabinets			
I. Walls have moisture damage			
J. Other: _____			
17. Interior Rooms			
A. Cracked walls, ceiling			
B. Loose nails, tape on drywall			
C. Soft, springy floor			
D. Carpeting water damaged			
E. Water stains near windows			

	OK	NA	PROBLEM/CONDITION
INTERIOR AREA (cont.)			
F. Mold/mildew on walls			
G. Other:_____			
18. Toilet Facility			
A. Cracked tile, plaster on walls			
B. Cracked plaster on ceilings			
C. Loose tiles on walls, floors			
D. Loose nails, tape on drywall			
E. Toilet cracked			
F. Water leaks at closet flange			
G. Grout missing around tub			
H. Shower pan damaged, missing			
I. Shower door damaged, missing			
J. Need new shower door			
K. Water stains on ceiling below bathroom			
L. Hot water heater tank corroded			
M. Water stains on floor around hot water heater			
N. Moisture present around hot water heater			
O. Other:_____			
19. Interior Doors			
A. Open freely			
B. Frame separation from walls			
C. Other:_____			
20. Attic			
A. Only if visual indicator			
B. Other:_____			

	OK	NA	PROBLEM/CONDITION
INTERIOR AREA (cont.)			
21. Foundation			
A. Minor cracks			
B. Settlement cracks at corners, walls			
C. Wall bulging inward			
D. Seepage into basement/cellar			
E. Mortar deteriorating			
F. Other: _____			
22. Basement or Cellar			
A. Seepage, water stains on floor/wall			
B. Sump pump installed			
C. Water pipe leaks			
D. Sewer pipe leaks			
E. Other: _____			
FOUNDATION AREA			
23. Foundation (Slab on Grade)			
A. Settlement cracks			
B. Joint separation			
C. Spalding			
D. Other: _____			
24. Foundation (Elevated Slab w/Crawl Space)			
A. Concrete support integrity			
B. Evidence of moisture or visible moisture in crawl space			
C. Evidence of water accumulation (e.g., water stains)			

	OK	NA	PROBLEM/CONDITION
FOUNDATION AREA (cont.)			
D. Sagging joist/support girders			
E. Fungus growth evident			
F. Sump pump evident			
G. Vents present			
H. Vapor barriers			
I. Pier settlement			
J. Uneven subgrade			
K. Insect damage			
L. Sill plate damaged			
M. Subfloor damaged, loose			
N. Need subfloor			
O. Other:_____			
25. Plumbing (Raised Floors Only)			
A. Pipe insulation crumbling, missing			
B. Need to insulate pipes			
C. Water pipes leaking			
D. Sewer pipes leaking			
E. Water pipe condition			
F. Other: _____			
26. Plumbing			
A. Water pipe conditions			
B. Sewage pipe conditions			
C. Pipes leaking			
D. Pipe insulation			
E. Corrosion on drain lines			
F. Other: _____			

	OK	NA	PROBLEM/CONDITION
FOUNDATION AREA (cont.)			
27. Other Area			
A. _____			
B. _____			
C. _____			
D. _____			

COMMENTS: _____

_____

_____

Topo Survey Requested ☐ Yes ☐ No

_____ _____

Inspector Signature Date

APPENDIX G

Examples of Property Closeout Forms

USEPA REMEDIATION AGREEMENT FORM

Name: Sam's Restaurant

Address: 5000 Main St.
Madison, IL 62060

Phone: 000-123-4567

This form documents the completion of remedial activity performed on my property. My signature will designate that I am satisfied with the restoration of my property, and that no items are in question, now, or at any time in the future, except those items listed below, if any.

Comments: 100% satisfied.

Restoration items in question:
1. NONE
2.
3.
4.
5.
6.
7.

Chloe Irish	Chloe Irish	01/24/98
Resident Signature	Printed Name	Date
Brad W. Bradley	Brad W. Bradley	04/13/98
USEPA Representative Signature	Printed Name	Date

RESIDENTIAL REMEDIATION INSPECTION/AGREEMENT FORM

Name Sara O'Mara

Address 777 East Ave, Whoville, IN 45123

Phone 000-987-6543

This form documents the completion of remedial activities performed on my property. My signature will designate that I am satisfied with the restoration of my property, and that no items are in question, now, or at any time in the future, except those items listed below, if any.

Comments

Restoration Items in Question:

1. Roll matting on sod to be trimmed off
2. Stone left side more stone to be added, taper from building
3. At double doors back left corner, add rock up to lip to allow vehicle to get in.
4. Also add rock at back of building in middle in front of concrete ledge.
5. Also add rock in open parking area & grade the tops off of the high spots.
6. Check outside of fence on 1st Street, clean up dirt clods rolling under sod & fence.
7.

Property Inspection Date 12/04/98

Lawn Care Instructions Reviewed/Delivered 12/04/98

Sara O'Mara	Sara O'Mara	12/09/98
Resident Signature	Printed Name	Date
Brad W. Bradley	Brad W. Bradley	02/12/99
USEPA Representative Signature	Printed Name	Date

APPENDIX H

Examples of Clean Letters

EPA LOGO AND ADDRESS

Date

Name
Address
City, State Zip

Dear :

The U.S. Environmental Protection Agency (EPA) has completed the cleanup of the lead contamination in your yard located at [ADDRESS, CITY, STATE], in connection with the [SITE NAME] site in [CITY, STATE] (the Site). By way of this letter, U.S. EPA is certifying that your yard has been cleaned up to less than [CLEAN-UP LEVEL] parts per million lead, the level which U.S. EPA considers protective of children's health at the Site.

Thank you for your cooperation in this clean-up effort. It has been our pleasure to work with you. If you have any questions concerning this letter or need further information, please contact me at [PROJECT MANAGER'S PHONE NUMBER].

Sincerely,

[PROJECT MANAGER NAME]
Remedial Project Manager

EPA LOGO AND ADDRESS

Date

Name
Address
City, State Zip

Dear :

The United States Environmental Protection Agency (U.S. EPA) has sampled your yard located at [ADDRESS, CITY, STATE] for lead. The results of this sampling, which are enclosed with this letter, indicate that your yard contains less than [CLEAN-UP LEVEL] per million lead, the level which U.S. EPA considers protective of children's health at the [SITE NAME, CITY, STATE]. Thus, U.S. EPA will not need to perform soil clean-up activities in your yard.

If you have any questions concerning this letter or the enclosure, please contact me at [PROJECT MANAGER'S PHONE NUMBER].

Sincerely,

PROJECT MANAGER NAME
Remedial Project Manager

Enclosure

ENCLOSURE

Analytical results for [ADDRESS]
in parts per million (ppm) of lead:

Depth Zone (inches)	Yards		OR Quadrant			
	Front	Back	1	2	3	4
0 to 1	ppm	ppm	ppm	ppm	ppm	ppm
1 to 6	ppm	ppm	ppm	ppm	ppm	ppm
6 to 12	ppm	ppm	ppm	ppm	ppm	ppm
18 to 24	ppm	ppm	ppm	ppm	ppm	ppm
Deeper Zones (if applicable)	ppm	ppm	ppm	ppm	ppm	ppm
Drip Zone Composite	ppm	ppm	ppm	ppm	ppm	ppm

Mr. John Smith
123 N. Main
Joplin, Missouri 64108

Dear Mr. Smith,

This letter serves as written notification that a lead-contaminated soil clean-up action was performed under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended by the Superfund Amendments and reauthorization Act of 1986 on property you have an interest in at the Jasper County, National Priorities Listed Superfund site. Our records show that your property located at **123 N. Main** was included in this action. The clean-up action conducted by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE) addressed residences with soil lead levels over 800 ppm, day care facilities, and residences with children under six years of age with blood lead levels over 15 g/dL.

Briefly, the primary objective of the clean-up action on your property was to remove highly lead-contaminated near-surface yard soils that were located at your residence. In some cases trees, shrubs, flowers, and other vegetation were left in place. As a result a small amount of lead-contaminated soils may be left near the surface on your property. This small amount of contamination should not cause a health threat under normal circumstances. In the future if additional landscaping, or planting requiring excavation below six inches are done, care should be exercised to minimize recontamination.

The excavation criteria for the project was as follows:

A) From the surface to 12 inches, excavation continued until 500 ppm or less lead levels concentrations were achieved;

B) If the residual lead concentrations at a depth of one foot exceeded 1,500 ppm a "marker barrier" was placed at that depth. The marker barrier used was the temporary orange plastic construction-type fence. This material is permeable, and will allow water and plant roots to pass through it. Only a small number of properties required the installation of the barrier. The primary purpose of this marker barrier is to inhibit and alert individuals excavating in these areas in future years.

In general, all areas of the yard that exceeded 500 mg/kg lead at the surface were removed. Soil brought in to backfill the excavation contained less than 240 mg/kg lead.

IF YOU HAVE PLANS TO DO ANY EXCAVATION WORK AT YOUR PROPERTY AND YOU ENCOUNTER THE ORANGE BARRIER PLEASE CONTACT YOUR LOCAL HEALTH DEPARTMENT, THE MISSOURI DEPARTMENT OF NATURAL RESOURCES, OR THE EPA FOR GUIDANCE.

Please save this document for your permanent records. In the event you sell or transfer the property to someone you can show the next owner that a lead cleanup was performed. If you require more specific information concerning the excavation on your property, please feel free to contact me at (xxx) xxx-xxxx.

Sincerely,

(Project Manager)