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FINAL
ENGINEERING EVALUATION/COST ANALYSIS

CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared to evaluate a possible Non Time Critical Removal Action (NTCRA) that can be conducted to reduce exposure to contaminants that have been found at the Centredale Manor Restoration Project Superfund Site (Site), specifically, in the soil and sediment of the Woonasquatucket River downstream of the Centredale Manor and Brook Village properties. This work was authorized by the U.S. Environmental Protection Agency (EPA) under work assignment 048-NSEE-016P, Contract No. 68-W6-0045.

The need to perform a NTCRA has been documented in the Approval Memorandum signed by EPA New England on February 1, 2000. The need for the action is based on the presence of dioxin in sediment and soils located on property that is used for residential purposes.

Dioxins were first identified in 1998 in fish collected from this river. Since then, additional studies have found dioxins in the soil and sediments. Historical records and other information indicate that the source may have been a former chemical manufacturing facility and/or a drum recycling facility, both located on the property that is now occupied by the Centredale Manor and Brook Village apartment complexes.

Assessment of the data collected during these additional studies indicate that dioxin is present at elevated concentrations in soil and sediment currently exposed due to the break in the Allendale Dam and flooding events, from the Centredale Manor property downstream to the Lymansville Dam. Elevated levels of dioxin exist generally to a depth of two feet, primarily within the former boundaries of the Allendale Pond, and the existing boundaries of Lymansville Pond.

This report presents a risk evaluation, which is a demonstration that chemicals in the soil and sediment may provide an increase in risk of cancer and non-cancer health effects to persons using this land for recreational or residential purposes. The demonstration shows that among the chemicals at the Site present at elevated levels, dioxin provides the highest risk of these health effects, and thus supports the EPA recommendation for a removal action. Isolation of the soil or sediment with dioxin at concentrations in excess of 1 ppb will reduce the risk of these health effects dramatically.

A similar evaluation was performed for ecological receptors such as birds, mammals and other animals that live in or near the affected areas. It was determined that while some of these animals may be affected by the contaminants present, further studies were necessary prior to recommending a response action based on these exposures. Therefore, it was determined that a removal action should be initiated to reduce the risk of health effects to nearby residents, provided it would be performed to support additional actions in the future if they were deemed necessary.

The February 1, 2000 Approval Memorandum calls for two NTCRAs. EPA later determined that it would be more efficient and cost-effective to combine the NTCRAs.

The chemical data was evaluated to determine which areas should be included in the removal action. It was determined that those properties with dioxin present at concentrations above one part per billion in the surface soil, and adjacent sediment that is under less than one foot of water should be included in the removal action. This assessment found 11 properties (eight adjacent to Allendale Pond and three adjacent to Lymansville Pond) to be included in this action.

Different technologies were evaluated for their use and practicality for the contaminants in the sediment and soils. Those that were determined to be likely to work were assembled into four possible removal alternatives. These alternatives were evaluated in regards to implementibility, effectiveness, and cost. The elements of the alternatives evaluated included covering the soils in place, removing the soils and replacing them with clean soils, while restoring the Allendale Dam and Allendale Pond.

Costs for these alternatives ranged from $1.6 million to over $13 million, depending largely on the size of the area left exposed by the receded waters of Allendale Pond. One of the alternatives (Alternative No. 3) was singled out as a preferred alternative based on the effectiveness, implementiblility and cost. This alternative includes:

a) removing all soil and adjacent exposed sediment from residential properties that contains dioxin in excess of 1 part per billion,
b) replacing that soil with clean fill and loam placed to fit the existing grade,
c) destroying the dioxin in that soil through controlled incineration at an off-site location, and

d) restoring the Allendale Dam, and returning Allendale Pond to its original elevation.

It is estimated that this alternative will cost approximately $2.5 million and will require almost one year to complete.

This recommendation is to be placed before the public at a public hearing and comments will be recorded. The final decision will be made after the evaluation of the public comments.

1.0 INTRODUCTION

As documented in the February 2000 Approval Memorandum (provided in Appendix G), the U.S. Environmental Protection Agency (EPA) determined that there has been a release of hazardous substances into the environment at the Centredale Manor Restoration Project Site in North Providence Rhode Island (the Site), and the conditions at the Site meet the NCP Section 300.415(b) criteria for a removal. EPA also determined that further investigation is necessary to plan and direct the future removal action. EPA contracted Tetra Tech NUS, Inc. (TtNUS) to perform an Engineering Evaluation/Cost Analysis (EE/CA) to evaluate the options for an NTCRA, and develop and support the selection of a removal action approach for the Site.

The EE/CA was prepared consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR 300; and the Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (EPA, 1993). The work was conducted by TtNUS for U.S. EPA New England, under Contract No. 68-W6-0045, Work Assignment No. 048-NSEE-016P.

In this report, various removal alternatives are investigated and evaluated in terms of effectiveness, implementability and cost. This report also identifies EPAs preferred alternative. EPA will solicit public comments on the EE/CA and preferred alternative prior to issuing an Action Memorandum which will select the removal action to be implemented at the Site.

1.1 Purpose and Organization of Report

The overall objectives of this EE/CA are to identify the objectives of the removal action and develop and evaluate response action alternatives to reduce or eliminate risk to human health and the environment currently present due to contaminants in sediment and soil at the Site. The Site and site boundaries are defined in Section 1.2 of this report.

The general EE/CA process consists of the following steps:

- Evaluate site contaminant conditions
- Evaluate general response actions and technologies
- Develop removal action alternatives
- Analyze each alternative based on effectiveness, implementability, and cost
- Conduct a comparative analysis of alternatives.
- Recommend a preferred alternative

Section 1.0 presents an introduction, purpose of the EE/CA, the report organization, a site description and historical information, summaries of environmental contamination, and a summary of the risk evaluations for human (residential and recreational exposures) and ecological receptors.

Section 2.0 identifies statutory limits and reviews EPA's justification for conducting a NTCRA, establishes the NTCRA objectives that must be met, identifies regulatory considerations, and includes a discussion of the NTCRA implementation schedule.

Section 3.0 presents the development of removal action alternatives based on a screening of general response actions and technologies. Detailed descriptions of the removal action alternatives are presented. Conceptual designs of the alternatives are developed and refined at this stage by characterizing factors such as volumes or areas of contamination along with regulatory and policy considerations.

Section 4.0 presents the detailed analysis of alternatives based on three evaluation criteria: effectiveness, implementability, and cost. A comparative analysis of the removal action alternatives is also presented, followed by selection of the recommended alternative.

1.2 Site Description and History

The Centredale Manor Restoration Project Superfund Site is located in the portion of North Providence, Rhode Island, known as the village of Centredale. The source area of the Site consists of two parcels located at 2072 and 2074 Smith Street, which together encompass approximately 9.7 acres (Figures 1-1A and 1-1B). The Woonasquatucket River runs along the western portion of both parcels.

The river widens at a point approximately 2,000 feet south of the Centredale Manor and Brook Village portions of the Site, where it forms Allendale Pond. Allendale Pond extends for a distance of approximately 1,100 feet south at which point it terminates at Allendale Dam. Below Allendale Dam, the Woonasquatucket River continues for approximately 1,000 feet before it widens again to form Lymansville Pond. Lymansville Pond is approximately 3,500 feet in length and ends at Lymansville Dam.

Evidence suggests that releases of a variety of contaminants, including polychlorinated biphenyls (PCBs) and 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin), historically occurred at the 2072 and 2074 Smith Street properties. Contaminants may have been buried, released directly onto the ground, and/or released directly into the Woonasquatucket River. As a result of these actions, contaminants have migrated downstream and have impacted sediments in the Woonasquatucket River, Allendale Pond, and Lymansville Pond, and some soils in the flood plain areas associated with these water bodies.

The Site was added to the National Priorities List (NPL) on February 4, 2000. The current conceptual Site model is that there has been an ongoing release of hazardous substances from the former industrial operations at the 2072 and 2074 Smith Street parcels. When the companies were operating, it appears that releases were made directly to soil and wetland areas at the 2072 and 2074 Smith Street parcels, as well as directly into the Woonasquatucket River. During former industrial operations and after those operations ceased, riverbank and flood plain areas, including downstream (primarily residential) properties, were presumably impacted through transport and deposition of contaminated soils and sediment. Significant depositions of dioxin- and PCB-contaminated sediment exist within areas of Allendale Pond, at the Allendale Dam, and just downstream from the Allendale Dam, approximately 2,000 feet downstream from the original source areas (2072 and 2074 Smith Street). The breach of the Allendale Dam in 1991 and its continuing deterioration are likely to facilitate continued transportation of contaminated sediment further downstream, in the Lymansville Pond portion of the Woonasquatucket River.

1.2.1 Source Area

2072 and 2074 Smith Street are occupied by the Brook Village and Centredale Manor apartment buildings, respectively. Brook Village is a multi-story building which houses

approximately 135 elderly residents. Centredale Manor is also multi-story and houses approximately 200 elderly residents. The remainder of these two parcels includes parking lots and landscaped areas with grass cover. Both parcels are located within the 100-year flood plain of the Woonasquatucket River and flood periodically. Most of the properties within the flood plain downstream of the Smith Street properties on the east side of the Woonasquatucket River are zoned residential with a few parcels zoned for industrial/commercial use. Population density in this area is moderate to dense. Properties on the west side of the River are zoned primarily for industrial/commercial use.

Prior to 1936, 2072 and 2074 Smith Street were occupied by Centredale Worsted Mills, a woolens manufacturing plant. Metro Atlantic Chemical Corporation, a chemical manufacturer, began operations on a portion of the property in approximately 1940. Information gathered by EPA indicate that the company manufactured hexachlorophene at the facility. Records also show that shipments of trichlorophenols were made to the facility. The company changed its name to Metro-Atlantic, Inc. in 1953 and operated until the late 1960's or early 1970s. In the late 1960s or early 1970s, Metro-Atlantic, Inc. changed its name to Crown-Metro, Inc. The company ceased operating in the early 1970s.

New England Container Company operated a drum reconditioning facility on a portion of the property from 1952 until approximately 1969. The company reportedly burned chemical residues present in the drums prior to reconditioning.

A major fire in the early 1970s destroyed most of the structures at the property. In the 1970s, the Rhode Island Department of Health (RIDOH) and the local fire department conducted a number of investigations at the property in response to complaints of fires, odors, and fumes. Evidence suggested that operations at the chemical company and the drum reconditioning facility resulted in disposal of wastes on-site into soil and directly into the Woonasquatucket River. These disposal practices resulted in releases and threats of releases of hazardous substances at the property.

From approximately 1970 to approximately 1986, RIDEM was involved in the inspection of the property and oversight of response actions performed by others. Approximately 800 drums were observed at the property by RIDEM representatives, some of which were visibly smoking.

The Brook Village Apartment Building was constructed in 1977 and the Centredale Manor Apartment Building was constructed in 1982. Releases of hazardous substances may have also occurred during construction of these buildings. A series of sampling and analysis events conducted by EPA and RIDEM from June 1996 through November 1999 consistently revealed elevated levels of dioxin in soils and sediments at the Site. Elevated levels of dioxin have also been found in fish taken from the Woonasquatucket River in the vicinity of the Site. Other contaminants detected in Site soils and sediments include PCBs, chlorinated and aromatic volatile organic compounds, PAH compounds, phthalates and metals.

1.2.2 Allendale Pond and Allendale Dam

Allendale Dam is a ramp style mill dam with a wooden spillway approximately 105 feet in length, an equivalent length of berm, and a race gate on the eastern end of the berm. The ramp is comprised of wooden planks supported by wooden beams. Current configuration of Allendale Dam and the associated raceway indicates that the pond was created by the dam to provide power to the Allendale Mill, located approximately 300 feet south of Allendale Dam. Allendale Mill buildings are still present and some of the buildings are currently used as residential condominium units.

The dam appears to be constructed such that the race gate could be opened to allow dammed water to flow down the raceway to presumably turn a water wheel or other energy transfer device that was once present. The raceway actually passes under the existing mill building, and rejoins the Woonasquatucket River downstream of the mill complex.

The elevation of the top of the ramp spillway was determined to be 93.46 feet National Geodetic Vertical Datum (NGVD) 1929 (USACOE, 1996). The bottom of the race gate was determined to be at elevation 90 feet. Based on these elevations, the top of the race gate was measured to be at elevation 97 feet. This indicates that the pond and dam were designed to operate such that the race gate could be opened to allow up to 3.5 vertical feet of backed water down the raceway to run the mill. The water level within Allendale Pond would have rarely been higher than the spillway ramp (93.5 ft el.), as the wide span would alleviate typical high water conditions. Similarly, the water within the pond would not have been lower than the bottom elevation of the race gate (90 ft el.).

The race gate is currently closed and blocked with debris. The raceway depth is approximately 7 feet, with concrete and stone walls and an armored bottom. Vegetation is growing within it, although the walls appear to be stable. The soil berm is heavily vegetated, with large trees growing within it. The spillway ramp was naturally breached in 1991 when several planks near the center failed. The USACOE conducted a visual inspection of the dam following the breach and reported that a major portion of the dam had washed away and there was no longer an impoundment (USACOE, 1999). The dam break lowered water levels in the pond and upstream areas of the Woonasquatucket River approximately 2 to 3 feet. This exposed contaminated pond sediments at the shoreline of residential properties. The dam has not been repaired or removed. Much of the wood in the structure currently exhibits moderate to severe deterioration, presumably due to natural aging. Current levels of the pond and river are variable and shallow; with a maximum depth of approximately 4 feet at high water periods.

In 1996, Senator John Chafee (R-Rhode Island) secured senate approval for funding to restore the Allendale Dam (RI PL 104-303, October 12, 1996). Upon securing this funding, the USACOE initiated specifications for an in-kind restoration of the dam. However, upon finding dioxin contamination within the sediments of the pond near the dam, the USACOE suspended restoration efforts until proper contingency planning could be organized.

1.2.3 Lymansville Pond

Downstream of Allendale Mill, the river is channelized for approximately 400 feet, and then widens into a forested shrub/scrub emergent wetland. There is no apparent channel present in this area. Approximately 700 feet downstream of the Allendale Mill, standing water is present, impounded by the Lymansville Dam.

Lymansville Pond is a large mill pond formed by the Lymansville Dam. Water depths up to 8 feet were measured by TtNUS Inc. in September 1999. Most of the pond bottom was noted at that time to be extensively vegetated, with soft sediments. The water level within the pond appears to be quite stable, as the Lymansville Dam is functional and does not currently employ a race gate to control water levels. Lymansville Dam consists of a vegetated soil berm and a concrete gravity spillway approximately 100 feet in length.

A mix of residential and commercial/industrial properties are present on the east shore (North Providence side) of Lymansville Pond. A single gravel operation occupies the west side (Johnston) of Lymansville Pond. The only public access points to the pond are several streets on the east side that end at the pond banks.

1.3 Previous Removal Actions

From approximately 1970 to approximately 1986, RIDEM was involved in inspections conducted at the Site. In November 1981, a Notice of Violation and Order was issued by RIDEM to the then-property owners requiring them to immediately identify all hazardous materials on-site, then dispose of all hazardous waste off-site. No record was available which indicated the owners attempted to comply with the Order.

During construction of the Brook Village and Centredale Manor apartment buildings, approximately 400 drums and 6,000 cubic yards of contaminated soil were removed from the property by GZA GeoEnvironmental, Inc.

In January 1999, EPA initiated an emergency action in response to sampling data which had been collected in 1998. Temporary fencing was installed around areas of surface soil contamination. In May 1999 and September 1999, Action Memorandums were signed which secured funds for a range of emergency response actions including installation of a chain-link fence to prevent access to contaminated areas, characterization of subsurface contamination, and construction of temporary protective caps over areas of heavily contaminated soil near residential housing.

As of July 2000, EPA's removal program has completed one protective interim soil cap in the source area; installed access-restricting fencing; and coordinated with the USACOE on a flood impact study of the Site. Potential Responsible Party (PRP) contractors have completed a second protective interim soil cap. Improvement of the drainage in the area of the tail race east of the Site is currently under consideration.

EPA initiated Remedial Investigation (RI) activities at the Site in August 1999. Additional Site evaluations for ecological risk assessments are currently being conducted.

1.4 Data Summary

This section provides a brief summary of data collected at the Site. Four major efforts have produced data that is used to support the EE/CA and the NTCRA. These include sampling conducted in support of the emergency response actions (IT, January 2000), sampling conducted in support of an Expanded Site Investigation (Weston, 1999), sampling conducted as an initial evaluation of dioxin presence at impoundments in the Woonasquatucket River (EPA, 1998) and sampling conducted in 1999 to further characterize sediment contaminants in the Allendale Pond and Lymansville Pond areas (TtNUS, June 2000).

Sampling results supporting the scope of this EE/CA and NTCRA are summarized in this section. Data on the Brook Village and Centredale Manor properties were used by EPAs removal program to conduct and oversee response actions including the installation of protective interim soil caps and the installation of fencing to restrict access to contaminated areas. "No Fishing" advisories have also been established on the Woonasquatucket River. Table 1-1 provides a summary of the data collected in conjunction with the Centredale Manor Restoration Project, and the role of each data group in the EE/CA. Figures 1-2A, B, and C present locations of samples described in this section.

This section is organized into the different media sampled and evaluated as a part of this EE/CA (residential soils, flood plain sediments, bank sediments, aquatic sediments, and surface water). These different media were defined during the Woonasquatucket River Sediment Investigation (TtNUS Inc., June 2000) and are described in the following subsections and in Appendix B of this report. This organization is provided since these different media are evaluated separately in the streamlined risk evaluations, as appropriate for the receptors evaluated. To evaluate the data from the different data sets, a database was developed which contains all the chemical data for the Site. Brief statistics for each set or subset, as appropriate to the discussion, were generated using database queries for specific groups of data. Statistical summaries for each data set discussed in this section are provided in Appendix A.

TABLE 1-1
SUMMARY OF DATA AVAILABLE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

DATE OF ORIGIN	MEDIA/ COLLECTED BY	ANALYTES	ORIGINAL USE OF DATA	Use in EE/CA
1) May, 1996:	Fish collected by USEPA at two locations: 15 sunfish collected at Valley St. site, Providence, RI. 3 American eel collected at Smith St. site (near Centredale), N. Providence, RI. Fillet and offal samples for each.	Selected metals, PCB congeners - #8, 18, 28, 52, 44, 66, 101, 118, 153, 105, 138, 187, 128, 180, 170, 195, 206, 209. Pesticides - HCB, DDE, DDD, DDT, lindane, alpha - chlordane, nonachlor. Dioxins and dioxin-like PCBs (#77, 126, 169).	Fish analyzed to provide an indicator of the quality of the river system.	Fish Data not Used for EE/CA
2) October, 1997	Water and sediment collected behind 7 dams on Woonasquatucket River - Esmond, Allendale, Lymansville, Manton, Dyerville, Olneyville, Lonigan. Samples identified as DAM-01 - DAM 07, North to South.	Water analyzed for DO, Temp, conductivity, pH. Sediment analyzed for total metals, PAHs, PCBs, pesticides, AVS, SEM, dioxin and TOC. *(Sediment Water Quality Analysis, 7/31/98, Prepared by EPA, Region 1, OEME)*	First sediment evaluation to locate possible source of dioxin.	Two samples fall within the boundaries of the area evaluated as aquatic sediment in the EE/CA
3) September, 1998	Soil and sediment samples collected from 42 locations. 5 soil samples at Centredale Manor property, 1 soil sample at Brook Village property, 35 sediment samples on Woonasquatucket. River and 4 sediment samples in Centredale Raceway. Samples identified as SD-##	Samples analyzed for dioxin and HCX, SVOCs, pest/PCBs. *(Final Summary Report for Expanded site inspection for Centredale Manor, March 9, 1999, prepared by Roy F. Weston.)*	Sediment investigation to confirm high concentrations of sediment near the Centredale Manor property.	Data from samples not taken at CM and BV properties were used for contaminant distribution evaluation and risk evaluation.
4) January 15, 1999	Soil samples collected from 17 locations at Centredale Manor, No. Providence Boys and Girls Club, Early Years Learning Center, Lee Romano Baseball Field. Samples identified as SS-99-00 thru SS-99-16.	Samples analyzed for dioxin only. *(Final Summary Report for Expanded site inspection for Centredale Manor, March 9, 1999, prepared by Roy F. Weston.)*	Determine possible risks to persons using these areas for recreational purposes.	Source area not evaluated in EE/CA. Ballfield and Boys/Girls club properties were found to not pose a risk to humans during emergency response actions, therefore they were not included in the EE/CA.

TABLE 1-1 (continued)
SUMMARY OF DATA AVAILABLE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
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DATE OF ORIGIN	MEDIA/ COLLECTED BY	ANALYTES	ORIGINAL USE OF DATA	Use in EE/CA
4) January 15, 1999 (cont'd)	Three drinking water samples collected also - 2 at Yacht Club Bottling Works Co. and 1 at Pied Piper School.	Samples analyzed for dioxin only. *(Final Summary Report for Expanded site inspection for Centredale Manor, March 9, 1999, prepared by Roy F. Weston.)*	Determine possible risks to persons drinking water at these locations.	Water not evaluated in EE/CA
5) January 27, 1999	Five soil samples collected by USEPA Emergency Response Group from Lee Romano Baseball Field. These samples are SS-21 through SS-25.	Samples analyzed for dioxins only. *(Final Summary Report for Expanded site inspection for Centredale Manor, March 9, 1999, prepared by Roy F. Weston.*	Determine possible risks to persons using these areas for recreational purposes.	These areas were found to not pose a risk to humans during emergency response actions, therefore they were not included in the EE/CA.
6) February 18, 1999	222 soil samples collected by USEPA Emergency Response Group from Centredale Manor and Brook Village properties and several residential properties located adjacent to Centredale Raceway.	Samples taken from Centredale Manor and Brook village properties, analyzed for 2,3,7,8-TCDD only. Samples from other residential properties sampled for all dioxins. *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Determine extent of surface contaminantion, and develop approach for short term actions under emergency response.	Data from samples not taken at CM and BV properties were used for contaminant distribution evaluation and risk evaluation.
7) June 21- July 21, 1999	A total of 524 soil samples collected by USEPA Emergency Response Group from Centredale Manor and Brook Village properties.	All soil samples analyzed for dioxins and PCBs. 20% of samples analyzed for SVOCs, metals, Pest/PCBs, dioxins. *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Determine vertical extent of contamination, support for the selected approach for short term actions.	Data from samples not taken at CM and BV properties were used for contaminant distribution evaluation and risk evaluation.
8) July 19-21, 1999	28 soil samples by USEPA Emergency Response Group collected at residential properties adjacent to Centredale raceway and wetlands by hand auger.	All samples analyzed for dioxins and PCBs. *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Identify presence of contaminants on residential property, and determine appropriate location of fence to control access to contaminated areas.	These used in EE/CA largely to define vertical extent of contamiants at Allendale Dam

TABLE 1-1 (continued)
SUMMARY OF DATA AVAILABLE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
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DATE OF ORIGIN	MEDIA/ COLLECTED BY	ANALYTES	ORIGINAL USE OF DATA	Use in EE/CA
9) July 23- August 13, 1999	68 soil samples collected by USEPA Emergency Response Group at residential properties adjacent to Allendale Pond by hand auger. CMS-457 to CMS-508.	All samples analyzed for dioxins and PCBs *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Identify presence of contaminants on residential property, and determine appropriate location of fence to control access to contaminated areas.	Data from samples not taken at CM and BV properties were used for contaminant distribution evaluation and risk evaluation.
10) September 29 - October 5, 1999	43 sediment samples collected by USEPA Emergency Response Group from Allendale Pond. CMS-600-CMS-634.	All samples analyzed for dioxins and PCBs. *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Begin to evaluate extent of downstream contamination.	Data from samples not taken at CM and BV properties were used for contaminant distribution evaluation and risk evaluation.
11) November 5, 1999	11 soil samples collected at Brook village by riverbank by USEPA Emergency Response Group. Soil still there but covered with rip-rap. CMS-700 to CMS-703.	Full suite of chemical analyses. *Refer to Final SI Report, prepared by The IT Group, January 2000.*	Determine need to cap bank sediments at Brook Village property.	No data from the source area used for EE/CA
12) August 3, 1999	5 indoor air samples collected in Centredale Manor and Brook Village by OEME and START.	Samples analyzed for volatile organic compounds. Report is currently in draft.	Performed to identify possible hazards to residents from air quality inside building.	No air data evaluated for EE/CA
13) September 8-9, 1999	165 vapor diffusion samplers installed by USGS to sample for soil gas in wetland areas and in sections of W. river.	Samples analyzed for select VOCs. Report by USGS is currently in draft.	Performed to locate possible discharge locations of specific contaminants at source area into the river.	No soil gas data, or data from the source area used for EE/CA

TABLE 1-1 (continued)
SUMMARY OF DATA AVAILABLE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
PAGE 4 OF 4

DATE OF ORIGIN	MEDIA/ COLLECTED BY	ANALYTES	ORIGINAL USE OF DATA	Use in EE/CA
14) October 20-November 29, 1999	50 Sediment samples collected by USEPA Remediation Group from aquatic and flood plain sediments in river and Allendale and Lymansville ponds.	All samples analyzed for dioxins and HCX, SVOCs, metals, Pest/PCBs, grain size TOC, and SEM/AVS	Performed to determine nature and extent of contaminants in sediment of river and ponds downstream of source area, also to support future risk assessments.	All data used for contaminant distribution evaluation and risk evaluation.
	36 water samples collected by USEPA Remediation Group from river and Allendale and Lymansville ponds.	All samples analyzed for dioxins and HCX, SVOCs, metals, Pesticides and PCBs.	Performed to determine nature and extent of contaminants in water in river and ponds downstream of source area, also to support future risk assessments.	All data used for contaminant distribution evaluation.
	24 samples of sediment collected USEPA Remediation Group from banks of river	All samples analyzed for dioxins and HCX, SVOCs, metals, Pesticides and PCBs.	Performed to determine nature and extent of contaminants in sediment of river and ponds downstream of source area, also to support future risk assessments.	All data used for contaminant distribution evaluation and risk evaluation.
	126 soil samples collected by USEPA Remediation Group from residential use soils along Centredale raceway, Allendale Pond, and Lymansville Pond.	All samples analyzed for dioxins and HCX. approximately half also analyzed for SVOCs, metals, Pest/PCBs, dioxin,. Sampled by Tetra Tech from just upgradient to Rte 44 Bridge to the Lymansville Pond area.	Performed to determine nature and extent of contaminants on residential use property adjacent to and downstream of source area, also to support future risk assessments.	All data used for contaminant distribution evaluation and risk evaluation.

Chemical data for dioxin compounds and other organic compounds is presented in micrograms per kilogram or ug/kg (parts per billion, ppb). Chemical data for metals in soil and sediment is presented in milligrams per kilogram or mg/kg (parts per million, ppm).

1.4.1 Residential Soil Data

Samples of soils were collected from residential-use land by The IT Group (IT) and TtNUS. Residential-use land was defined as land on or adjacent to lots that are currently zoned for residential use. Some of these samples were purposely collected as close as was reasonable to the existing waters edge at the time of sampling, presuming these would be the areas where contaminant concentrations are the highest. In the case of property adjacent to Allendale Pond which has dropped in elevation since the dam breach occurred 1991, it is believed that many of the residential samples were taken below the historic shoreline of that pond, as the pond waters have dropped in elevation since the dam breach occurred in 1991. Almost all samples collected from residential use soils were from the surface (0-1 foot in depth).

Most residential soil samples were collected in groups of three, such that for each town tax lot sampled, three samples were collected in a line from the waters edge up-gradient to a point approximately one to three feet vertically from each other. This approach was developed to test the presumption that Site contaminants were transported downstream from the source area and deposited with sedimentation processes. It was anticipated that if the presumption was correct, contaminant concentrations would decrease with vertical distance from the waters edge.

Summary of Residential Soil Data

Dioxin, identified as 2,3,7,8 TCDD, was detected in 128 of the 133 residential soil samples collected. Concentrations ranged from below detection limits to a maximum concentration of 57.3 ug/kg. This high concentration was located in a depositional cove south of Centredale Avenue. Most residential soil samples in the Lymansville area showed dioxin levels below 1 ug/kg, while approximately half of the residential soil samples in the Allendale area showed dioxin levels above 1 ug/kg.

Hexachloroxanthene (HCX) was detected above sample reporting limits in 63 residential soil samples. The concentrations of HCX ranged from 0.0006 ug/kg to 5.15 (J) ug/kg. The highest

concentration was detected at sample location RES-SS-14-449, colocated with the maximum concentration of 2,3,7,8-TCDD detected south of Centredale Avenue.

PCBs as total Aroclors were detected in 37 of 61 residential soil samples collected by TtNUS. Total Aroclor concentrations ranged from 30 ug/kg to 48,000 ug/kg. Five of these stations, RES-SS-14-303, RES-SS-14-333, RES-SS-14-448, RES-SS-14-449, and RES-SS-555, also had elevated dioxin results (TtNUS, 2000). Two of the five stations referenced above are adjacent to the Centredale Manor property, the remaining three stations are located adjacent to Allendale Pond and its associated wetlands. Aroclors detected in residential soils included Aroclor 1242, Aroclor 1254, and Aroclor 1260.

Approximately one soil sample from each property was analyzed for metals and semivolatile organic compounds (SVOCs). The highest concentrations of arsenic, barium, and lead were detected in samples collected on residential property abutting Lymansville Pond. Chromium and mercury were detected at the highest concentrations at location RES-SS-14-449, adjacent to Allendale Pond. Elevated concentrations of semivolatile organic compounds, notably polycyclic aromatic hydrocarbons (PAHs), were found in residential soils adjacent to Lymansville Pond.

Evaluation of Residential Soil Data

To evaluate the residential soil data, the summary statistics were generated for residential soils in six groups. The data was first divided into two sections: data from residential soils upstream of Allendale Dam, and data from residential soils between Allendale Dam and Lymansville Dam. Where possible, data points were further divided between the vertical location relative to the existing waters edge at the time of sampling: samples closest to the water were placed in a group identified as 01, highest upgradient samples were placed in a group identified as 03, and the samples in between were placed in a group identified as 02. Summary statistics for these six groups are provided in Appendix A.

In the Allendale groups, the average concentrations of dioxins did not clearly fit the presumption described above. Although average concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in the 01, 02 and 03 groups were 3.3 µg/kg, 2.9 µg/kg and 0.08 µg/kg, respectively, average concentrations of total TCDD were 2.7 µg/kg, 2.9 µg/kg, and 10.4 µg/kg,

respectively. Other dioxin/furan compounds showed various trends and as a result, no confirmation could be made. Other contaminant groups could not be evaluated, as most were only analyzed for in the 01 group.

In the Lymansville groups, the average concentrations of detected dioxins did clearly fit the presumption described above. Average concentrations detected for 2,3,7,8-TCDD were 0.18 µg/kg, 0.02 µg/kg, and 0.004 µg/kg for the 01, 02 and 03 groups respectively. Other dioxin and furan compounds also fit this pattern including total TCDD (0.27 µg/kg, 0.04 µg/kg and 0.04 µg/kg), polychlorinated dibenzo-p-dioxins (PCDD/Fs) (3.55 µg/kg, 0.87 µg/kg, and 0.59), total tetrachlorodibenzofuran (TCDF) (0.31 µg/kg, 0.08 µg/kg, and 0.05 µg/kg), etc.

After considering the data trends described above, it was noted that the samples from the three groups taken in the Allendale area were primarily taken from locations within the limits of the pond that existed prior to the dam breach in 1991. This was done because those areas are currently accessible to humans. Because these locations are in areas below the historic water level it is believed they have similar concentrations due to water transport activities prior to 1991.

The samples from all three groups taken in the Lymansville area were also taken from the existing waters edge at the time of sampling. This water level is still similar to that which has been present for several decades, since there has been no break in Lymansville Dam. With this consideration, it is not surprising that there is no concentration gradient evident between the three sample groups in Allendale Pond, while there is a notable concentration gradient evident between the three sample groups in Lymansville Pond. Finally, this also indicates that the data from the residential use soils between Allendale Pond and Lymansville Pond are not comparable, as they are collected from soils with different histories.

1.4.2 Flood Plain Sediment Data

Flood plain sediment samples were collected by Roy F. Weston, Inc. (Weston), IT and TtNUS as part of the different stages of the investigations for the Site. Flood plain sediments (not be confused with flood zone areas) were defined during the October 1999 sampling effort as sediment that is periodically inundated with one foot of water or less. Specifically, the sampling team from TtNUS (October 1999) attempted to identify sediments that would be inundated with

one foot of water or less for one month annually or less. Samples collected in such areas were defined as flood plain samples. During this data assessment, other locations previously sampled (Weston 1999 "SD" samples and some "CMS" samples collected by IT) were also identified as flood plain samples, as their locations were believed to fit this definition. The designation of flood plain sediment is approximate, since actual inundation is dependent on the behavior of the breach at Allendale Dam and weather conditions.

Flood plain sediment samples included surface samples (between 0-1 foot in depth) at all locations, and deep samples (> than 1 foot in depth) at selected locations. Sample intervals were selected based on the initial planned use of the data.

Summary of Flood Plain Sediment Data

On September 9, 1998, Weston collected 35 sediment samples from the Woonasquatucket River and four sediment samples from the drainage channel adjacent to the Centredale Manor property. The sediment samples were analyzed for SVOCs, pesticides/PCBs, dioxins, and HCX (Weston, 1999). Results from SVOC analyses indicated elevated levels of PAHs. Twelve key PAHs were noted in particular: anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

Pesticide/PCB analyses of the sediment samples indicated 4 pesticides (4,4'-DDE, 4,4'-DDT, alpha chlordane, and gamma chlordane) above sample detection limits. The concentrations of these detected pesticides ranged from 9.1 ug/kg to 27(J) ug/kg. The highest pesticide concentration detected was of 4,4'-DDT and was detected at sample station SD-11, which is located along the western side of the Lymansville Pond.

PCB analysis indicated Aroclor 1254 at 14 sample locations. The concentrations ranged from 33 ug/kg to 4,200 ug/kg, with the highest concentration located in the Centredale Raceway. The next three highest concentrations were detected at one station in the south end of the Centredale Raceway and at 2 stations at the Allendale Dam.

Concentrations of dioxin (as 2,3,7,8-TCDD) above sample detection limits were detected in 29 of the 39 sediment samples collected by Weston. Dioxin concentrations in these 29 locations

ranged from 0.017 µg/kg to 10.05 µg/kg. Higher dioxin concentrations (greater than 1 µg/kg) were detected in 9 of these samples and were primarily located at sediment stations along Allendale Pond and at the Allendale Dam. The one exception was a sediment station located in the wetland between the Allendale Dam and Lymansville Pond (7.9 µg/kg).

Sediment sample analyses detected HCX above sample reporting limits in 13 samples. The HCX concentration in these 13 samples ranged from 6.8 (J) µg/kg to 365 (J) µg/kg. The highest concentrations of HCX coincided with those of dioxins and were detected in the same samples located along Allendale Pond and at the Allendale Dam as well as in the additional sample located downstream of the dam.

From June 1999 through November 1999, IT collected sediment and soil samples in support of the emergency response actions at the Site. A report of their findings was provided to EPA on March 9, 2000. Review of the sample locations indicates that 60 of the stations sampled by IT are located in areas that would be designated as flood plain sediment as defined above. Thirty-six of these stations are located in the former raceway for the Centredale Mill, and 24 are located in the wetland to the south of the Centredale Manor property. All the samples in this data set were analyzed only for 2,3,7,8-TCDD.

Results of the dioxin analyses were presented graphically in the March 2000 IT report. These results indicate the presence of dioxin at concentrations up to 33 µg/kg of 2,3,7,8-TCDD in surface flood plain sediments (CMS-186). Samples with dioxin exceeding 1 µg/kg were noted to be prevalent in the sediment between the main river channel and a drainage swale extending from a point west of George Street south to a point west of Aldrich Street. Only two flood plain stations in the raceway were found to exceed the 1µg/kg (ppb) action level (CMS-123 and CMS-159).

Deeper intervals of flood plain sediment sampled showed a rapid decrease of 2,3,7,8-TCDD, with two exceedances of 1 µg/kg in the 1-2 foot interval below the sediment surface (CMS-186 and CMS-195).

Between October and December 1999, TtNUS collected 20 sediment samples from 10 stations within the flood plain of the Site. Additionally, 2 flood plain samples were collected upstream of the Centredale Manor and Brook Village properties along with a reference sample, RAB-FP-

3004, collected from a tributary west of the Woonasquatucket River and the Centredale Manor site. The flood plain samples were collected in areas predicted to be inundated with less than 1 foot of water for less than 1 month per year. The flood plain sediment samples were analyzed for dioxin, pesticide/PCBs, SVOCs, metals, and total organic carbon (TOC) (TtNUS, 2000).

The dioxin analysis results indicated the presence of dioxin above sample detection limits in all flood plain sediment samples collected. The concentration of dioxin in the samples ranged from below the detection limit to 16.3 μg/kg. The lowest concentration was detected in the tributary reference sample, RAB-FP-3004. The lowest downstream concentration was detected in a sample collected from Allendale Pond (0.002 μg/kg). This sample was collected at a depth interval of 0 to 0.5 foot below ground surface (bgs).

The highest dioxin concentration was detected at sample location CMW-FP-2026 at a depth interval of 0–0.5 feet bgs. The dioxin concentration at this location decreased to 0.3 μg/kg at a depth interval of 0.5-2.0 feet bgs, and then decreased even further to 0.025 μg/kg at a depth interval of 2.0-4.0 feet bgs.

The concentrations of HCX detected in flood plain samples above sample reporting limits ranged from below the detection limit to 6.3 μg/kg. The highest concentration was detected at sample location CMW-SD-2021 at a depth interval of 0 to 0.5 feet bgs. This sample station is located along the drainage channel east of the Centredale Manor property. Overall, HCX was detected at higher concentrations at lower depth intervals below ground surface.

PCBs were detected above sample reporting limits in 17 of the flood plain sediment samples collected by TtNUS. PCBs were measured as individual and total Aroclors. Total Aroclor concentrations ranged from 22 ug/kg to 7,000 ug/kg. The highest was detected at depth intervals of 0.5-2.0 feet bgs. The highest PCB concentrations were detected in the samples collected adjacent to the Centredale Manor site and the Allendale Pond. The individual Aroclor most commonly detected was Aroclor 1254, but Aroclor 1248 and Aroclor 1260 were detected in 4 samples and 1 sample, respectively.

Flood plain sediment samples were analyzed for 23 metals. The highest concentrations of barium, lead, and mercury were detected at concentrations of 244 ppm, 1,090 ppm, and 1.4 ppm, respectively, in samples collected along and within Allendale Pond. These

concentrations were detected in the 0-0.5 feet bgs depth interval. The highest concentrations of arsenic and chromium were detected at concentrations of 13.3 ppm and 331 ppm, respectively. Both were found upstream from the Allendale Pond, in the wetlands south of the Centredale Manor property.

Evaluation of Flood Plain Sediment Data

To evaluate the flood plain sediment data, the summary statistics were generated for flood plain sediment in four groups. The data was first divided into two sections: Data from flood plain sediment taken between the suspected source area and Allendale Dam (Allendale Group), and Data from flood plain sediment taken between Allendale Dam and Lymansville Dam (Lymansville Group). Each of these two data groups was further divided between surface sediment (i.e. sediment collected from intervals between 0-0.25 foot and 0-1 foot depth) and deep sediment (all sediment collected from deeper intervals). Summary statistics for these four groups are provided in Appendix A.

Based on these groups, there did not appear to be a notable difference between average concentrations in the surface flood plain sediment group and the deep flood plain sediment group. However, this may be due to the intervals selected for these groups. The surface group includes samples in the 0-0.25 foot to 0-1 foot intervals, and the deep group includes all the remaining samples from 0.5 feet to up to 6.0 feet. IT reported dioxin concentrations in Allendale Pond in groups of one foot intervals, and this evaluation showed highest concentrations of dioxin in the intervals between ground surface and 2.0 feet of depth (IT, March 2000).

1.4.3 Bank Sediment Data

Between October and December 1999, TtNUS collected 24 bank sediment samples from eight stations, such that three samples were collected at each location. This sample set included two reference stations. The bank samples were given an "X", "Y", or "Z" designation in the sample identification number indicating where each sample was located. The "X" samples were collected immediately adjacent to the water (typically within 1 foot) the "Y" and "Z" samples were collected at distances ranging from 3 to 23 feet further from the water as the "X" sample location. Therefore, these samples were taken further from the current water edge as compared to the residential soil samples. The bank sediment samples were collected from a

depth interval of 0 to 0.5 foot bgs. Bank sediment samples were analyzed for dioxin, HCX, pesticides/PCBs, SVOCs, and metals (TtNUS, 2000).

Summary of Bank Sample Data

Dioxin was detected above sample reporting limits in 23 of the 24 bank sediment samples collected. The dioxin concentrations in these samples ranged from 0 to 2.9 µg/kg. The lowest concentration was detected in bank sediment sample LPX-BK-2008Y-01, which was the most downstream location. The highest concentration was detected in bank sediment sample WRL-BK-2004Z-01, located immediately downstream of the Allendale Dam. While dioxins were detected at bank samples collected upstream of the Brook Village portion of the Site, concentrations were lower upstream than compared to the sediments near the Centredale Manor and Brook Village Properties and downstream.

HCX was detected above sample reporting limits in 13 of the 24 bank sediment samples collected. The concentrations ranged from 0.001 µg/kg to 1.2 µg/kg. The lowest concentration was detected in sample WRL-BK-2005Y-01, located downstream from the Allendale Dam, across the river from the Lee Romano baseball field. The highest concentration was detected in sample WRL-BK-2004Z-01, located across the river from the Allendale Mill complex, which is where the highest dioxin concentration was detected.

PCBs were analyzed as Aroclors, which are commercially available blends of PCB congeners. Aroclors were detected in 11 of the 24 bank sediment samples collected. The total Aroclor concentrations ranged from 13 ug/kg to 450 ug/kg. The lowest concentration was detected in sample WRL-BK-2004X-01, collected immediately downstream from the Allendale Dam. The highest PCB concentration in bank samples was detected in sample RCC-BK-3001X-01, located upstream from the Brook Village portion of the Site. Bank sediment station RCC-BK-3001 was the only station where Aroclor 1221 was detected, at all other stations Aroclor-1254 was the only PCB detected.

Seven pesticide compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, endrin, and gamma-chlordane) were detected in the bank sediment samples. The highest concentrations for four of these pesticides (4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane) were detected at bank sediment sample station RCC-BK-3001, located

upstream from the Brook Village portion of the Site. Of the remaining three pesticides, 4,4'-DDE and endrin were only detected at station WRL-BK-2005. The highest concentration of dieldrin was detected at station WRL-BK-2004, across the river from the Allendale Mill complex.

Bank sediment samples were analyzed for 23 metals. The highest concentrations in bank sediment samples for arsenic, barium, and lead were all detected at sample station APB-BK-2003, which is located on the upstream side of Allendale Dam. The specific concentrations at this location were 10.5 ppm, 262 ppm, and 373 ppm, respectively. The highest chromium concentration of 311 ppm was detected at sample station RCC-BK-3001, located upstream of the Brook Village portion of the Site. The highest mercury concentration, 0.48 ppm, was detected in a sample collected from bank sediment station WRL-BK-2004, near Allendale Mill Condominiums.

Bank sediment samples were analyzed for SVOCs. The highest concentrations for 8 key PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene) were detected in the upstream sediment sample collected at RCC-BK-3001, located upstream from the Brook Village portion of the Site. Four other key PAHs (anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, fluoranthene) were detected at highest concentrations at sample station APB-BK-2003, located on the upstream side of Allendale Dam.

Evaluation of Bank Sediment Sample Data

To evaluate the bank sediment sample data, the summary statistics were generated for these samples in three groups. Data from bank samples taken between the suspected source area and Allendale Dam (six samples), data from bank samples taken from the banks of the Woonasquatucket River between Allendale Dam and Lymansville Pond (two stations, six samples) and data from bank samples taken from Lymansville Pond (three stations, nine samples). Summary statistics for these three groups are provided in Appendix A.

Evaluation of these statistics sets do not show notable differences in the average concentrations of dioxins between the groups. Rather than showing evidence of an upstream to downstream gradient, these results seem to show a gradient based on depositional characteristics of the area sampled. The Woonasquatucket River stations (second group described above) are

located in the most depositional of the bank stations, and these do show the highest average detected concentrations of 2,3,7,8-TCDD, Total TCDD, and HCX. One thing that was notable was elevated average detected concentrations of PAHs in the bank stations in Allendale Pond.

1.4.4 Aquatic Sediment Data

Aquatic sediments were defined by TtNUS in October 1999 as sediments which are predicted to be inundated with more than one foot of water more than one month annually. The designation between aquatic sediment and flood plain sediment is approximate, since actual inundation is dependent on the behavior of the breach at Allendale Dam and weather conditions. Aquatic sediment samples included surface samples (from intervals 0-0.5 feet or 0-1.0 feet in depth), and selected deep samples. Sample intervals were dependent on the targets identified by the different objectives of each group collecting samples.

Summary of Aquatic Sediment Data

IT collected 12 sediment samples from five locations adjacent to the Allendale Dam. These samples were analyzed for PCDDs/Fs, PCBs, pesticides, PAHs, RCRA Metals, and TOC (IT, 2000).

PCDD/PCDF analyses were performed on the sediment samples collected from the Allendale Dam by IT. After data analyses, IT determined that 2,3,7,8-TCDD concentration was a suitable indicator of PCDDs/Fs (IT, 2000). Dioxin was detected above sample reporting limits in 10 samples with concentrations ranging from 0.00068 (J) µg/kg to 26 (J) µg/kg. At four of the locations, the dioxin concentrations decreased with increased depth.

PCBs were detected above sample reporting limits in 4 of the 12 sediment samples collected from the Allendale Dam. The concentrations ranged from 14 (J) ug/kg to 9,100 pbb. Three of the four samples with detections were collected at the 0.5 foot depth.

The IT results indicate dieldrin as the only pesticide detected above sample reporting limits in the Allendale Dam sediment samples. Dieldrin was detected in sample AD-04 at a concentration of 0.17 (J) mg/kg.

SVOC analysis on the sediment samples indicated concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene above sample reporting limits. The highest concentration for each of these PAHs within this set of data was detected at sample station AD-04.

Arsenic, chromium, and lead were the only metals detected above sample reporting limits in the Allendale Dam sediments. Arsenic was detected at a concentration of 3.8 (J) ppm at sample location AD-02. Chromium and lead were detected at concentrations of 382 (J) ppm and 629 ppm, respectively, at sample station AD-04.

From June 1999 through November 1999, IT collected sediment and soil samples in support of the emergency response actions at the Site. A report of their findings was provided to EPA on March 9, 2000. This report states that 43 of the stations (identified as the 600 series samples) sampled by IT were taken from within the existing pond. All the 600 series samples collected by IT were analyzed for 2,3,7,8-TCDD, and PCBs. At all stations, the 0-1 foot interval was sampled, and at selected stations, deeper intervals were collected.

Results of the dioxin analyses were presented graphically in the IT report. These results indicate the presence of dioxin at concentrations up to 46 µg/kg of 2,3,7,8-TCDD in surface aquatic sediments of the pond (CMS-605). Deeper intervals of aquatic sediment sampled showed a rapid decrease of 2,3,7,8-TCDD, with no exceedances of 1 µg/kg below a depth of 1 foot below the sediment surface.

Results of the PCB analyses was also presented graphically in the IT report. These results indicate elevated concentrations of PCBs in surface aquatic sediment, with the maximum concentration of 28,000 ug/kg at CMS-607. However, these levels decreased with depth, evidenced by the findings of almost no exceedance of 1,000 ug/kg below the 1 foot depth. One variant was noted in this data set: One sample, collected at 4-5 feet below ground surface at station CMS-605, located in the northern portion of Allendale Pond found 1,000 ug/kg of total PCBs.

Between October and December 1999, TtNUS collected 50 surface sediment samples from the Woonasquatucket River from a location upstream of the Brook Village portion of the site, down

to the Lymansville Dam. Surface sediment samples were collected from a depth interval of 0 to 0.5 feet bgs. Additionally, deep (subsurface) sediment samples were collected from 15 of these 50 surface sediment stations in portions of the river with hydrological characteristics favorable to deposition (TtNUS, 2000). Sediment samples were analyzed by TtNUS for dioxin, HCX, pesticides/PCBs, SVOCs, and metals.

Dioxin was detected above sample reporting limits in 31 of the 50 surface sediment samples collected. Dioxin concentrations ranged from 0.006 µg/kg to 8.3 µg/kg. These results are from samples collected from the 0 to 0.5-foot bgs depth interval. The highest concentration was detected at sample station WRC-SD-2014, which is located between Centredale Manor portion of the Site and the Allendale Pond.

HCX was detected above sample reporting limits in 45 of the 50 sediment samples. The concentrations ranged from 0.001 µg/kg to 8.1 µg/kg. The lowest concentration was detected at a 2-4 foot bgs depth interval. The highest concentration of HCX was detected at sample station CMW-SD-2019, at a 0-0.5 foot bgs depth interval. This station is located adjacent to the Centredale Manor portion of the Site.

Thirteen pesticides were detected above sample reporting limits in 35 sediment samples collected for the Centredale Manor site investigation. PCBs were analyzed as total and individual Aroclors. Aroclor compounds were detected in 44 of the 50 sediment samples collected. The total PCB concentrations ranged from 22 ug/kg to 5,200 pbb. The lowest concentration was detected at a 2.0-4.0 depth interval. The highest concentration was detected at sample station CMW-SD-2019 at a 0-0.5 foot bgs depth interval. This station is located along the drainage channel adjacent to the Centredale Manor portion of the Site.

Sediment samples were analyzed for 23 metals. The highest concentrations of arsenic and barium were detected along the Lymansville Pond at concentrations of 14.8 ppm and 342 ppm, respectively. The highest concentrations of chromium and lead were detected along Allendale Pond at concentrations of 248 ppm and 719 ppm, respectively. Samples with the highest concentrations of chromium and lead were collected at a 0-0.5 foot bgs depth interval. Mercury was detected at its highest concentration, 3.6 ppm, in a sediment sample collected adjacent to the Centredale Manor portion of the Site.

Evaluation of Aquatic Sediment Data

To evaluate the aquatic sediment data, the summary statistics were generated for aquatic sediment in four groups. The data was first divided into two sections: data from aquatic sediment taken between the suspected source area and Allendale Dam, and data from aquatic sediment taken between Allendale Dam and Lymansville Dam. Each of these two data groups was further divided between surface sediment (i.e. sediment collected from the 0-0.5 or 0-1 foot intervals) and deep sediment (all sediment collected from deeper intervals). Summary statistics for these four groups are provided in Appendix A.

Average detected concentrations of 2,3,7,8-TCDD in these groups do show predicted gradients of contaminants. The average detected concentrations are higher in the surface intervals than in the deeper intervals, and also higher in the Allendale groups than in the Lymansville groups. This is also evident for HCX, but for the other dioxins and furans, the gradient is less evident. Average detected concentrations of PCBs also show a similar gradient with the exception of the deep sediment in Lymansville Pond, where 2,600 ug/kg of Aroclor 1254 was detected in a single deep sample (LPX-SD-2046).

1.4.5 Surface Water Samples

Surface water samples were collected at 35 locations by TtNUS Inc in October 1999, which include four reference sample stations. In addition, water samples were taken at the Allendale Dam and Lymansville Dam as a part of the river study in 1998. Samples were analyzed for a full suite of analytes in support of the possible future risk evaluations.

Summary of Surface Water Data

Contaminants detected in the surface water samples collected included dioxins, metals, PCBs and pesticides. Only two semivolatile compounds were detected in the surface water samples. Bis(2-ethylhexyl)phthalate and phenol were both detected at trace concentrations.

Dioxin and furan compounds were detected in approximately half the samples collected. The 2,3,7,8-TCDD compound was detected in 15 samples reported. The maximum detected was found at station CMW-SW/SD-2019, at 0.0127 µg/l located in the wetland and former raceway

on the east side of the Centredale Manor portion of the Site. Other detections were found in both the Allendale Pond and Lymansville Pond areas, although the higher concentrations were found to be associated with the shallower water and wetland areas (maximum detected in Lymansville Pond was found in the wetland behind the Boys and Girls club at 0.0008 µg/l). Since dioxins are hydrophobic and tend to adhere to sediment particles, the higher concentrations are likely to be associated with the samples containing higher suspended solids, which were visibly present in these wetland areas.

One PCB compound, Aroclor 1254, was detected in one of the water samples collected at the 2019 station, at 4.6 µg/l. Pesticides, including DDT, DDE chlordane and endrin compounds were detected at various locations throughout the Site, and not limited to depositional areas, indicating that these may be present as a result of lawn treatments nearby.

Metals were detected as is expected in surface water samples, with concentrations dominated by natural minerals present, including calcium, magnesium, sodium, iron and other metals. Most of these metals were found in both filtered and unfiltered samples, indicating natural source. Heavy metals detected that could be associated with sediment contamination included chromium and lead. Mercury was not detected in surface water.

Evaluation of Surface Water Data

To evaluate the surface water samples, the summary statistics were generated in two groups: data from filtered and unfiltered water samples taken between the suspected source area and Allendale Dam, and data from filtered and unfiltered water samples taken between Allendale Dam and Lymansville Dam. Summary statistics for these groups are provided in Appendix A.

Differences between the groups show the obvious higher average detected concentrations of dioxins in the Allendale reach, dominated by the concentrations detected at station 2019 discussed above. In addition, lead, which was found on the Centredale Manor portion of the Site at high concentrations was found to have higher detected average concentrations in water in the Allendale area compared to the Lymansville area.

1.4.6 Summary

Results of analyses from the investigations indicate high concentrations of contaminants, including dioxin, HCX, and PCBs in the areas adjacent to the Centredale Manor portion of the Site, and in Allendale Pond and Lymansville Pond. The concentrations of these contaminants tend to be highest in sediment collected from depths less than two feet below the ground surface or sediment surface. Concentrations of dioxins and PCBs appear to decrease with upland distance from the existing shoreline of Lymansville Pond, such that lowest concentrations were found in the samples collected from the highest elevations. This trend appears to also be present for the former shoreline of Allendale Pond, although it is less demonstrable due to the data set available.

Concentrations of PCBs and 2,3,7,8-TCDD appear to be somewhat less in Lymansville Pond than those in Allendale Pond. Maximum concentrations of dioxins and PCBs were generally found in the wetland area between the Centredale Manor portion of the Site and Allendale Pond. These trends are particularly notable in the aquatic sediment.

Other contaminants including PAHs and metals appear to be present in variable concentrations and do not follow a specific pattern that could be identified in this limited evaluation.

1.5 Demographics

North Providence is a suburb of Providence, Rhode Island with a population of approximately 32,000 residents. Numerous residences are in close proximity to the Site and Site boundaries may extend into residential parcels in some cases. Residents of North Providence obtain drinking water from the Providence Water Supply Board (PWSB), which services the City of Providence and surrounding communities. The primary source of PWSB water is the Scituate Reservoir, located approximately 9 miles southwest of the Site.

1.6 Streamlined Human Health Risk Evaluation

A streamlined human health risk evaluation was performed to identify the risk to humans from soil and sediment at the Site. This is an assessment that is focused on the soil and sediment to support selection of removal actions under the NTCRA. Other media (surface water,

groundwater, air etc.), were not evaluated for this EE/CA. A full Human Health Risk Assessment, which is typically performed as a part of a remedial investigation, would evaluate risk to all receptors interacting with all these media. The streamlined human health risk evaluation is presented in Appendix B of this report. This section summarizes the findings of that streamlined evaluation as well as the process for estimation of risk to humans.

Residential receptors and recreational receptors were evaluated for exposure to sediment and soil in the river, ponds, banks, and flood plain areas. Recreational receptors were presumed to interact with bank and floodplain sediment, (the shoreline sediment which was predicted by field investigators to be present under less than one foot of water less than one month out of the year). Residential receptors were presumed to interact with the soil and sediment adjacent to the residential properties that abut the river and ponds. It was presumed that aquatic sediments (sediment under more than one foot of water more than one month out of the year) would not be regularly contacted by persons under either a residential use or recreational use of the area.

Contaminants described in Section 1.4 of this report were compared to the EPA Region IX Preliminary Removal Goals (PRGs) to identify contaminants of potential concern (COPCs). Those that were detected more than once at concentrations above the PRGs were identified as COPCs.

Thirty-six different exposure areas were defined based on physical features of the Site, the data available from sampling points, and the persons expected to access them. These included thirty-two residential exposure areas, and four recreational exposure areas. Dermal and ingestion exposures were considered for both child and adult, summarily. Exposure point concentrations were estimated for each exposure area using either a maximum concentration detected, or a 95 percent upper concentration limit (UCL) (if more than 20 samples were available within the exposure area). Carcinogenic and noncarcinogenic risk was calculated for each COC within each exposure area.

For the purposes of this EE/CA, a target cancer risk equal to or greater than one in ten thousand, or $1x10^{-4}$ was used as an indicator of unacceptable risk, and a target noncancer risk hazard index (HI) equal or greater than 1 was used as an indicator of unacceptable risk. It was found that a PCB compound, Aroclor 1254, posed noncancer risk of greater than one at eight

exposure areas, and arsenic posed a noncancer HI greater than one at one exposure area. It was also found that the target cancer risks were exceeded at 20 of the exposure areas. The contributors to the increased cancer risks were dominated by the presence of dioxin at all but three exposure areas, which were supported by arsenic and PAHs.

While evaluating these findings, the areas and exceedances were compared. The exposure areas where PCB concentrations caused an exceedance of the target noncancer risk were found to be co-located with the exposure areas where dioxin caused an exceedance of the cancer risk. In addition, the samples where the maximum Aroclor concentrations were detected were either the same sample or co-located with the samples that found dioxin in excess of 1 μg/kg (1 ppb). Dioxin concentrations of 1 ug/kg correspond to a cancer risk of $9x10^{-5}$ under the residential exposure conditions evaluated in this report. This cancer risk falls within the acceptable risk range under EPA guidelines for protection of human health.

PAHs were noted in the risk evaluation to contribute to risk at most areas due to use of a calculated benzo(a)pyrene equivalent. At two of these areas, this calculated value was the primary contributor to cancer risk. At one residential exposure area at the north end of Lymansville Pond (Appendix B, Table B-3.19), benzo(a)pyrene was found at 170 mg/kg, exceeding the risk calculated for dioxin at a concentration of 1.5 μg/kg. Such a concentration may be found from recent use of two-cycle motors or other fuel combustion. This location will be a part of the NTCRA because dioxin above 1 ppb is colocated with the PAHs found here. At another residential exposure area at the southern end of Lymansville Pond (Appendix B, Table B-3.26), PAHs exceeded the target risk, although dioxins at this location did not exceed 1 μg/kg. Therefore, this area will be further evaluated as a part of the on-going Remedial Investigation.

One area exceeded both cancer and non cancer risk targets due to a very high concentration of arsenic. This was found well downstream of the Centredale Manor site, at one station only. Arsenic is commonly identified as a COPC because although it is a natural component of bedrock in the Rhode Island formations, the risk benchmarks are low. Concentrations of arsenic in soils in Rhode Island have been found in excess of 30 ppm, although it has not been proven that these concentrations are truly a background condition. However, since dioxins and PCBs were not particularly elevated in the samples taken from this area, and since the area is not a particularly depositional area, it is believed that the concentration of arsenic at this location may not be a site-related condition, and it should not be a focus of the EE/CA.

The findings of the streamlined human health risk evaluation strongly indicate that the unacceptable risks are present due primarily to the presence of dioxin, and also due to the presence of PCBs represented by Aroclor 1254. Other contaminants supporting risk include arsenic and PAHs. However, due to the co-location of contaminants, a NTCRA focused on dioxin will result in a large risk reduction at the Site.

1.7 Streamlined Ecological Risk Evaluation

A streamlined ecological risk evaluation was performed to make a preliminary assessment of the contaminants present at the Site, and identify if any may merit removal under the NTCRA due to the potential contribution of risk to environmental receptors or the ecology of the Site itself. The streamlined ecological risk evaluation is presented in Appendix C of this report.

The streamlined ecological risk evaluation consists of problem formulation, exposure assessment, ecological effects assessment, and risk characterization. These elements make up the first two steps identified by EPA guidance for ecological risk assessment. The remaining steps are performed if the first two identify a need to continue assessment of risk.

The problem formulation consists of an evaluation of the physical site characteristics and chemical contaminants found. The problem formulation was performed using information gathered on the physical features of the Site, the vegetation types that are present, the chemical data gathered as described in Section 1.4 of this report, and other information available on the behavior of contaminants after they are released into the environment. Lists of species found on-site as well as those that are likely to be present were developed, and exposure pathways were identified. Assessment endpoints were defined which included:

1 invertebrate communities exposed to contaminants from surface soil and sediment
2 piscivorous mammal and bird populations exposed to contaminants in sediment and soil
3 insectiverous mammal and bird populations exposed to contaminants in sediment and soil
4 herbiverous mammal and bird populations exposed to contaminants in sediment and soil

The exposure assessment and ecological effects assessment were performed together. These portions include identification of contaminant concentration data used to represent ecological exposure from sediment, soil or water, and comparison of that data to toxicity screening values.

The contaminant concentration data used were derived from the existing database of chemical data collected from the Site as described in Section 1.4 of this report. Ecological COPCs were selected based on the results of the screening.

As previously described, the data were separated into surface water, residential use soils, flood plain sediment, aquatic sediment, and bank soils. Bank soil and residential soil samples were compared with the lower of the toxicity values identified for terrestrial plant, invertebrate, or wildlife screening value. Flood plain samples were considered sediment samples, and these as well as the aquatic sediment were compared with the lower of the toxicity values identified for the aquatic and semiaquatic receptors. Surface water samples were compared with ambient water quality criteria and other published values.

Risk characterization for this risk evaluation consisted of developing hazard quotients for each contaminant against the screening value. Typically, the maximum concentration is compared to the criteria, however, for this evaluation, all sample results were compared to the selected screening benchmarks. Exceedances, or quotients were tabulated (Table 1-G of Appendix C). Typically, contaminants that exhibit Hazard Quotients (HQs) greater than 1 are retained for additional assessment. However, at this site quotients ranged from below 1 to more than 100,000, partially due to the conservative benchmarks employed. As a result, contaminants and groups of contaminants were selected as primary contaminants and the HQs for these contaminants were plotted on bar graphs with samples arranged upstream to downstream on a logarithmic scale. These included the following:

- Chromium
- Copper
- Lead
- Mercury
- Zinc
- 4,4'-DDT
- 4,4'-DDE
- Endosulfan II
- Total PAHs
- Low Molecular Weight PAHs
- High Molecular Weight PAHs

- Hexachloroxanthene
- Total PCDD/Fs
- Total TCDD
- Total PCBs

The findings of this evaluation indicate that the concentrations of many of the contaminants detected at the site are far in excess of the ecotoxicity benchmarks. However, based on the plots made for each contaminant, it is evident that there are not constrained hot spots of exceedances of benchmarks that can be addressed with a NTCRA. Widespread removal actions, if undertaken, may have more of a detrimental effect on the ecology of the Site than the hazards that the contaminants pose themselves. Therefore, the remaining steps of the ecological risk assessment need to be performed to fully characterize the nature of the contaminants impact to the environment and the individual receptor groups prior to selection of a response action based on ecological risk.

EPA initiated a baseline ecological risk assessment (BERA) in the spring of 2000. The BERA includes collection and analysis of biota samples, including bird and fish tissue. Completion of the BERA is anticipated concurrent with the other remedial investigation tasks.

1.8 Selection of Contaminants of Concern

Using information developed in the streamlined risk evaluations described in Sections 1.6 and 1.7, contaminants of concern (COCs) that were identified as posing threats to human health and ecological receptors were identified and selected.

The streamlined human health risk assessment identified nine COCs, including dioxin, chromium, arsenic, copper, PAHs (evaluated as benzo(a)pyrene equivalents), and PCBs (particularly Aroclor 1254). These COCs have been identified as contributing to increased risk to humans under recreational and residential scenarios above $1x10^{-4}$. However, the primary COC that contributes the majority of that incremental increase is dioxin, measured as a toxicity equivalency quotient (TEQ).

The TEQ is a calculated value that compiles the relative toxicity of all the dioxin-like compounds detected. The dioxin compound 2,3,7,8-TCDD is generally believed to be the most toxic of all

the dioxin congeners, and has been defined to make up 98 percent of the TEQ (IT, 2000). Therefore, the majority of the risk measured for the recreational and residential exposures can be attributed to 2,3,7,8-TCDD.

Regarding ecological risk, numerous contaminants of potential concern (COPCs) were identified at concentrations in excess of the benchmark concentrations identified in the scientific literature although these chemicals were not limited to a specific area or location. Instead, they were found ubiquitously throughout the study area, in the soils as well as the sediment. The largest exceedances in the sediment were the dioxins which are dominated by the congener 2,3,7,8-TCDD. Although these compounds may reduce the overall health of the ecological system, the risk indicated by the benchmark exceedances do not justify a removal action at this time. Instead, a full risk assessment should be performed to identify specific compounds that contribute to actual risk to specific receptors as part of a Remedial Investigation (RI).

Based on the evaluation of the data collected and the risk screening evaluations performed, 2,3,7,8-TCDD is selected as the single COC for the NTCRA at the Centredale Manor Restoration Project Site. Other contaminants described in Appendices B and C will be further evaluated through the on going Remedial Investigation.

1.9 Selection of Preliminary Removal Goals

PRGs are the numerical chemical concentrations for environmental media that would not cause excess health risks to receptors. Protection of human health and the environment can be achieved once a response action has addressed environmental media that contain contaminants in excess of these PRGs. PRGs may be developed on a site-specific basis, if there are sufficient analytical data available. Otherwise, using available default screening criteria, regulatory standards, or guidances are acceptable ways for establishing PRGs that are consistent with the purpose of a NTCRA.

As discussed in Section 1.6, Streamlined Human Health Risk Evaluation, a target cancer risk of 1×10^{-4} was used as an indicator of unacceptable risk. This target risk will be used to determine what locations as outlined in Section 1.4 will require cleanup. Any location that has a target risk equal to or greater than 1×10^{-4} will be evaluated for potential removal actions. Appendix B shows the calculated risk and the contaminants that drive that risk. As shown in Appendix B,

dioxin which is a source related compound, is present at each of the locations that have a risk greater than 1×10^{-4}.

OSWER Directive 9200.4-26, Approaches for Addressing Dioxins in Soil at CERCLA and RCRA Sites (April 13, 1998), provides guidance in establishing cleanup levels for dioxins. Based on this document, 1 ug/kg (ppb) of dioxins (as 2,3,7,8-TCDD) has been established as the PRG for the Site for situations involving residential exposure scenarios. For the areas evaluated under this EE/CA, the criteria of 1 μg/kg shall be used for residential and recreational areas where cancer risk was estimated to exceed 1×10^{-4} and non-cancer risk was estimated to exceed 1.0.

2.0 NON-TIME-CRITICAL REMOVAL OBJECTIVES

This section presents the statutory limitations on removal actions, identifies the conditions that justify the performance of a NTCRA, presents the overall goals and objectives of the proposed NTCRA, and identifies potential Federal and State regulations with which the selected removal action must comply. The NTCRA implementation schedule is also discussed in this section.

2.1 Statutory Limits on Removal Actions

40 CFR Part 300.415(b)(5) and Section 104(c)(1) of CERCLA set limits of 12 months and $2 million for CERCLA fund-financed removal actions. An exemption from the time and dollar limitations in the statute can be granted in situations where EPA determines that the proposed removal action is appropriate and consistent with the anticipated long-term remedial action.

Costs for the NTCRA recommended in this Report exceeds the $2 million limit. If the recommended NTCRA (or another NTCRA exceeding $2 million) is selected, the Action Memorandum will provide the approval mechanism.

2.2 Conditions that Justify a Removal Action

This section presents Site conditions that provide the regulatory basis for conducting a NTCRA, the overall goals of the NTCRA, and EPA's specific objectives for achieving the overall goals. The NTCRA objectives were used to identify and develop an initial list of appropriate removal alternatives, as described in Section 3.0.

The February 2000 Approval Memorandum documents that Site conditions meet the NCP criteria for a removal action and that the required action is non time critical. Site conditions were identified that correspond to factors providing a basis for a removal action under Section 300.415(b)(2) of the NCP and include:

- 40 CFR 300.415(b)(2)(i): Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants

Threats to human health exist through potential current and future direct exposure to contaminants present in Woonasquatucket River flood plain sediments, including those in Allendale and Lymansville Ponds, and in residential-use soils adjacent to the River. While measures have been taken to limit access to contaminated sediments and soil, these measures have had limited long-term effectiveness. In some areas, such as residential properties, such measures are not practical.

- 40 CFR 300.415(b)(2)(iv): <u>High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate</u>

Sediments in Allendale Pond are highly contaminated with dioxin and PCBs. Recent sampling and analysis shows that high concentrations of these contaminants are present within the top two feet of the sediments. Due to the current condition of Allendale Dam, storm or flood conditions could result in a large transfer of contaminated sediments across the breached dam and downstream. This would significantly increase the contaminated areas and place additional populations at risk.

- 40 CFR 300.415(b)(2)(v): <u>Weather conditions that may cause hazardous substances or pollutants to migrate or to be released</u>

In its current state, Allendale Dam has the potential to fail completely. Complete failure of the dam would result in a one-time catastrophic release of contaminated sediment from Allendale Pond to downstream reaches of the Woonasquatucket River, including Lymansville Pond. Restoring the dam prior to such an event is crucial to prevent a large scale release of contaminants from Allendale Pond to downstream areas.

- 40 CFR 300.415(b)(2)(vii): <u>The availability of other appropriate Federal or State response mechanisms to respond to the release</u>

There are no other known Federal or State funds or response mechanisms available to fully finance this action.

2.3 Removal Action Scope and Objectives

Based on the conditions described in Section 1.4, a NTCRA is necessary to mitigate risks posed by the hazardous substances that were released and have migrated to residential use soils and flood plain sediments in areas along the eastern shoreline of the Woonasquatucket River and associated ponds (Figures 1-2a, 1-2b, and 1-2c). Residential use areas are defined as properties inhabited by private individuals or areas which have the potential to be used for recreational purposes.

Removal measures proposed in this EE/CA are not intended to be a final solution to all environmental contamination at the Site. The on-going remedial investigation followed by a feasibility study will address contaminants remaining in other areas of the Site following the NTCRA.

The objectives of the NTCRA are to:

- Reduce or eliminate contaminants that may cause elevated human health risks from exposure to contaminated soils or sediments within the Site,
- Reduce or eliminate future migration of Site contaminants downstream of Allendale Dam, and;
- Properly treat or dispose of waste materials generated during the removal action.

Contamination in Lymansville Pond appears to be somewhat less severe than contamination in Allendale Pond. Under current conditions, however, the potential exists for Lymansville Pond to become severely impacted due to a continued influx of contaminated sediments from Allendale Pond and the source area. A major component of the second objective mentioned above will be eliminating this threat.

The scope of this removal action shall include the final treatment and/or disposal of any sediments or soils excavated from the Site as part of this removal action. The scope also includes any decontamination and restoration activities that are required as a result of this removal action.

2.4 Removal Action Schedule

The EE/CA will be submitted to the EPA and the State of Rhode Island for review and comment. Following this review, the EE/CA will be made available for public comment prior to a final removal action selection decision by EPA. The removal action selection by EPA will be documented in an Action Memorandum to be issued by EPA which authorizes the implementation of the measures selected. Implementation of the selected removal action can begin upon issuance of the Action Memorandum presuming there are no delays due to access issues, funding, or other factors.

The time required to implement the removal action will vary depending on the alternative selected. Until final selection of a specific response alternative is made, any projected implementation schedules discussed in this document should be considered conceptual in nature and subject to adjustment. Under each of the alternatives discussed in this report, the NTCRA is anticipated to be completed within 18 months following the issuance of the action memorandum.

2.5 Applicable or Relevant and Appropriate Requirements (ARARs)

Section 300.415 (l) of the NCP requires that "Fund-financed removal actions under CERCLA Section 104 and removal actions pursuant to CERCLA Section 106, shall to the extent practicable considering the exigencies of the situation, attain Applicable or Relevant and Appropriate Requirements (ARARs) under Federal or State environmental or facility siting laws. Other Federal and State advisories, criteria, or guidance, as appropriate [to be considered - TBC], should be considered in formulating the removal action." The NTCRA guidance states: "chemical-specific and location-specific ARARs should be identified as promptly as possible..." and "...only State standards that are promulgated, identified by the State in a timely manner, and more stringent than Federal requirements may be applicable or relevant and appropriate."

ARARs, standards, and guidance to be considered are divided into three categories: chemical-specific, location-specific, and action-specific. In Sections 2.5.1 through 2.5.3, these

categories are briefly described and potential ARARs and "to be considered" guidelines for the Site are discussed.

ARARs are promulgated, enforceable Federal environmental and State environmental or facility siting requirements. There are two categories of requirements: "applicable" and "relevant and appropriate". CERCLA does not allow a regulation to be considered as both "applicable" and "relevant and appropriate". These categories are defined below:

Applicable Requirements - Section 300.5 of the NCP defines applicable requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site".

Relevant and Appropriate Requirements - Section 300.5 of the NCP defines relevant and appropriate requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site."

To be considered guidelines (TBCs) are non-promulgated criteria, advisories, and guidances issued by the Federal or State governments. Along with ARARs, TBCs may be used to develop the interim action limits necessary to protect human health and the environment or to guide development of the removal action source control measures, i.e., cap system conceptual design.

While ARAR requirements under CERCLA pertain only to on-site activities, off-site activities relating to hazardous waste disposal are required to meet all applicable laws including, but not limited to: Department of Transportation regulations governing the marking and labeling of hazardous materials shipments (49 CFR 192), shipping requirements (49 CFR 173), and transport of hazardous materials by motor vehicles (49 CFR 173 and 49 CFR 177); the

Resource Conservation and Recovery Act (RCRA) regulations governing transporter activities and treatment, storage, and disposal facilities (40 CFR 261-264), land disposal restrictions (40 CFR 268), and off-site response actions (40 CFR 300.440); and CERCLA 121(d)(3). Other non-ARAR off-site requirements include State labeling, shipping, and transport requirements for State-designated hazardous wastes (CAR 12-032-001 and CERCLA Section 121 (d)(3)) requirements for the off-site transfer of CERCLA wastes.

The Occupational Safety and Health Administration (OSHA) regulations are not ARARs, but apply to both on- and off-site activities. These include regulations governing performance of activities at hazardous waste sites (29 CFR 1910.120), general construction guidelines (29 CFR 1926), and occupational exposure to asbestos (29 CFR 1910.1001).

2.5.1 Chemical-Specific ARARs

Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the determination of numerical values that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. In general, chemical-specific requirements are set for a single chemical or a closely-related group of chemicals. These requirements do not consider the mixture of chemicals. Potential chemical-specific ARARs include EPA Region IX RBCs and OSWER Directive 9200.4-26.

The EPA Region IX Risk-Based Concentrations (RBCs) are TBCs that may be used to identify potential contaminants of concern and to develop PRGs for the Site soils and sediments. The OSWER directive 9200.4-26 provides guidance for establishing dioxin cleanup levels for residential and commercial/industrial-use property.

A summary of identified chemical-specific ARARs is presented in Table D-1 of Appendix D.

2.5.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances, or the conduct of activities solely because they are in specific areas. The general types of location-specific ARARs that may be applied to the Site are briefly described below.

Several Federal and State ARARs regulate activities that may be conducted in wetlands and flood plains. These regulations and requirements may apply because portions of the Site are either occupied by wetlands or are situated in the 100-year flood plain. The Wetlands Executive Order (E.O. 11990) and the Flood Plains Executive Order (E.O. 11988), incorporated into 40 CFR Part 6, Appendix A, require that wetlands and flood plains be protected and preserved, and that adverse impacts be minimized. Section 404 of the Clean Water Act and State wetland protection regulations restrict activities that adversely affect wetlands and waterways.

Because some of the alternatives evaluated involve containment of hazardous materials under a cap on site, Federal hazardous waste regulations (RCRA) and The State Hazardous Waste Management Act are applicable. If one of the alternatives that includes containment on site is selected, the intent of these laws will be met through the design of the containment structures.

Additional location-specific ARARs include the Fish and Wildlife Coordination Act, which requires that any Federal agency proposing to modify a wetland or body of water must consult with the U.S. Fish and Wildlife Service.

Regulations governing endangered species at the Federal and State levels would need to be considered for any proposed on-site actions, if such species are encountered. In addition, construction of dams and other structures would need to be conducted in accordance with substantive requirements set forth under 33 USC Section 400.

A summary of identified location-specific ARARs is presented in Table D-2 of Appendix D.

2.5.3 Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous wastes. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be implemented. The general types of action-specific ARARs that may be applied to the Site are briefly described below.

A number of State hazardous waste regulations govern handling, treatment, storage, and disposal of hazardous wastes including: general facility standards, groundwater monitoring, closure and post-closure activities, hazardous waste piles, land treatment, and landfills. These requirements may need to be considered depending on the response actions selected.

RIDEM regulations require that a facility selected for treating, storing, or disposing of wastes generated as the result of a CERCLA response action is acceptable, i.e. the receiving facility has no relevant releases or violations. All alternatives would be implemented to comply with this requirement. Federal action-specific ARARs include NPDES discharge requirements and water quality standards which govern the discharges of water to water bodies. Due to the nature of the work anticipated under all alternatives, NPDES requirements are applicable.

A summary of identified action-specific ARARs is presented in Table D-3 of Appendix D.

3.0 DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

This section presents the rationale for developing removal action alternatives to address areas at the Site where concentration of dioxin exceeds 1 μg/kg based on the findings of the streamlined risk evaluation described in Section 1.0. A potential elevated risk was determined to be present from human exposure to residential use soils and flood plain sediments. The process of developing removal action alternatives consists of identifying statutory and policy considerations, identifying appropriate response actions and remedial technologies, and assembling selected response actions and technologies into removal action alternatives. The detailed evaluations and alternative cost estimates are presented in Section 4.0.

Screening of the assembled alternatives is performed as part of the alternatives development process to help eliminate removal actions that may not be viable based on site-specific conditions or removal action objectives. In this way, the detailed analysis would only focus on the set of removal options that would best address site contamination and risks.

The alternatives presented in this section have all been retained for further analysis since they provide removal actions that meet the Removal Action Objectives (RAOs) discussed in Section 3.4. The following subsections detail the key factors or considerations used in formulating the removal action alternatives.

3.1 Statutory, Policy, and Other Considerations

Statutes and policies were identified and reviewed to help formulate the range of removal action alternatives. A discussion of TtNUS' findings are presented in the following narrative.

3.1.1 Statutory Considerations

The alternatives were developed in accordance with the NCP (40 CFR 300.415) requirements for assessing and selecting response actions. The NCP (40 CFR 300.415 (c)) encourages developing alternatives that, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action with respect to the release concerned. The NCP (40

CFR 300.415 (d)) also identifies appropriate removal actions that address risks to the public health or welfare, or the environment including:

- Establishing site control and security measures
- Installing controls to reduce or prevent contaminant migration
- Capping to prevent contact and reduce contaminant migration
- Using chemicals or materials to prevent or mitigate contaminant releases
- Excavating, consolidating, or removing highly contaminated soils to reduce direct contact with or spread of contamination
- Containing, treating, disposing, or incinerating hazardous materials.

CERCLA Section 121 (b) states that treatment methods should be preferred over conventional containment or land disposal methods to address the principal threat at a site. This preference for treatment appears to apply to remedial actions, but the overall strategy is also appropriate for removal actions. Where viable, the preference for treatment under this EE/CA was considered.

3.1.2 Wetlands Considerations

Under 40 CFR Part 6, Appendix A, "Statement of Procedures on Floodplain Management and Wetlands Protection", before undertaking an Agency action, EPA must determine whether or not the action will be located in or affect a wetlands. When it is apparent that a proposed or potential agency action is likely to impact a floodplain or wetland, the public must be informed through appropriate public notice procedures. An assessment must be prepared which describes the proposed action, discusses the effect on the wetlands/floodplain, and describes the alternatives considered.

Once an alternative is selected (in this instance, at the Action Memorandum stage, after public comment on the EE/CA), the Agency must make public a Statement of Findings which includes (1) why the action must be located in or affect the floodplain or wetlands; (2) a description of significant facts considered in making the decision to locate in or affect the floodplain or wetlands including alternative sites and actions; (3) a statement indicating whether the proposed action conforms to applicable State or local floodplain protection

standards; (4) a description of the steps taken to design or modify the proposed action to minimize potential harm to or within the floodplain or wetlands; (5) a statement indicating how the proposed action affects the natural or beneficial values of the floodplain or wetlands.

The portion of the Site being addressed by this EE/CA consists primarily of a river environment and associated wetlands and floodplains. Each of the alternatives described in this section is expected to impact wetlands and floodplains. Section 3.6 describes each alternative in detail, including which activities will occur in wetlands and floodplain areas such as excavation, capping, and dam restoration activities.

Although excavation will temporarily disturb certain wetland areas at the Site, once excavation is completed the affected area can be regraded and replanted to the extent practicable. If the Allendale Dam is restored, it would be relatively simple to adjust the water level in Allendale Pond in order to help minimize potential harm to or within the floodplain or wetlands during flood events. Additionally, EPA expects that when compiling more specific design documents for the remedy, all practicable steps will be taken to minimize potential harm to or within the floodplain or wetlands, including wetland restoration activities and flood planning activities.

3.1.3 Dredging Considerations

The FY 2000 VA HUD Appropriation Conference Report, which accompanied EPA's FY2000 appropriations, includes the following language regarding EPA's use of dredging:

> For Fiscal year 2000 and consistent with fiscal year 1999, the conferees direct the agency not to initiate or order dredging, except as noted in the conference report and statement of managers accompanying the 1999 Appropriations Act, until the National Academy of Sciences has completed its dredging study and that study has been properly considered by EPA. Further, the Agency should only initiate or order dredging in cases where a full analysis of long and short-term health and environmental impacts has been conducted. [emphasis added]

Similarly, the FY 1999 VA HUD Appropriations Conference Report, which accompanied EPA's FY 1999 appropriations includes the following language regarding EPA's use of dredging:

> The conferees urge EPA to await the completion of the [National Academy of Sciences] study before spending any Superfund money on dredging, initiating any new dredging action, or issuing any more dredging orders. Exceptions to this should be considered where EPA has found on the record that the contaminated sediment poses a significant threat to the public health to which an urgent or time critical response is necessary, remedial and/or removal alternatives have been fully evaluated, an appropriate site for disposal of contaminated material has been selected, and the potential impacts of dredging, associated disposal, and alternatives have been explained to the affected community. [emphasis added] (It should be noted that a colloquy between Senators Lautenberg and Bond clarified this language somewhat. EPA interprets the colloquy to mean that any response action that involved dredging of contaminated sediments that "pose a substantial threat to public health or the environment" should proceed, with the appropriate analysis performed and documented in the administrative record file. See "Implementing FY2000 Appropriations Report Language on Sediment Dredging" (January 29, 2000)).

Although conference report language is not legally binding, EPA has indicated in two memoranda that it intends to generally act in accordance with the views expressed in conference language to the extent possible within the confines of its statutory language. See "Implementing FY '99 Appropriations Conference Report Language on Sediment Dredging" (May 17, 1999) and "Implementing FY2000 Appropriations Report Language on Sediment Dredging" (January 19, 2000) in the Administrative Record for this Action. In addition, EPA is considering the FY 1999 and 2000 Conference Report language even though the recommended alternative involves mostly dry excavation and not dredging.

The National Academy of Sciences dredging study is not yet completed. Therefore, when considering dredging issues at a Superfund Site, EPA looks to the criteria mentioned in the FY 1999 and FY 2000 VA HUD Appropriations Conference Report. As applied to this Site, EPA analyzes dredging issues as follows:

First, the contaminated sediment and soils in the Woonasquatucket River and its floodplain pose a substantial threat to the public health that requires a response in the areas identified in the EE/CA. The long and short-term threat to public health is explained in detail in

Appendix B, Human Health Risk Evaluation of this EE/CA Report and in the EE/CA Approval Memorandum. Second, removal alternatives to mitigate direct exposure to contaminated floodplain soil and sediment have been fully evaluated for the Allendale and Lymansville reaches of the Woonasquatucket River in the EE/CA. Third, options for disposal of contaminated material and an appropriate site for disposal has been identified as described in this Section 3.7 of the EE/CA. Fourth, the potential impacts of this response, associated disposal, and alternatives have been discussed with the Management Action Committee and will be explained to the affected community in the EE/CA Fact Sheet and at the public meeting scheduled during the formal public comment period to be held following issuance of this EE/CA report. Public comments and EPA's responses will be documented in Responsiveness Summary at the time the Action Memorandum with the selected removal action is issued by EPA.

3.2 Description of Removal Action Areas

Contaminants have been detected in sediment and soil at the Site. Specifically, contaminants have been detected in sediments of the Woonasquatucket River, Allendale Pond, and Lymansville Pond. This section describes the areas that have been impacted and considerations given to the development of removal alternatives.

3.2.1 Source Area - Centredale Manor and Brook Village Properties

The Source area of the site is currently occupied by Centredale Manor and Brook Village apartment complexes. As described in Section 1 of this report, two protective caps have been installed to prevent contaminated sediment and soil erosion and to reduce possible human exposure to these sediments.

3.2.2 Woonasquatucket River

The Woonasquatucket River flows past the west boundary of the source area, and south to form Allendale Pond, then south again to form Lymansville Pond. Where the river is not impounded, exposed soil and sediment have been found that contain dioxin in excess of the removal action level described in Section 1 at two locations. Bank sediments on the west bank of the river

between Allendale Pond and Lymansville Pond have been noted to contain dioxin at concentrations above 1 ppb. However, since this area is not residential nor recreational property, and is owned with the asphalt plant (industrial property) to the north, this area was not included in the removal action described in this EE/CA.

3.2.3 Allendale Pond

Allendale pond is an impoundment formed by the Woonasquatucket River and a mill dam known as Allendale Dam. Allendale dam was designed to power the mill immediately downstream, currently occupied by residential condominiums. The dam breached in 1991, lowering the standing level of the pond substantially. Prior to the breach, the Allendale Pond is presumed to have had an average elevation of approximately 93.5 feet (USACOE 1996). After the dam breached, water levels lowered in the pond to approximately 91 feet, which exposed previously submerged sediments. These sediments that are below the 93.5 foot elevation, along with sediments generally covered by less than one foot of water, are referred to in this EE/CA as "flood plain sediments". Because dioxin has been detected in this area at concentrations above 1 ug/kg, and because these areas are adjacent to residential property, these sediments are included in the action areas under this EE/CA.

The USACOE has determined the 10 year flood elevation of Allendale Pond was approximately 96 feet when Allendale Dam was fully functional (USACOE, 1996). Concentrations of dioxin greater than 1 ppb have not been detected above the 10 year flood elevation, but have been detected at some locations between the 93.5 foot elevation and the 96 foot elevation. Because dioxin has been detected in this area at concentrations above 1 ug/kg, and because these areas are on or adjacent to residential property, these sediments and soils are included in the action areas under this EE/CA.

3.2.4 Lymansville Pond

Lymansville pond is a large impoundment also formed by a mill dam. However, this dam is currently operable, and the water levels in the pond are fairly stable. Although a flood study has not been conducted for this pond, sample data described in Section 1 of this report indicates that at specific locations dioxin has been found at concentrations slightly above 1 ug/kg. However, these

data points are surrounded by other samples with analytical results below this criteria, so the available data has been used to define several small action areas under this EE/CA.

3.2.5 Allendale Dam

In its current state, Allendale Dam is breached and has the potential to fail completely. Complete failure of the dam during a high water period would result in a one-time catastrophic release of contaminated sediment from Allendale Pond to downstream reaches of the Woonasquatucket River, including Lymansville Pond. Additionally, the existing breached condition of the dam has allowed erosion of some sediments near the dam and transport of Allendale Pond sediments past the dam.

3.3 Risk Evaluation Summary

Results of the streamlined risk evaluation discussed in Section 1.0 indicate an elevated level of risk (1×10^{-4}) to humans is currently present in portions of the following areas:

- flood plain sediments in Allendale Pond between elevations of 90 and 93.5 feet.
- flood plain sediments in Lymansville Pond between the existing shoreline and into the pond to a depth of one foot of water.
- residential use soils between elevation 93.5 feet and the 10 year flood elevation along the eastern shoreline of the Allendale Reach of the Woonasquatucket River.
- limited residential use soils along the eastern shoreline of the Lymansville Reach of the Woonasquatucket River.

If Allendale Dam is restored, water levels in Allendale Pond will rise to an elevation of approximately 93.5 feet. This would greatly reduce the area of flood plain sediments in the vicinity of Allendale Pond as these areas would be covered by water. With the dam restored, results of the streamlined risk evaluation indicate areas with an elevated level of risk to humans would be reduced to portions of the following areas:

- flood plain sediments in Allendale Pond between elevations of 92.5 and 93.5 feet.

- flood plain sediments in Lymansville Pond from the existing shoreline into the pond to a depth of one foot of water.

- residential use soils between elevation 93.5 feet and the 10 year flood elevation (96 feet along Allendale Pond, elevation unknown along Lymansville Pond).

The results of the streamlined risk evaluation indicate that aquatic sediments at the Site do not present an elevated level of risk to humans. The sediments may pose a risk to ecological receptors, and a full Environmental Risk Assessment has been initiated to provide a basis for response action for the aquatic sediments.

3.4 Removal Action Objectives

The removal action objectives at the Site include the following:

- Prevent migration of contaminated sediments to downstream areas
- Eliminate or reduce the risk of human exposure to flood plain sediments containing concentrations of dioxin in excess of removal action goals (1 μg/kg)
- Eliminate or reduce the risk of human exposure to residential use soils containing concentrations of dioxin in excess of removal action goals (1 μg/kg)

An overview of areas containing dioxin at a concentration greater than 1 μg/kg is presented in Figures 1-2A, B, and C. Dioxin has generally been found at elevated concentrations at the surface sediment intervals (0-2 foot).

3.5 General Response Actions and Response Technologies

A series of general response actions were evaluated in terms of the expected effectiveness of each at achieving the removal action objectives described in Section 3.4 and the general applicability of each to the Site. These actions and a summary of the evaluation process are presented in Table 3-1. Considering the removal action objectives, the selected site contaminants of concern, and the available referenced guidance and presumptive remedy guidance, two general response actions were found to be potentially applicable to impacted flood plain sediments and residential use soils: containment and removal. Containment would

TABLE 3-1
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Limited Action	Access Restrictions	Fencing/Signs	Install fencing and post signs to inform public of use restrictions and to deter access.	Eliminated: Not effective for use on private property as a long term solution. Fencing implemented as part of the time-critical removal action.
	Long-Term Monitoring	Monitoring	Periodic monitoring of contaminant concentrations in sediment, soil, and water to assess contaminant leaching and migration.	Potentially Applicable: Does not reduce contaminant concentration or risk, but may be useful for stable contaminants (e.g. dioxin) with a low risk of human contact.
Containment In Place	Horizontal Barrier	Low permeability cap	Clay, asphalt, concrete, or multi-media cover over areas of contamination to prevent direct contact and minimize leaching of contaminants from soil into groundwater.	Potentially Applicable
		Permeable cover	Crushed stone or vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially Applicable
	Vertical Barrier	Dam	Repair Allendale Dam to reduce transport of contaminated sediments to downstream areas.	Potentially Applicable
Removal - Consolidation	Horizontal Barrier	Low permeability cap	Excavate contaminated soils and transport to central location at Site. Then use clay, asphalt, concrete, or multi-media cover to cap area of consolidation to prevent direct contact and minimize leaching of contaminants from soil into groundwater.	Potentially Applicable: for limited quantities of soil.

TABLE 3-1 (continued)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
In-Situ Treatment	Physical/ Chemical/ Thermal Treatment	Vitrification	An electrical network is used to melt contaminated soils in-place. Metals are immobilized within a vitreous mass, organics are destroyed by pyrolysis.	Eliminated: Not feasible with shallow water table. End product not suitable for residential environment.
		Thermal Desorption	Use of electrically heated in-situ blanket and well system to volatilize and oxidize organic contaminants.	Eliminated: Not feasible for use with small areas.
		Soil Flushing	In-situ process which employs a water-based extraction fluid and an injection/extraction well system to flush contaminants from soils.	Eliminated: Difficult to ensure capture of extraction fluid due to low water table and proximity to pond.
		Solidification	Deep soil mixing equipment is used to apply treatment reagents to contaminated soils. Contaminants are physically and/or chemically immobilized in a cement-like mass.	Eliminated: End product not suitable in a residential environment. Not feasible with shallow water table.
	Biological Treatment	Bioremediation	Biological organisms are used to breakdown target compound.	Eliminated: Difficult to monitor, less efficient at low concentrations. May involve significant time commitment.
		Phyto-remediation	Specialized plants are used to extract or degrade soil contaminants.	Eliminated: Applicability to this type of contamination not well established. Less effective at low concentrations.
Removal	Soil Excavation	Hand Excavation	Hand tools such as shovels and picks are used to remove soil.	Applicable to small areas of soil or locations which are difficult to access with machinery.
		Mechanical Excavation	Mechanical equipment such as excavators, backhoes, bulldozers, and scrapers are used to remove soil.	Applicable to large areas of soil.

TABLE 3-1 (continued)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Ex-situ Treatment	Immobilization	Solidification/ Stabilization	Mixing of excavated contaminated materials with treatment reagents to physically and/or chemically bind and decrease the mobility of contaminants. Common treatment reagents include cement, pozzolanic materials, thermoplastics, polymers, and asphalt.	Potentially Applicable
	Thermal Treatment	Vitrification	Melting of wastes to entrain contaminants in a stable vitreous residual.	Eliminated: Excessively high energy requirements. Would require additional handling and disposal.
		Thermal Desorption	Contaminated soils are treated at elevated temperatures to volatilize organics, which are subsequently removed and captured or destroyed.	Potentially Applicable: But may not be well established or commercially available for dioxin waste.
		Incineration	Contaminated soils are heated to extremely high temperatures where organic compounds are destroyed through oxidation.	Potentially Applicable: for soil and aquatic sediment
		Pyrolysis	Chemical decomposition is induced in organic materials by heat in the absence of oxygen.	Eliminated: An emerging technology, not well established.
		Supercritical Water Oxidation	Contaminated soil is exposed to water in a high temperature, high pressure environment. Under such conditions, organic substances are oxidized.	Eliminated: Not well established and not readily available.
		Dehalogenation	Reagents are added to contaminated soil. The mixture is heated in a reactor where chlorine molecules are removed from the target compound.	Eliminated: Not well established and not readily available.

TABLE 3-1 (continued)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Ex-situ Treatment	Physical Treatment	Clay Pelletizing/ Sintering	Encapsulation of wastes by mixing with clay, followed by sintering.	Eliminated: Not permitted with dioxin waste in the U.S.
		Soil Washing	Water-based process in which soils are separated into coarse and fine fractions to reduce the volume of materials requiring intensive treatment or disposal.	Eliminated: May be difficult to achieve necessary effectiveness. Additional residuals created.
	Chemical Treatment	Solvent Extraction	Desorption of contaminants from soil particles through washing with a solvent solution.	Eliminated: May be difficult to achieve necessary effectiveness. Additional residuals created.
Disposal	Landfill	Off-Site Landfill	Permanent disposal of contaminated soils at an off-site location.	Potentially Applicable: But not permitted in the U.S.
		On-Site Landfill	Permanent disposal of contaminated soils at a central location on-site.	Potentially Applicable as a containment measure.
	Land Disposal	On-Site Disposal	On-site use of treated soils as fill material.	Eliminated: Transport of soil back to Site from treatment facility not feasible, as treatment facility is outside the U.S.

involve installing a low permeability protective cap over contaminated sediments and soil. Removal of the soils would be conducted as a general excavation to a depth of approximately 2 feet. Confirmatory sampling and screening analysis will be conducted prior to backfilling excavations to ensure additional removal is not necessary. Disposal of excavated material will be conducted using one of the following methods:

- consolidation and capping at a protected area on-site
- stabilization and disposal at an off-site hazardous materials landfill
- off-site treatment and disposal at a hazardous material incineration facility.

3.6 Description of Alternatives

Table 3-1 presents a summary of response action alternatives and corresponding technologies. The technologies were screened based on the nature of contamination to be addressed; the effectiveness of each in reducing contaminant mobility, toxicity, and volume; and statutory and guidance considerations. The above-noted general response actions were then used to form a range of viable removal alternatives using combinations of technology types (that were retained after the screening step) to achieve the removal action objectives. The viable alternatives are summarized in Table 3-2, based on the removal action objectives identified in Section 3.4. Detailed descriptions of the alternatives are provided in the following sections.

Affected portions of the soils and sediment under each element of the alternatives described in the following sections are shown on referenced figures.

3.6.1 Alternative 1: Cap Residential Soils and Flood Plain Sediments and Restore Allendale Dam

Alternative 1 includes the installation of a low permeability cap over impacted residential use soils and flood plain sediments and restoration of Allendale Dam. Restoration of the dam would result in a reduction in the area of flood plain sediments as the standing water level in Allendale Pond would rise to 93.5 feet. Flood plain sediments submerged by the higher water levels would in effect become less accessible aquatic sediments. Action areas under this alternative are presented in Figures 3-1 and 3-2. These figures show impacted soil and sediments as colored areas. These

TABLE 3-2
SUMMARY OF ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Alt.	Risk Reduction from Residential Soil and Flood Plain Sediment	Contaminant Transport
1	Allendale: Cap impacted soil and sediment from elevation 92.5' to 96' Lymansville: Cap impacted soils and sediment as determined by samples collected on each property lot.	Restore Allendale Dam to act as a sediment trap.
2	Allendale: Cap impacted soil and sediment from el. 90' to 96' Lymansville: Cap impacted soils and sediment as determined by samples collected on each property lot.	No Dam Restoration, extended cap will reduce potential for transport of sediment.
3	Allendale: Remove* impacted soil and sediment from elevation 92.5' to 96' Lymansville: Remove* impacted soils and sediment as determined by samples collected on each property lot.	Restore Allendale Dam to act as a sediment trap.
4	Allendale: Remove* impacted soil and sediment from el. 90' to 96' Lymansville: Remove* impacted soils and sediment as determined by samples collected on each property lot.	No Dam Restoration, extended removal area will reduce potential for transport of sediment.

* Alternatives involving soil or sediment removal will be evaluated for three disposal options:
1. Transport to Centredale Manor Property and cap on-site
2. off-site disposal
3. off-site treatment (incineration) and disposal

Elements:

Limit of work - action area would be residential areas and recreational areas from an "acceptable risk" line based on sample results downhill to a point one vertical foot below the pond or river waters edge.

Removal - removal of up to two feet of surface soil. Clean fill material replaced to bring the surface back to grade.

colored areas were identified by the presence of dioxin in samples at concentrations above 1 µg/kg. The key features of Alternative 1 are summarized on Figure 3-3. A conceptual cross section of the Site under Alternative 1 is depicted in Figure 3-4.

Cap Residential Use Soils and Flood Plain Sediments

Capping contaminated residential use soils would reduce the potential for contaminant transport into the Woonasquatucket River and associated ponds and reduce the potential for human exposure to contaminated soils. Vegetation would be removed as necessary from areas to be capped. A multi-layer, low permeability cap would be installed over affected areas. Eleven separate caps are anticipated under this alternative, with an estimated total area of 17,500 ft^2.

Restoration of Allendale Dam

Restoring Allendale Dam would control migration of contaminated sediments in Allendale Pond to downstream areas. Restoration of the dam would include replacement of the spillway and improvement of the flow control structure. The spillway would be replaced with a cantilever dam to an elevation consistent with the original configuration of the dam. Sediment and soil located in the vicinity of the existing dam would be excavated as necessary to facilitate restoration activities. Soil and sediments would also be removed from the associated raceway located approximately 120 feet east of the existing dam. A temporary cofferdam structure would be installed to divert water flow during restoration activities. The cofferdam structure would be removed upon completion of the dam restoration.

i. Pre-Design Investigation (PDI)

Existing sample data has been used to delineate residential use soils and flood plain sediments containing concentrations of dioxin greater than 1 µg/kg. The limits of these areas would be better defined through limited additional sampling and analysis (PDI). Design drawings and specifications for the restoration of Allendale Dam would be prepared based on preliminary plans prepared by the COE (US ACOE, 1997). PDI activities would include identification of sediments and soils containing dioxin at concentrations exceeding 1 µg/kg within the dam restoration work area and in residential-use and flood plain cap areas.

ii. **Mobilization**

Personnel, equipment, materials, and subcontractors would be mobilized to the Site. Equipment and support facilities to be employed may include:

- Field office trailer, personnel decontamination/shower trailer, and sanitary facilities
- Heavy equipment (excavator, backhoe, skid loader, hydraulic grapple, hydraulic breaker, crane, dump trucks, vibratory compactor, etc.)
- Health and safety, sampling, and decontamination equipment
- Subcontractor equipment needed for clearing and grubbing, fence dismantling, debris removal, excavation, and waste management
- Dam restoration materials (concrete, reinforcing steel, form work, sheet piling, etc.).

iii. **Site Preparation**

As mobilization of personnel, equipment, and materials to the Site commences, site preparation activities would be implemented to prepare for the subsequent construction activities. Some site preparation activities, such as grubbing and clearing, may occur simultaneously with mobilization activities. Grubbing and clearing of vegetation and trees within the work areas would be conducted as necessary to allow access by heavy machinery for earthwork and unloading materials. Other tasks which might be necessary to allow equipment access include fence dismantling and access route improvements (grading, compaction, etc.). Improvements to work areas may be necessary to facilitate storage and use of equipment and materials.

iv. **Excavation/Site Work**

Capping materials would be placed as shown in the conceptual cross section of the Site, Figure 3-4. Construction equipment and other mechanical means would be used to the fullest extent possible to place the caps. However, a significant amount of handwork may be required to complete this task due to the sensitive nature of residential property. The capped area would extend from the limit of flood plain sediment as would exist with the dam restored (approximately elevation 92.5 feet) up-gradient to the 10 year flood elevation (as is predicted to exist when the dam was functional - approximately elevation 96 feet). The cap would be hydroseeded, where appropriate, to allow for re-vegetation. Edges of the cap would be sloped to meet the existing grade. Measures to assure proper drainage of water away from capped areas would be conducted as necessary.

Dam restoration activities would require the excavation of soils and sediments in the vicinity of the dam as shown in Figure 3-1. This task would be accomplished primarily with heavy excavation equipment. Excavation spoils would be stockpiled within the work area in a manner that controls leaching and runoff. Approximately 1,100 yd^3 of soil and sediment would be removed. After the dam repairs have been made, voids created by this removal would be backfilled with gravel or other acceptable clean fill material and compacted.

The excavation area may require dewatering if water is encountered. Dewatering would be accomplished by first pumping water into two frac tanks. After settling, the water would be pumped through a filtering system and into two additional frac tanks. Once full, samples from these tanks would be tested, prior to discharge of the water back into Allendale Pond or to a publicly owned treatment works (POTW).

It is estimated that approximately 25% of soil and sediment excavated as part of the dam restoration operation is expected to contain dioxin contamination. Sampling and analysis would be used to more accurately define the contaminated fraction. Excavated materials would be addressed as described in Section 3.7.

v. **Site Restoration**

Following completion of site activities, open, cleared, or denuded areas would be graded and hydroseeded to reduce erosion and sediment transport.

vi. **Flood Storage Capacity Restoration**

Since shoreline areas of Allendale and Lymansville Ponds would be capped, flood storage capacity of the pond would be reduced slightly. If this alternative is selected for implementation, an analysis of the change in flood storage capacity would be conducted to determine if this change is significant. Based on the results of this analysis, flood storage capacity restoration activities may be necessary.

Flood storage capacity restoration would require coordination between the EPA, RIDEM, and local officials to determine the best location to conduct these activities. A potential location is the western shoreline of both Allendale and Lymansville Ponds.

vii. **Wetlands Mitigation**

Implementation of this alternative may have a minor impact on wetland areas adjacent to Allendale Pond. Actions associated with this alternative would be conducted in a manner which minimizes impacts to wetland resources to the fullest extent practicable. If this alternative is selected for implementation, TtNUS would consult with RIDEM to determine whether wetland mitigation activities would be necessary.

viii. **Post Removal Site Control**

Institutional controls would be set for each of the capped areas and for the structure of the dam. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the capped areas and to the dam structure. Such restrictions would include disturbance of the materials placed as a part of this removal action, through drilling, digging, or vegetation growth etc.

Additionally, the dam will require maintenance to assure that a buildup of debris at the spillway does not occur and cause undue stress to the structure. The flood gate will also need to be maintained in working condition.

Finally, the Site would be inspected on a quarterly basis for 30 years (for EE/CA costing purposes) following the removal action. The site inspection would focus on the integrity of cap, re-vegetation progress, and erosion controls. Every two years during this period, brush clearing would be conducted at the capped areas and in the vicinity of the dam.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

3.6.2 Alternative 2 - Cap Residential Soils and Flood Plain Sediments

This alternative is similar to Alternative 1 with the exception that Allendale Dam is not restored. Therefore, under this alternative, the area of flood plain sediments requiring capping would be larger. Due to the similarities between this alternative and Alternative 1, only the differences are discussed below. Action areas under this alternative are presented in Figures 3-2 and 3-5. These figures show impacted soil and sediments as colored areas. These colored areas were identified by the presence of dioxin in samples at concentrations above 1 μg/kg. The key features of Alternative 2 are identified on Figure 3-6. A conceptual cross section of the Site under this alternative is depicted in Figure 3-7.

Cap Residential Use Soils

The area of residential use soils and flood plain sediments requiring capping under this alternative is estimated at 257,500 ft^2, or approximately 6 acres.

Restoration of Allendale Dam

Under this alternative, Allendale Dam would not be restored and would be left in its current condition. This change would not affect water levels in Lymansville Pond.

i. Mobilization

- Dam restoration materials would not be required.

ii. Excavation/Site Work

Capping materials would be placed as shown in the conceptual cross section of the Site, Figure 3-7. The capped area would extend from shoreline areas of the river and ponds currently covered by less than one foot of water (approximately elevation 90 feet) to the 10 year flood elevation (as is predicted to exist when the dam was functional - approximately elevation 96 feet). The cap would be hydroseeded, where appropriate, to allow for re-vegetation. Edges of the cap would be sloped to meet the existing grade. Measures to assure proper drainage of water away from capped areas would be conducted as necessary.

Dam restoration activities would not be conducted under this alternative. Therefore excavated soil and sediment from this area would not be generated.

iii. Post Removal Site Control

Institutional controls would be set for each of the capped areas. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the capped areas. Such restrictions would include disturbance of the materials placed as a part of this removal action, through drilling, digging, or vegetation growth etc.

Finally, the Site would be inspected on a quarterly basis for 30 years (for EE/CA costing purposes) following the removal action. The site inspection would focus on the integrity of cap,

re-vegetation progress, and erosion controls. Every two years during this period, brush clearing would be conducted at each of the capped areas.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

3.6.3 Alternative 3 - Excavate Residential Soils and Flood Plain Sediments and Restore Allendale Dam

Alternative 3 includes excavation of impacted residential use soils and flood plain sediments and restoration of Allendale Dam. Under this alternative, the area of impacted residential use soils and flood plain sediments would be reduced as current water levels in Allendale Pond would increase due to the restoration of Allendale Dam. Sediments submerged by the higher water levels of Allendale Pond would in effect become aquatic sediments. Action areas under this alternative are the same as those under Alternative 1 and are presented in Figures 3-1 and 3-2. The key features of Alternative 3 are identified on Figure 3-8. A conceptual cross section of the Site under this alternative is depicted in Figure 3-9.

Excavate Residential Use Soils

Excavation of contaminated residential use soils and flood plain sediments would eliminate or reduce the risk of human exposure to contaminants in these areas. Vegetation would be removed as necessary from areas to be excavated. Excavation would be conducted to a depth of approximately two feet. An alternate depth may be used in some areas where localized data indicates that contamination extends beyond two feet. Confirmatory sampling and screening analysis would be conducted at excavation bottoms to ensure PRG's have been met. Additional material would be removed as necessary. Excavations would be backfilled with gravel or sand and topped with a minimum of six inches topsoil. Backfilled materials would be compacted and graded to meet original ground contours. Upon completion of excavation and backfilling activities, all disturbed areas would be hydroseeded to promote re-vegetation and prevent erosion.

Restoration of Allendale Dam

Restoring Allendale Dam would control migration of contaminated sediments from Allendale Pond to downstream areas. Restoration activities which would cause water levels in Allendale Pond to rise, would not commence until excavation and backfilling of shoreline areas was completed. Restoration of the Dam would include replacement of the spillway and improvement of the flow control structure. The spillway would be replaced with a cantilever dam to an elevation consistent with the original configuration of the dam. Sediment and soil located in the vicinity of the existing dam would be excavated as necessary to facilitate restoration activities. Soil and sediments would also be removed from the associated raceway located approximately 120 feet east of the existing dam. A temporary cofferdam structure would be installed to control water flow during restoration activities. The cofferdam structure would be removed upon completion of dam restoration activities.

i. Pre-Design Investigation (PDI)

Existing sample data has been used to delineate residential use soils and flood plain sediments containing concentrations of dioxin greater than 1 μg/kg. The limits of these areas would be better defined through limited additional sampling and analysis. Design drawings and specifications for the restoration of Allendale Dam would be prepared based on preliminary plans prepared by the USACOE (USACOE, 1997). PDI activities would include identification of sediments and soils containing dioxin at concentrations exceeding 1 μg/kg within the dam restoration work area.

ii. Mobilization

Personnel, equipment, materials, and subcontractors would be mobilized to the Site. Equipment and support facilities to be employed may include:

- Field office trailer, personnel decontamination/shower trailer, and sanitary facilities
- Heavy equipment (excavator, backhoe, skid loader, hydraulic grapple, hydraulic breaker, crane, dump trucks, vibratory compactor, etc.)

- Health and safety, sampling, and decontamination equipment

- Subcontractor equipment needed for clearing and grubbing, fence dismantling, debris removal, excavation, and waste management

- Dam restoration materials (concrete, reinforcing steel, form work, sheet piling, etc.).

iii. Site Preparation

As mobilization of personnel, equipment, and materials to the Site commences, site preparation activities would be implemented to prepare for the subsequent construction activities. Some site preparation activities, such as grubbing and clearing, may occur simultaneously with mobilization activities. Grubbing and clearing site vegetation and trees within the work area would be conducted as necessary to allow access by heavy machinery for earthwork and unloading materials. Other tasks which might be necessary to allow equipment access include fence dismantling and access route improvements (grading, compaction, etc.). Improvements to work areas may be necessary to facilitate storage and use of equipment and materials.

iv. Excavation/Site Work

Excavation would be conducted as shown in Figure 3-9, prior to restoration of the Allendale Dam. Construction equipment and other mechanical means would be used to the fullest extent possible to conduct excavation and backfilling activities. However, handwork may also be required to complete this task due to the sensitive nature of the residential properties.

Excavation areas will consist of impacted residential use soils and flood plain sediments that would exist with the dam restored (approximately elevation 92.5 feet) up-gradient to the limits of the 10 year flood boundary (as is predicted to exist when the dam is functional, approximately elevation 96 feet). The area requiring excavation under this alternative is approximately 17,500 ft^2. Based on an average excavation depth of two feet, the total volume of excavated soils would be approximately 1,300 yd^3.

Dam restoration activities would require the excavation of soils and sediments in the vicinity of the dam. This task would be accomplished primarily with heavy excavation equipment. Excavation spoils would be stockpiled within the work area in a manner which controls leaching and runoff. Approximately 1,100 yd^3 of soil and sediment would be removed. After the dam repairs have been made, voids created by this removal would be backfilled with gravel or other suitable fill material and compacted.

Excavation areas may require dewatering if water is encountered. In the dam restoration area, dewatering would be accomplished by first pumping water into two frac tanks. After settling, the water would be pumped through a filtering system and into two additional frac tanks. Once full, samples from these tanks would be tested, prior to discharge of the water back into Allendale Pond or to a publicly owned treatment works (POTW).

Dewatering of residential excavation areas would be accomplished using a vacuum truck. Water would be extracted and collected in the truck. It would then be transported to the dam restoration area and added to the frac tanks receiving water from dam excavation.

It is estimated that approximately 25% of soil and sediment excavated as part of the dam restoration operation is expected to contain dioxin above the action level of 1 µg/kg. Sampling and analysis would be used to more accurately define the contaminated fraction. Excavated materials would be handled as described in Section 3.7.

Engineering controls would be implemented when warranted during excavation and backfill activities to prevent fugitive dust emissions. As appropriate, controls such as dust suppressants and water sprays would be applied to wet the soils. The presence of VOCs is expected to be minimal or non-existent based on the results of previous sampling events; however, as a precaution, air monitoring for VOCs would be performed during the removal action. If VOCs are detected, then vapor control measures would be assessed and implemented.

v. **Site Restoration**

Following completion of site activities, open, cleared, or denuded areas would be graded and hydroseeded to reduce erosion and sediment transport.

vi. **Flood Storage Capacity Restoration**

Since excavated areas would be graded to original contours following backfilling, there would be no net loss in flood storage capacity under this alternative. Therefore, flood storage capacity restoration activities would not be necessary.

vii. **Wetlands Mitigation**

Implementation of this alternative may have a minor impact on wetland areas adjacent to the Woonasquatucket River, Allendale Pond, and Lymansville Pond. Actions associated with this alternative would be conducted in a manner which minimizes impacts to wetland resources to the fullest extent practicable. These actions would not change ground elevations or flow patterns in and around the river and ponds. The manner in which activities would be implemented under this alternative is consistent with the goals of wetland protection as outlined in Appendix D.

viii. **Post Removal Site Control**

Institutional controls would be set for the structure of the dam. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the dam structure. Such restrictions would include disturbance of the materials or structure placed as a part of the dam construction, through drilling, digging, or vegetation growth etc.

Additionally, the dam will require maintenance to assure that a buildup of debris at the spillway does not occur and cause undue stress to the structure. The flood gate will also need to be maintained in working condition.

Finally, the Site would be inspected on a quarterly basis for 30 years (for EE/CA costing purposes) following the removal action. The site inspection would focus on structure deterioration, debris and flood gate operation. Every two years during this period, brush clearing would be conducted in the vicinity of the dam.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

3.6.4 Alternative 4 - Excavate Residential Soils and Flood Plain Sediments

Alternative 4 is similar to Alternative 3 with the exception that Allendale Dam is not restored. Therefore, under this alternative, the area of flood plain sediments requiring excavation would be larger. Due to the similarities between this alternative and Alternative 3, only the differences are discussed below. Action areas under this alternative are presented in Figures 3-2 and 3-5. The key features of Alternative 4 are identified on Figure 3-10. A conceptual cross section of the Site under this alternative is depicted in Figure 3-11.

Excavate Residential Use Soils

The area of residential use soils requiring excavation under this alternative is estimated at 257,500 ft^2. Based on an average excavation depth of 2 feet, the total volume of excavated soils would be approximately 19,075 yd^3.

Restoration of Allendale Dam

Under this alternative, Allendale Dam would not be restored and would be left in its current condition. This change would not affect water levels or predicted actions adjacent to Lymansville Pond.

i. Mobilization

- Dam restoration materials would not be required.

ii. **Excavation/Site Work**

Excavation would be conducted as shown in Figure 3-11. Excavation areas would include impacted residential use soils and flood plain sediments from shoreline areas of the river and ponds currently covered by less than one foot of water (approximately elevation 90 feet) to the 10 year flood elevation (as existed when dam was functional - approximately elevation 96 feet).

Excavation areas may require dewatering if water is encountered. Dewatering would be accomplished by first pumping water into four strategically placed frac tanks. After settling, the water would be pumped through a filtering system and into four additional frac tanks. Once full, samples from these tanks would be tested, prior to discharge of the water back into Allendale Pond or to a publicly owned treatment works (POTW).

The use of a vacuum truck may be needed in some locations due to access limitations. Water would be extracted and collected in the truck. It would then be transported to the nearest frac tank receiving water from excavations.

Dam restoration activities would not be conducted under this alternative.

viii. **Post Removal Site Control**

No PRSC activities are anticipated under this alternative.

3.7 Options for Disposal of Excavated Materials

Excavated materials believed to be contaminated will be addressed through one of the following options:

1 on-site consolidation and capping
2 off-site disposal at an approved landfill
3 off-site incineration and disposal at a properly permitted facility.

On-site consolidation and capping would be accomplished by transporting excavated sediments and soil to areas at 2074 Smith Street where a cap was recently installed. This option calls for placing the material on top of the existing cap, located at the source area of the Site, spreading and compacting, and then installing a new cap on this material. Landfill disposal would involve shipping the material to a facility in Canada where it would be chemically stabilized and disposed of at a properly permitted facility. Incineration would involve transportation to an incinerator out-of-state, followed by disposal of the material at the treatment facility. Incineration would be followed by disposal of the material at the treatment facility. The estimated costs for options 1, 2, and 3 are $71/ton, $222/ton, and $310/ton, respectively.

Materials with high water content, such as sediments, may need to be de-watered or stabilized prior to shipment. Water removed from excavation areas would be stored, treated and tested to meet discharge requirements prior to disposal.

Non-contaminated materials will be backfilled into voids created during excavation activities or in other acceptable locations within the work area.

All excavated materials would be loaded directly into lined roll-off containers, covered, and staged at a central area prior to transportation. Transportation would be coordinated to take place during off-peak traffic times.

4.0 ANALYSIS OF ALTERNATIVES

The following analysis of alternatives provides information to facilitate the selection of a specific removal action option. The alternative analysis was developed in accordance with the EPA Guidance on Conducting NTCRAs under CERCLA (OERR Publication No. 9360.0-32, EPA/540-R-93) and the NCP. Section 4.1 provides an overview of the evaluation criteria used in the detailed analysis. Section 4.2 presents the detailed evaluation of the alternatives based on the evaluation criteria. Section 4.3 presents the comparative analysis of the removal alternatives considered. Section 4.4 presents the recommended removal action alternative.

4.1 Alternatives Evaluation Criteria

In accordance with the NTCRA guidance, the following three criteria and their components were used to evaluate each retained alternative during the detailed analysis:

1. Effectiveness
   - overall protection of human health and the environment
   - compliance with ARARs
   - long-term effectiveness and permanence
   - reduction of toxicity, mobility, or volume through treatment
   - short-term effectiveness

2. Implementability
   - technical feasibility
   - administrative feasibility
   - availability of services and materials
   - state acceptance
   - community acceptance

3. Cost
   - direct and indirect capital costs
   - post-removal site control (PRSC) costs

Summaries of these evaluation criteria, as described in the NTCRA guidance, are presented in Appendix E.

4.2 Individual Analysis of Removal Action Alternatives

This section presents a detailed evaluation of each of the four alternatives developed in Section 3 using the three criteria listed in Section 4.1. The State and community acceptance criteria will be addressed further following receipt of comments during the public comment period.

4.2.1 Alternative 1 - Cap Impacted Residential Use Soils and Flood Plain Sediments, Restore Dam

Alternative 1 features capping impacted residential use soils and flood plain sediments present between elevation 92.5 and 96 feet in Allendale Pond, small portions of Lymansville Pond, and restoring Allendale Dam. The components of this alternative are detailed in Section 3.4.1, affected areas are depicted on Figures 3-1 and 3-2.

Effectiveness

Alternative 1 would meet the primary removal objectives of this EE/CA by preventing direct contact with impacted soils and sediments, and by reducing the potential for contaminant migration. However, prevention of human contact with the contaminated materials is dependent upon the integrity of the cap. Risk of exposure to contaminants may return in the future if the cap is disturbed or damaged

Overall Protection of Human Health and the Environment - Restoring Allendale Dam will reduce downstream migration of contaminated sediments and prevent a massive release of such sediments in the event of a complete failure of the existing dam. Capping residential use soils and flood plain sediments will reduce human exposure to contaminants. However, the capping measure is not a permanent solution and the contaminated materials will likely need to be addressed in the future. Over time, the effectiveness of the cap may be compromised by river flow, precipitation, and surface erosion. Contaminated soil and sediment may eventually be exposed.

Compliance with ARARs - The Federal Floodplain Management Executive Order (E.O. 11988) states that Federal Agencies shall avoid conducting actions which impact or modify a flood plain zone where a practical alternative is available. Rhode Island Wetland Regulations have similar provisions. Capping areas located within the flood plain will slightly decrease flood storage capacity of the Woonasquatucket River within the affected areas. This impact could be mitigated if necessary by creating new areas of flood storage capacity along other parts of the River, if required.

Analytical results for decontamination waste, construction debris, and excavated soils and sediments would be evaluated against the criteria and definitions of hazardous waste to determine the proper disposal method, in compliance with State requirements for the identification and listing of hazardous wastes (RIDEM Hazardous Waste Management Act of 1978). Disposal of non-hazardous wastes generated or handled during the implementation of Alternative 1 would be performed in compliance with the Rhode Island Solid Waste Regulations.

RIDEM Water Quality Regulations are designed to protect the quality of the State's surface water resources and prevent improper discharges of foreign materials. Alternative 1 will not adversely affect the quality of the Woonasquatucket River. The level of the Pond will rise to previously established levels due to restoration of the dam, and these new levels will be similar to those prior to the failure of Allendale Dam in 1991. Measures such as installing silt fence, will be implemented to prevent accidental deposition of materials into the River or ponds while capping activities are being conducted. Water collected during excavation will be treated prior to discharge.

Dioxin-containing waste is defined as a land-disposal restricted, hazardous waste under RCRA. The disposal option selected for dioxin containing waste generated during implementation of this alternative will be performed in compliance with all applicable Federal and State hazardous waste management regulations.

EPA's Off-Site Rule (40 CFR 300.440) requires that an off-site facility selected for treating, storing, or disposing of hazardous substances, pollutants, and contaminants generated as the result of a CERCLA response action be acceptable; i.e., the receiving facility has no relevant

releases or violations. To ensure that debris and contaminated wastes are disposed of properly so that the NTCRA is protective of human health and the environment, this alternative will be conducted in compliance with the Off-Site Rule.

Long-Term Effectiveness and Permanence - Through periodic inspections and proper maintenance, the cap can be expected to provide an effective barrier to impacted areas for a period of 20 to 30 years or more. However, this measure is not a permanent solution and additional actions will likely be required at some point in the future. This alternative includes quarterly inspections of the cap and backfilled areas for a period of 30 years following completion of the removal action to ensure stability.

With proper maintenance, the dam is expected to last 75 to 100 years or more. The restored dam will be equipped with a flow control structure that would allow for draining or lowering water levels in the pond should the need for access to pond sediments develop in the future.

Institutional controls would be set for each of the capped areas and for the structure of the dam. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the capped areas and to the dam structure. Such restrictions would include disturbance of the materials placed as a part of this removal action, through drilling, digging, or vegetation growth etc.

Additionally, the dam will require maintenance to assure that a buildup of debris at the spillway does not occur and cause undue stress to the structure. The flood gate will also need to be maintained in working condition.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

Reduction of Toxicity, Mobility, or Volume through Treatment - Because treatment of impacted soil and sediments is not a component of Alternative 1, there would not be any reduction in the toxicity, mobility, or volume of these materials through treatment or recycling.

The materials would instead be capped in place. While this action does not constitute treatment or a reduction in contaminant toxicity, mobility of the contaminants will effectively be reduced.

Soil and sediment generated from dam restoration activities which is found to be contaminated will either be consolidated at the source area of the Site and capped (Disposal Option 1) or disposed of off-site. Off-site disposal options include stabilization followed by landfilling (Disposal Option 2) and incineration (Disposal Option 3). Selection of Option 3 would, in part, satisfy the statutory preference for treatment.

Short-Term Effectiveness - Implementation of Alternative 1 would be expected to have limited short-term impacts to the local community, workers, and the environment. Environmental controls will be used to contain any material removed from the dam site which is expected or found to be contaminated. Erosion controls, such as silt fence and hay bales, will be installed in work areas bordering the Woonasquatucket River or associated ponds to prevent discharges of sediment into these water bodies. Releases of dust will be controlled by employing water sprayers or similar devices. Workers would be protected by wearing personal protective equipment, such as Tyvek suits, whenever a potential for exposure to site contaminants exists.

An increase in heavy vehicle (dump trucks, flatbeds, etc.) traffic into and out of the Site would be expected along Woonasquatucket Avenue and Route 44 during mobilization, site preparation, dam restoration, capping, contaminated soil transport, site restoration, and demobilization phases of the removal action.

An increase in noise levels during the removal action would be expected, as with any construction activity. Efforts would be made to minimize the potential impact to the local community by working during regular hours and coordinating with the nearby residents, if necessary.

The cap can be completed in approximately 3 months, whereas the dam will take approximately 6 months to complete. Since work on these tasks may proceed simultaneously, the total on-site time to complete construction under Alternative 1 would be approximately

6 months. Because of winter weather conditions and spring flooding conditions that would impede the construction process, up to an additional 3 months may be required.

Implementability

Alternative 1 is readily implementable. A specialty construction firm with experience involving dam construction would be employed to restore Allendale Dam. Capping would be accomplished using an environmental firm with light earth moving construction capabilities, construction experience in floodplains, and experience working with individual homeowners.

Installation of the cap will provide some level of difficulty in the Lymansville area, since some portions of this cap will have to be installed under water. However, this requires only some extra considerations during construction. Contaminated soils and sediments from the dam restoration operation can be disposed of using any of the three proposed options. Under Disposal Option 1, soils and sediments would be transported to Cap Area I at the source area of the Site. A new cap would be installed over this material which is similar to the one used to cover residential use soils and flood plain sediments. Facilities have been identified which can provide the services needed to implement Disposal Options 2 and 3. These facilities have provided quotes which were used in the cost estimate for this alternative. Capacity at these facilities is expected to remain available well into the future.

Technical Feasibility - Alternative 1 is technically feasible and non-complex. No technical difficulties are expected during any phase of this alternative since common construction techniques and equipment will be used.

Alternative 1 is somewhat supportive of a long-term remedial solution at the Site. The alternative calls for the restoration of Allendale Dam which will reduce downstream migration of contaminated sediment. Also, the restored dam would be equipped with a flow control structure that would allow the pond to be drained if a need to access pond sediments develops in the future. The cap installed over impacted residential use soils and flood plain sediments will prevent human exposure to contaminants in the soils and control mobility of these contaminants, but it is not a final solution to this problem.

Administrative Feasibility - While permits would not be required for any of the site preparation and capping activities because these activities would be performed at a site under a CERCLA initiative, all removal actions would be performed to comply with the substantive requirements of all applicable or appropriate and relevant requirements. Coordination with RIDEM would be necessary for all on-site activities. Coordination with residents will be necessary to secure access to or across residential properties. Coordination with the town will also be required to facilitate traffic flow to and from the Site.

Institutional controls may present an administrative feasibility issue. Use of governmental controls (e.g. zoning, building permit restrictions, advisories) are largely dependent on the protean State and local government. Over the long term, such controls may not be enforced due to political or fiscal restraints. Use of proprietary controls (e.g. easements, covenant) is also challenging, particularly since these controls are essentially property rights that must be transferred by a willing property owner. Although portions of the Site (Centredale Manor and Brook Village portions) are owned by potentially liable parties, most parcels on which the Site are located have little or no potential liability in relation to the Site. Therefore, they may not be willing to transfer property rights readily.

Permits and approvals would be required and could be obtained for the off-site disposal of non-hazardous wastes and debris. Permits and approvals would also be required for the off-site disposal of the contaminated soils and sediments. TtNUS has found the most economical providers of disposal services specified for Options 2 and 3 are located in Canada. Disposal of waste material outside of the United States may be administratively difficult but it remains a viable option, particularly since the necessary services are scarce or non-existent in the United States. The Canadian facilities quoted have been used in the past by other Federal Agencies for waste disposal, including wastes generated at Superfund Sites.

Availability of Services and Materials - Providers of off-site treatment and disposal services for dioxin-containing wastes are limited. However, TtNUS has contacted vendors capable and willing to provide the services necessary to implement Disposal Options 2 and 3. These vendors have provided price quotes which were used in computing a cost estimate for this alternative. Disposal Option 1 may be carried out using the contractor installing the cap on residential use soils under this alternative.

Materials and other services necessary to implement this alternative are readily available. Little or no difficulty is anticipated to procure these items should this alternative be selected for implementation.

State Acceptance - The State of Rhode Island has been apprised by EPA about the pending NTCRA and the range of removal alternatives being considered in the EE/CA. The State is providing input to this EE/CA and the recommended removal action. The State's position and comments on this alternative would be evaluated following the public comment period.

Community Acceptance - Community acceptance would be considered based on comments received during the public comment period for EPA's proposed removal action alternative, prior to selecting the removal action in the Action Memorandum.

Cost

Based on the assumptions presented in Appendix F, the capital costs for Alternative 1 are $1,627,711 (for waste containment under a cap at the source area), $1,711,876 (for off-site disposal at an approved landfill), and $1,760,926 (for off-site incineration and disposal at an approved facility). The Post Removal Site Control (PRSC) costs for the first year are $768; and the total present-worth costs range from $1,657,507 to $1,790,722. These items are summarized and in Table 4-1. A detailed cost estimate for this alternative is presented in Appendix F.

4.2.2 Alternative 2 - Cap Impacted Residential Use Soils and Flood Plain Sediments

Alternative 2 features capping impacted residential soils and flood plain sediments present between approximately elevation 90 and 96 feet in Allendale Pond, and small portions of the shoreline of Lymansville Pond. Alternative 2 is similar to Alternative 1, with the exception that Allendale Dam is not restored. The components of this alternative are detailed in Section 3.4.2, affected areas are depicted on Figures 3-2 and 3-5.

TABLE 4-1
PRESENT WORTH COST ANALYSIS
ALTERNATIVE 1 - CAP RESIDENTIAL USE SOILS AND FLOODPLAIN SEDIMENTS, RESTORE DAM
FINAL ENGINEERING EVALUTION/COST ANALYSIS
CENTREDALE MANOR RESOTRATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

YEAR	PRESENT WORTH FACTOR	DISPOSAL OPTION 1 CAPITAL COSTS	DISPOSAL OPTION 1 O & M COSTS	DISPOSAL OPTION 1 PRESENT WORTH	DISPOSAL OPTION 2 CAPITAL COSTS	DISPOSAL OPTION 2 O & M COSTS	DISPOSAL OPTION 2 PRESENT WORTH	DISPOSAL OPTION 3 CAPITAL COSTS	DISPOSAL OPTION 3 O & M COSTS	DISPOSAL OPTION 3 PRESENT WORTH
0	1.000	$1,627,711		$1,627,711	$1,711,876		$1,711,876	$1,760,926		$1,760,926
1	0.935		$768	$718		$768	$718		$768	$718
2	0.873		$1,645	$1,437		$1,645	$1,437		$1,645	$1,437
3	0.816		$768	$627		$768	$627		$768	$627
4	0.763		$1,645	$1,255		$1,645	$1,255		$1,645	$1,255
5	0.713		$768	$548		$768	$548		$768	$548
6	0.666		$1,645	$1,096		$1,645	$1,096		$1,645	$1,096
7	0.623		$768	$478		$768	$478		$768	$478
8	0.582		$1,645	$957		$1,645	$957		$1,645	$957
9	0.544		$768	$418		$768	$418		$768	$418
10	0.508		$1,645	$836		$1,645	$836		$1,645	$836
11	0.475		$768	$365		$768	$365		$768	$365
12	0.444		$1,645	$730		$1,645	$730		$1,645	$730
13	0.415		$768	$319		$768	$319		$768	$319
14	0.388		$1,645	$638		$1,645	$638		$1,645	$638
15	0.362		$768	$278		$768	$278		$768	$278
16	0.339		$1,645	$557		$1,645	$557		$1,645	$557
17	0.317		$768	$243		$768	$243		$768	$243
18	0.296		$1,645	$487		$1,645	$487		$1,645	$487
19	0.277		$768	$212		$768	$212		$768	$212
20	0.258		$1,645	$425		$1,645	$425		$1,645	$425
21	0.242		$768	$185		$768	$185		$768	$185
22	0.226		$1,645	$371		$1,645	$371		$1,645	$371
23	0.211		$768	$162		$768	$162		$768	$162
24	0.197		$1,645	$324		$1,645	$324		$1,645	$324
25	0.184		$768	$142		$768	$142		$768	$142
26	0.172		$1,645	$283		$1,645	$283		$1,645	$283
27	0.161		$768	$124		$768	$124		$768	$124
28	0.150		$1,645	$247		$1,645	$247		$1,645	$247
29	0.141		$768	$108		$768	$108		$768	$108
30	0.131		$1,645	$216		$1,645	$216		$1,645	$216
Subtotal O&M Costs				$14,788			$14,788			$14,788
O&M Cost Adjustments*				$15,008			$15,008			$15,008
		TOTAL PRESENT WORTH		$1,657,507	TOTAL PRESENT WORTH		$1,741,672	TOTAL PRESENT WORTH =		$1,790,722

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

* Adjustment to Present Worth Costs for O&M to account for cost adjustment factors and contingency as outlined in Appendix F Cost Tables

Odd year O & M costs based on 4 site visits per year, 8 hrs. labor per visit at $24/hr

Even year O & M costs include site vist costs plus brush clearing from 0.65 acres at $1,350/acre (Means Item No. 021 108 0010)

Effectiveness

Alternative 2 would meet, in part, the primary removal objectives of this EE/CA by preventing direct contact with contaminated soils and sediments and by reducing contaminant mobility. However, the potential will exist for migration of contaminated sediments from Allendale Pond since Allendale Dam will not be restored. In its current condition, the potential exists for Allendale Dam to completely collapse. Large amounts of contaminated sediments which have become deposited in front of and near the dam will be transported downstream if this occurs. Furthermore, prevention of human contact with the contaminated materials is dependent upon the integrity of the cap. Risk of exposure to contaminants may return in the future if the cap is disturbed or damaged.

Overall Protection of Human Health and the Environment - This alternative is less protective of the environment as the possibility of contamination spreading into presently uncontaminated areas will only be partially addressed following its implementation. Capping impacted soils and sediments under this alternative will reduce human exposure to contaminants. However, the capping measure is not a permanent solution and the impacted material will likely need to be addressed in the future. Over time, the effectiveness of the cap may be compromised by river flow, precipitation, and surface erosion. Contaminated soil and sediment may eventually be exposed.

Compliance with ARARs - The Federal Floodplain Management Executive Order (E.O. 11988) states that Federal Agencies shall avoid conducting actions which impact or modify a flood plain zone where a practical alternative is available. Capping areas located within the flood plain will decrease flood storage capacity of the Woonasquatucket River. The impact could be mitigated, however, by creating new areas of flood storage capacity along other parts of the River.

Analytical results for decontamination waste, construction debris, and miscellaneous debris would be evaluated against the criteria and definitions of hazardous waste to determine the proper disposal method, in compliance with State requirements for the identification and listing of hazardous wastes (RIDEM Hazardous Waste Management Act of 1978). Disposal of non-

hazardous wastes generated or handled during the implementation of Alternative 2 would comply with the Rhode Island Solid Waste Regulations.

RIDEM Water Quality Regulations are designed to protect the quality of the State's surface water resources and prevent improper discharges of foreign materials. Implementation of Alternative 2 is not expected to affect the Woonasquatucket River. Measures such as installing silt fence, would be implemented to prevent accidental deposition of materials into the River while capping activities are being conducted.

Dioxin-containing waste is defined as a land-disposal restricted hazardous waste under RCRA. If any dioxin containing waste is generated during implementation of this alternative, a disposal option will be selected which complies with all applicable Federal and State hazardous waste management regulations. Since the dam is not being restored and no other excavation work is expected, it is unlikely that waste soil will be generated under this alternative.

Long-Term Effectiveness and Permanence - Through periodic inspections and proper maintenance, the cap can be expected to provide an effective barrier to contaminated areas for a period of 20 to 30 years or more. However, this measure is not a permanent solution and additional actions will likely be required at some point in the future. This alternative includes quarterly inspections of the cap for a period of two years following completion of the removal action to ensure stability.

Since the dam is not restored under this alternative, the potential exists for contaminated sediments to migrate downstream into areas which are currently not contaminated.

Institutional controls would be set for each of the capped areas. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the capped areas. Such restrictions would include disturbance of the materials placed as a part of this removal action, through drilling, digging, or vegetation growth etc.

Finally, the Site would be inspected on a quarterly basis for 30 years (for EE/CA costing purposes) following the removal action. The site inspection would focus on the integrity of cap, re-vegetation progress, and erosion controls.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

Reduction of Toxicity, Mobility, or Volume through Treatment - Because treatment of impacted residential use soils and flood plain sediments is not a component of Alternative 2, there would not be any reduction in the toxicity or volume of these materials through treatment or recycling. The soils and sediments would be capped in place. While this action does not constitute treatment or a reduction in contaminant toxicity, mobility of the contaminants will effectively be reduced.

Short-Term Effectiveness - Implementation of Alternative 2 would be expected to have limited short-term impacts to the local community, workers, and the environment. Erosion controls, such as silt fence and hay bales, will be installed in work areas bordering the Woonasquatucket River or associated ponds to prevent discharges of soil or sediment into these water bodies. Releases of dust will be controlled by employing water sprayers or similar devices. Workers would be protected by wearing personal protective equipment, such as Tyvek suits, whenever a potential for exposure to site contaminants exists.

An increase in heavy vehicle (dump trucks, flatbeds, etc.) traffic into and out of the site would be expected along Woonasquatucket Avenue and Route 44 during mobilization, site preparation, capping, site restoration, and demobilization phases of the removal action.

An increase in noise levels during the removal action would be expected, as with any construction activity. Efforts would be made to minimize the potential impact to the local community by working during regular hours and coordinating with the nearby residents, if necessary.

The estimated on-site time to complete the Alternative 2 construction would be approximately 6 months. Because of winter weather conditions and spring flooding conditions that would impede the construction process, up to an additional 3 months may be required.

Implementability

Alternative 2 is readily implementable. Capping would be accomplished using an environmental contracting firm with basic construction and earth moving capabilities. Installation of the cap will provide some level of difficulty in the Lymansville area, since some portions of this cap will have to be installed under water. However, this requires only some extra considerations during construction.

Technical Feasibility - Alternative 2 is technically feasible and non-complex. No technical difficulties are expected during any phase of this alternative since common construction techniques and equipment will be used.

Alternative 2 will not significantly contribute to a long-term remedial solution at the site. Since the dam is not restored under this alternative, contaminated sediments may migrate into currently non-contaminated areas. The cap installed on impacted residential use soils and flood plain sediments will prevent human exposure to contaminants and control mobility of these contaminants, but it is not a final solution to this problem.

Administrative Feasibility - While permits would not be required for any of the site preparation and capping activities because these activities would be performed at a site under a CERCLA initiative, all removal actions would be performed to comply with the substantive requirements of all applicable or appropriate and relevant requirements. Coordination with the RIDEM would be necessary for all on-site activities. Coordination with residents will be necessary to secure access to residential properties. Coordination with the town will also be required to facilitate traffic flow to and from the Site.

Institutional controls may present an administrative feasibility issue. Use of governmental controls (e.g. zoning, building permit restrictions, advisories) are largely dependent on the protean state and local government. Over the long term, such controls may not be enforced

due to political or fiscal restraints. Use of proprietary controls (e.g. easements, covenant) is also challenging, particularly since these controls are essentially property rights that must be transferred by a willing property owner. Although portions of the Site (Centredale Manor and Brook Village portions) are owned by potentially liable parties, most parcels on which the Site are located have little or no potential liability in relation to the Site. Therefore, they may not be willing to transfer property rights readily.

Permits and approvals would be required and could be obtained if off-site disposal of non-hazardous wastes and debris is necessary. Permits and approvals would also be required for off-site disposal of any contaminated soil that is generated. Since the dam is not being restored and no other excavation work is expected under this alternative, it is unlikely that waste soil will be generated.

Availability of Services and Materials - Materials and other services necessary to implement this alternative are readily available. Little or no difficulty is anticipated to procure these items should this alternative be selected for implementation.

State Acceptance - The State of Rhode Island has been apprised by EPA about the pending NTCRA and the range of removal alternatives being considered in the EE/CA. The State is providing input to this EE/CA and the recommended removal action. The State's acceptance and comments on this alternative would be evaluated following the public comment period.

Community Acceptance - Community acceptance would be considered based on comments received during the public comment period for EPA's proposed removal action alternative, prior to selecting the removal action in the Action Memorandum.

Cost

Based on the assumptions presented in Appendix F, the capital costs for Alternative 2 total $2,519,123. The PRSC costs for the first year are $768; and the total present-worth costs are $2,603,930. These items are summarized in Table 4-2. A detailed cost estimate for this alternative is presented in Appendix F.

TABLE 4-2
PRESENT WORTH COST ANALYSIS
ALTERNATIVE 2 - CAP RESIDENTIAL USE SOILS AND FLOOD PLAIN SEDIMENTS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$2,519,123		$2,519,123
1	0.935		$768	$718
2	0.873		$8,868	$7,746
3	0.816		$768	$627
4	0.763		$8,868	$6,765
5	0.713		$768	$548
6	0.666		$8,868	$5,909
7	0.623		$768	$478
8	0.582		$8,868	$5,161
9	0.544		$768	$418
10	0.508		$8,868	$4,508
11	0.475		$768	$365
12	0.444		$8,868	$3,937
13	0.415		$768	$319
14	0.388		$8,868	$3,439
15	0.362		$768	$278
16	0.339		$8,868	$3,004
17	0.317		$768	$243
18	0.296		$8,868	$2,624
19	0.277		$768	$212
20	0.258		$8,868	$2,292
21	0.242		$768	$185
22	0.226		$8,868	$2,002
23	0.211		$768	$162
24	0.197		$8,868	$1,748
25	0.184		$768	$142
26	0.172		$8,868	$1,527
27	0.161		$768	$124
28	0.150		$8,868	$1,334
29	0.141		$768	$108
30	0.131		$8,868	$1,165
Subtotal O&M Costs				$58,087
O&M Cost Adjustments*				$26,720
		TOTAL PRESENT WORTH =		$2,603,930

4.2.3 Alternative 3 - Excavate Impacted Residential Use Soils and Flood Plain Sediments, Restore Dam

Alternative 3 features excavation of impacted residential use soils and flood plain sediments present between elevation 92.5 and 96 feet in Allendale Pond, small portions of the shoreline of Lymansville Pond and restoration of Allendale Dam. The components of this alternative are detailed in Section 3.6.3.

Effectiveness

Alternative 3 would meet the primary removal objectives of this EE/CA by preventing direct contact with contaminated soils and sediments, and by reducing the potential for contaminant migration.

Overall Protection of Human Health and the Environment - Restoring Allendale Dam would reduce downstream migration of contaminated sediments and prevent a massive release of such sediments which may occur if the existing dam fails completely. Excavation of contaminated residential use soils and flood plain sediments will permanently eliminate human exposure to contaminants in these soils.

Compliance with ARARs - The Federal Floodplain Management Executive Order (E.O. 11988) states that Federal Agencies shall avoid conducting actions which impact or modify a flood plain zone where a practical alternative is available. Excavating areas located within the flood plain will temporarily affect the flood storage capacity of the Woonasquatucket River by causing an increase in this capacity. However, the original contours of the shoreline will be restored after the excavation is backfilled. Upon completion of the removal action there will be no net change in flood storage capacity of the River.

Analytical results for decontamination waste, construction debris, and excavated soils and sediments would be evaluated against the criteria and definitions of hazardous waste to determine the proper disposal method, in compliance with State requirements for the identification and listing of hazardous wastes (RIDEM Hazardous Waste Management Act of 1978). Excavated residential use soil and flood plain sediments are expected to be hazardous

and will be consolidated or disposed of as such. Disposal of non-hazardous wastes generated or handled during the implementation of Alternative 3 would be performed in compliance with the Rhode Island Solid Waste Regulations.

RIDEM Water Quality Regulations are designed to protect the quality of the State's surface water resources and prevent improper discharges of foreign materials. Implementation of Alternative 3 will not adversely affect the Woonasquatucket River. The level of Allendale Pond will rise due to restoration of the dam, but this level will be similar to those prior to the failure of Allendale Dam in 1991. Measures would be implemented to prevent accidental deposition of materials into the River while excavation activities are being conducted. Water collected during excavation will be treated prior to discharge.

Dioxin-containing waste is defined as a land-disposal restricted, hazardous waste under RCRA. The disposal option selected for dioxin containing waste generated during implementation of this alternative will comply with all applicable Federal and State hazardous waste management regulations.

EPA's Off-Site Rule (40 CFR 300.440) requires that an off-site facility selected for treating, storing, or disposing of hazardous substances, pollutants, and contaminants generated as the result of a CERCLA response action be acceptable; i.e., the receiving facility has no relevant releases or violations. To ensure that debris and contaminated wastes are disposed of properly so that the NTCRA is protective of human health and the environment, this alternative will be consistent with the Off-Site Rule.

Long-Term Effectiveness and Permanence - Removal of impacted residential use soils and flood plain sediments will permanently eliminate the risk of human exposure to contaminants in these materials. With proper maintenance, the dam is expected to last 75 to 100 years or more. Actions proposed under Alternative 3 are supportive of a long-term remedial solution to contamination at the site by reducing the volume of contaminated material present and by preventing further contaminant migration. The restored dam will also be equipped with a flow control structure that would allow for draining or lowering water levels in the pond should the need for access to pond sediments develops in the future.

Institutional controls would be set for each of the capped areas and for the structure of the dam. The institutional controls would essentially be governmental (e.g. zoning, building permit restrictions, advisories) or proprietary (e.g. easement, covenant) restrictions on alteration or damage to the capped areas and to the dam structure. Such restrictions would include disturbance of the materials placed as a part of this removal action, through drilling, digging, or vegetation growth, etc.

Additionally, the dam will require maintenance to assure that a buildup of debris at the spillway does not occur and cause undue stress to the structure. The flood gate will also need to be maintained in working condition.

Finally, the Site would be inspected on a quarterly basis for 30 years (for EE/CA costing purposes) following the removal action. The site inspection would focus on the integrity of cap (disposal option 1), re-vegetation progress, and erosion controls.

Inspection and maintenance activities are expected to be performed by potentially responsible parties performing the NTCRA or by the State of Rhode Island via a State Superfund Contract if the performance of the NTCRA is Fund-Lead.

Reduction of Toxicity, Mobility, or Volume Through Treatment - Excavated soil or sediment which is found to be contaminated will either be consolidated at the Centredale Manor Site and capped (Disposal Option 1) or disposed of off-site. Off-site disposal options include stabilization followed by landfilling (Disposal Option 2) and incineration (Disposal Option 3). While capping does not constitute treatment or a reduction in contaminant toxicity, mobility of the contaminants will effectively be reduced. Using Disposal Option 2 would result in decreased toxicity and mobility of the contaminants. Disposal Option 3 would eliminate the contaminants and therefore the volume of contaminated material. Selection of an off-site disposal facility that employs a treatment method such as stabilization or incineration to dispose of contaminated soils would satisfy the statutory preference for treatment.

Short-Term Effectiveness - Implementation of Alternative 3 would be expected to have limited short-term impacts to the local community, workers, and the environment. Measures will be taken to ensure containment of any material removed from the dam site which is expected or

found to be contaminated. These materials would be placed in sealed roll-off soil containers. Erosion controls, such as silt fence and haybales, would be installed in work areas bordering the Woonasquatucket River or associated ponds to prevent discharges of sediment or foreign materials into these water bodies. Releases of dust would be controlled by employing water sprayers or similar devices. Workers would be protected by wearing personal protective equipment, such as Tyvek suits, whenever a potential for exposure to site contaminants exists.

An increase in heavy vehicle (dump trucks, flatbeds, etc.) traffic into and out of the work areas would be expected along Woonasquatucket Avenue and Route 44 during mobilization, site preparation, dam restoration, excavation, waste transport, backfilling, site restoration, and demobilization phases of the removal action.

An increase in noise levels during the removal action would be expected, as with any construction activity. Efforts would be made to minimize the potential impact to the local community by working during regular hours and coordinating with the nearby residents, if necessary.

Excavation work under this alternative can be completed in approximately 3 months, whereas the dam will take approximately 6 months to complete. Since work on these tasks may proceed simultaneously, the total on-site time to complete construction under Alternative 3 would be approximately 6 months. Because of winter weather conditions and spring flooding conditions that would impede the construction process, up to an additional 3 months may be required.

Implementability

Alternative 3 is readily implementable. A specialty construction firm with background experience involving dam construction would be used to restore Allendale Dam. Excavation of residential use soils and flood plain sediments would be accomplished using an environmental contracting firm with basic earthmoving capabilities.

Contaminated soil and sediments from excavation operations can be disposed of using any of the three proposed options. Disposal Option 1 would involve transportation and consolidation

under a low permeability cap at a central on-site location. Facilities have been identified which can provide the services needed to implement Disposal Options 2 and 3. These facilities have provided quotes which were used in the cost estimate for this alternative. Capacity at these facilities is expected to remain available well into the future.

Technical Feasibility - Alternative 3 is technically feasible and non-complex. No technical difficulties are expected during any phase of this alternative since common construction techniques and equipment will be used.

Administrative Feasibility - While permits would not be required for any of the site preparation and excavation activities because these activities would be performed at a site under a CERCLA initiative, all removal actions would be performed to comply with the substantive requirements of all applicable or appropriate and relevant requirements. Coordination with RIDEM would be necessary for on-site activities.

Institutional controls may present an administrative feasibility issue. Use of governmental controls (e.g. zoning, building permit restrictions, advisories) are largely dependent on the protean state and local government. Over the long term, such controls may not be enforced due to political or fiscal restraints. Use of proprietary controls (e.g. easements, covenant) is also challenging, particularly since these controls are essentially property rights that must be transferred by a willing property owner. Although portions of the Site (Centredale Manor and Brook Village portions) are owned by potentially liable parties, most parcels on which the Site are located have little or no potential liability in relation to the Site. Therefore, they may not be willing to transfer property rights readily.

Permits and approvals would be required and could be obtained for the off-site disposal of non-hazardous wastes and debris. Permits and approvals would also be required for the off-site disposal of the contaminated soils and sediments. TtNUS has found the most economical providers of disposal services specified for Options 2 and 3 are located in Canada. Disposal of waste material outside of the United States may be administratively difficult but it remains a viable option, particularly since the necessary services are scarce or non-existent in the United States. The Canadian facilities quoted have been used in the past by other Federal Agencies for waste disposal, including wastes generated at Superfund Sites.

Availability of Services and Materials - Providers of off-site treatment and disposal services for dioxin-containing wastes are limited. However, TtNUS has contacted vendors capable and willing to provide the services necessary to implement Disposal Options 2 and 3. These vendors have provided price quotes which were used in computing a cost estimate for this alternative. Disposal Option 1 may be carried out using a common environmental construction firm.

Materials and other services necessary to implement this alternative are readily available. Little or no difficulty is anticipated to procure these items should this alternative be selected for implementation.

State Acceptance - The State of Rhode Island has been apprised by EPA about the pending NTCRA and the range of removal alternatives being considered in the EE/CA. The State is providing input to this EE/CA and the recommended removal action. The state's acceptance and comments on this alternative would be evaluated following the public comment period.

Community Acceptance - Community acceptance would be considered based on comments received during the public comment period for EPA's proposed removal action alternative, prior to selecting the removal action in the Action Memorandum.

Cost

Based on the assumptions presented in Appendix F, the capital costs for Alternative 3 are $1,791,058 (for waste containment under a cap at the source area), $2,270,699 (for off-site disposal at an approved landfill), and $2,550,225 (for off-site incineration and disposal at a properly permitted facility). The PRSC costs for the first year are $768; and the total present-worth costs range from $1,816,743 to $2,575,910. These items are summarized in Table 4-3. A detailed cost estimate for this alternative is presented in Appendix F.

TABLE 4-3
PRESENT WORTH COST ANALYSIS
ALTERNATIVE 3 - EXCAVATE RESIDENTIAL USE SOILS AND FLOOD PLAIN SEDIMENTS, RESTORE DAM
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

YEAR	PRESENT WORTH FACTOR	DISPOSAL OPTION 1 CAPITAL COSTS	O & M COSTS	PRESENT WORTH	DISPOSAL OPTION 2 CAPITAL COSTS	O & M COSTS	PRESENT WORTH	DISPOSAL OPTION 3 CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$1,791,058		$1,791,058	$2,270,699		$2,270,699	$2,550,225		$2,550,225
1	0.935		$768	$718		$768	$718		$768	$718
2	0.873		$1,106	$966		$1,106	$966		$1,106	$966
3	0.816		$768	$627		$768	$627		$768	$627
4	0.763		$1,106	$843		$1,106	$843		$1,106	$843
5	0.713		$768	$548		$768	$548		$768	$548
6	0.666		$1,106	$737		$1,106	$737		$1,106	$737
7	0.623		$768	$478		$768	$478		$768	$478
8	0.582		$1,106	$643		$1,106	$643		$1,106	$643
9	0.544		$768	$418		$768	$418		$768	$418
10	0.508		$1,106	$562		$1,106	$562		$1,106	$562
11	0.475		$768	$365		$768	$365		$768	$365
12	0.444		$1,106	$491		$1,106	$491		$1,106	$491
13	0.415		$768	$319		$768	$319		$768	$319
14	0.388		$1,106	$429		$1,106	$429		$1,106	$429
15	0.362		$768	$278		$768	$278		$768	$278
16	0.339		$1,106	$374		$1,106	$374		$1,106	$374
17	0.317		$768	$243		$768	$243		$768	$243
18	0.296		$1,106	$327		$1,106	$327		$1,106	$327
19	0.277		$768	$212		$768	$212		$768	$212
20	0.258		$1,106	$286		$1,106	$286		$1,106	$286
21	0.242		$768	$185		$768	$185		$768	$185
22	0.226		$1,106	$250		$1,106	$250		$1,106	$250
23	0.211		$768	$162		$768	$162		$768	$162
24	0.197		$1,106	$218		$1,106	$218		$1,106	$218
25	0.184		$768	$142		$768	$142		$768	$142
26	0.172		$1,106	$190		$1,106	$190		$1,106	$190
27	0.161		$768	$124		$768	$124		$768	$124
28	0.150		$1,106	$166		$1,106	$166		$1,106	$166
29	0.141		$768	$108		$768	$108		$768	$108
30	0.131		$1,106	$145		$1,106	$145		$1,106	$145
Subtotal O&M Costs				$11,553			$11,553			$11,553
O&M Cost Adjustments*				$14,132			$14,132			$14,132
		TOTAL PRESENT WORTH =		$1,816,743	TOTAL PRESENT WORTH =		$2,296,384	TOTAL PRESENT WORTH =		$2,575,910

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

*** Adjustment to Present Worth Costs for O&M to account for cost adjustment factors and contingency as outlined in Appendix F Cost Tables**

Odd year O & M costs based on 4 site visits per year, 8 hrs. labor per visit at $24/hr.
Even year O & M costs include site vist costs plus brush clearing from 0.25 acres at $1,350/acre (Means Item No. 021 108 0010)

4.2.4 Alternative 4 - Excavate Impacted Residential Use Soils and Flood Plain Sediments

Alternative 4 features excavation of impacted residential use soils and flood plain sediments present between elevation 90 and 96. Alternative 4 is similar to Alternative 3 with the exception that Allendale Dam is not restored. The components of this alternative are detailed in Section 3.4.4, affected areas are depicted on Figures 3-2 and 3-5.

Effectiveness

Alternative 4 would meet, in part, the primary removal objectives of this EE/CA by preventing direct contact with and eliminating mobility of some of the contaminated soils and sediments. But this alternative will not be effective at reducing the potential for contaminant migration since Allendale Dam will not be restored. In its current condition, the potential exists for Allendale Dam to completely collapse. If this occurs, large amounts of contaminated sediments which are present near and in front of the dam will be transported downstream.

Overall Protection of Human Health and the Environment - Excavation of impacted soils and sediments will eliminate human exposure to contaminants in these materials. However, this alternative is not protective of the environment, as the possibility of contamination spreading into presently uncontaminated areas will remain unaddressed following its implementation.

Compliance with ARARs - The Federal Floodplain Management Executive Order (E.O. 11988) states that Federal Agencies shall avoid conducting actions which impact or modify a flood plain zone where a practical alternative is available. Excavating areas located within the flood plain will temporarily affect the flood storage capacity of the Woonasquatucket River by causing an increase in this capacity. However, the original contours of the excavated area will be restored after the excavation is backfilled. Upon completion of the removal action there will be no net change in flood storage capacity of the River.

Analytical results for decontamination waste, construction debris, and excavated soils and sediments would be evaluated against the criteria and definitions of hazardous waste to

determine the proper disposal method, in compliance with State requirements for the identification and listing of hazardous wastes (RIDEM Hazardous Waste Management Act of 1978). Excavated residential use soil and flood plain sediment is expected to be hazardous and will be disposed of as such. Disposal of non-hazardous wastes generated or handled during the implementation of Alternative 4 would comply with the Rhode Island Solid Waste Regulations.

RIDEM Water Quality Regulations are designed to protect the quality of the State's surface water resources and prevent improper discharges of foreign materials. Implementation of Alternative 4 will not adversely affect the Woonasquatucket River. Measures would be implemented to prevent accidental deposition of materials into the River while excavation activities are being conducted. Water collected during excavation will be treated prior to discharge.

Dioxin-containing waste is defined as a land-disposal restricted hazardous waste under RCRA. The disposal option selected for dioxin containing waste generated during implementation of this alternative will comply with all applicable Federal and State hazardous waste management regulations.

EPA's Off-Site Rule (40 CFR 300.440) requires that an off-site facility selected for treating, storing, or disposing of hazardous substances, pollutants, and contaminants generated as the result of a CERCLA response action be acceptable; i.e., the receiving facility has no relevant releases or violations. To ensure that debris and contaminated wastes are disposed of properly so that the NTCRA is protective of human health and the environment, this alternative would be conducted in accordance with the Off-Site Rule.

Long-Term Effectiveness and Permanence - Removal of impacted residential use soils and flood plain sediments will permanently eliminate the risk of human exposure to contaminants in these soils. Actions proposed under Alternative 4 are, in part, supportive of a long-term remedial solution to contamination at the site by reducing the volume of contaminated material present. However, since the dam is not restored under this alternative, the potential exists for contaminated sediments to migrate downstream into areas which are currently not contaminated.

Reduction of Toxicity, Mobility, or Volume through Treatment - Excavated materials will either be consolidated at the Centredale Manor Site and capped (Disposal Option 1) or disposed of off-site. Off-site disposal options include stabilization followed by landfilling (Disposal Option 2) and incineration (Disposal Option 3). While capping does not constitute treatment or a reduction in contaminant toxicity, mobility of the contaminants will effectively be reduced. Using Disposal Option 2 would result in decreased toxicity and mobility of the contaminants. Disposal Option 3 would eliminate the contaminants and therefore the volume of contaminated material. Selection of an off-site disposal facility that employs a treatment method, such as stabilization or incineration, to dispose of contaminated materials would satisfy the statutory preference for treatment.

Short-Term Effectiveness - Implementation of Alternative 4 would be expected to have limited short-term impacts to the local community, workers, and the environment. Erosion controls, such as silt fence and haybales, will be installed in work areas bordering the Woonasquatucket River or associated ponds to prevent discharges of soil/sediment or foreign materials into these water bodies. Releases of dust would be controlled by employing water sprayers or similar devices. Workers would be protected by wearing personal protective equipment, such as tyvek suits, whenever a potential for exposure to site contaminants exists.

An increase in heavy vehicle (dump trucks, flatbeds, etc.) traffic into and out of the site would be expected along Woonasquatucket Avenue and Route 44 during mobilization, site preparation, excavation, contaminated soil transport, backfilling, site restoration, and demobilization phases of the removal action.

An increase in noise levels during the removal action would be expected, as with any construction activity. Efforts would be made to minimize the potential impact to the local community by working during regular hours and coordinating with the nearby residents, if necessary.

Dam restoration work under this alternative can be completed in approximately 6 months, whereas the excavation work will take approximately 9 to 18 months to complete. Since work on these tasks may proceed simultaneously, the total on-site time to complete construction under Alternative 4 would be approximately 9 to 18 months. Because of winter weather

conditions and spring flooding conditions that could impede the construction process, up to an additional 3 months may be required.

Implementability

Alternative 4 is readily implementable. Excavation would be accomplished using an environmental contracting firm with general construction capabilities.

Contaminated soil and sediments from excavation operations can be disposed of using any of the three proposed disposal options. Facilities have been identified which can provide the services needed to implement Disposal Options 2 and 3. These facilities have provided quotes which were used in the cost estimate for this alternative. Capacity at these facilities is expected to remain available well into the future.

Technical Feasibility - Alternative 4 is technically feasible and non-complex. No technical difficulties are expected during any phase of this alternative since common construction techniques and equipment will be used.

Administrative Feasibility - While permits would not be required for any of the site preparation and excavation activities because these activities would be performed at a site under a CERCLA initiative, all removal actions would be performed to comply with the substantive requirements of all applicable or appropriate and relevant requirements. Coordination with the RIDEM would be necessary for on-site activities.

Permits and approvals would be required and could be obtained for the off-site disposal of non-hazardous wastes and debris. Permits and approvals would also be required for the off-site disposal of the contaminated soils and sediments. TtNUS has found the most economical providers of disposal services required for options 2 and 3 are located in Canada. Disposal of waste material outside of the United States may be administratively difficult but it remains a viable option, particularly since the necessary services are scarce or non-existent in the United States. The facilities of interest have been used in the past by other Federal Agencies for waste disposal, including wastes generated at Superfund Sites.

Availability of Services and Materials - Providers of off-site treatment and disposal services for dioxin-containing wastes are limited. However, TtNUS has contacted vendors capable and willing to provide the services necessary to implement Disposal Options 2 and 3. These vendors have provided price quotes which were used in computing a cost estimate for this alternative. Disposal Option 1 may be carried out using a common environmental construction firm.

Materials and other services necessary to implement this alternative are readily available. Little or no difficulty is anticipated to procure these items should this alternative be selected for implementation.

State Acceptance - The State of Rhode Island has been apprised by EPA about the pending NTCRA and the range of removal alternatives being considered in the EE/CA. The State is providing input to this EE/CA and the recommended removal action. The state's acceptance and comments on this alternative would be evaluated following the public comment period.

Community Acceptance - Community acceptance would be considered based on comments received during the public comment period for EPA's proposed removal action alternative, prior to selecting the removal action in the Action Memorandum.

Cost

Based on the assumptions presented in Appendix F, the capital costs for Alternative 4 are $4,480,170 (for containment under a cap at the source area of the Site), $10,283,524 (for off-site disposal at an approved landfill), or $13,665,611 (for off-site incineration and disposal at a properly permitted facility). No PRSC activities are required under this alternative. A detailed cost estimate for this alternative is presented in Appendix F.

4.3 Comparative Analysis of Removal Action Alternatives

In this Section, the alternatives are compared to each other in terms of evaluation criteria presented in the previous Section. The purpose of this comparative analysis is to identify advantages and disadvantages of each alternative relative to one another so that key tradeoffs

that may affect the removal action selection can be identified. Table 4-4 summarizes the comparative analysis.

The removal action objectives at the Site include the following:

- Prevent migration of contaminated sediments to downstream areas
- Eliminate or reduce the risk of human exposure to flood plain sediments containing concentrations of dioxin in excess of removal action goals (1 μg/kg)
- Eliminate or reduce the risk of human exposure to residential use soils containing concentrations of dioxin in excess of removal action goals (1 μg/kg)

4.3.1 Effectiveness

Overall Protection of Human Health and the Environment

Alternative 1 meets the removal objectives, but the sustained effectiveness of this alternative is dependent on the integrity of the cap installed on the residential use soils. Human health would be protected by preventing exposure to contaminated soil and sediment and the dam would control migration of contaminants. Alternatives 2 and 4 meet the first removal objective but not the second. Under these alternatives the dam is not restored and the potential for downstream migration of some of the contaminated sediments is not addressed. Alternative 2 also calls for use of a cap to prevent human exposure to contaminated soils and sediment and therefore effectiveness of this alternative is based on the integrity of the cap. Alternative 3 meets the removal objectives through excavation of impacted residential use soils and flood plain sediments to prevent human exposure and through restoration of the dam to control downstream migration of contaminated sediments.

Compliance with ARARs

All alternatives include measures that would protect the Woonasquatucket River from discharges of foreign material during their implementation.

TABLE 4-4
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

CRITERION	ALTERNATIVE 1: CAP RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 2: CAP RESIDENTIAL SOILS	ALTERNATIVE 3: EXCAVATE RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 4: EXCAVATE RESIDENTIAL SOILS
EFFECTIVENESS				
Overall Protection of Human Health and the Environment	Would meet removal action objectives although effectiveness is based on integrity of cap and is reversible. Would partially support a long term remedial solution at the Site by controlling future contaminant migration, but contaminated soil will remain on site.	Would partially meet removal action objectives although effectiveness is based on integrity of cap and is reversible. Not consistent with long term remedial solution at Site since contaminated soil will remain on site and further contaminant migration is possible.	Would fully meet removal action objectives by removing contaminated soil from site and controlling further contaminant migration. Would support a long-term remedial solution at the site by reducing contaminated area and volume.	Would partially meet removal action objectives by removing contaminated soil from site, but does not control further contaminant migration. Would partially support a long-term remedial solution at Site by reducing the volume of contaminated soil currently present.
Compliance with ARARs	Would have minor impacts on floodplain under federal floodplain and state wetland regulations, but impacts could be mitigated through restoration efforts.	Would have major impacts on floodplain zone under federal floodplain and state wetland regulations, but impacts could be mitigated through restoration efforts.	Would result in no net loss of wetlands or floodplain.	Would result in no net loss of wetlands or floodplain.
	Measures would be taken to ensure compliance with federal and state hazardous waste standards and associated regulations.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
	Would comply with state testing and waste identification regulations.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
	Would comply with state air pollution control regulations.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
	Would comply with state solid waste regulations, as applicable.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.

TABLE 4-4 (continued)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
PAGE 2 OF 3

CRITERION	ALTERNATIVE 1: CAP RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 2: CAP RESIDENTIAL SOILS	ALTERNATIVE 3: EXCAVATE RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 4: EXCAVATE RESIDENTIAL SOILS
Long-term Effectiveness and Permanence	Capping is a temporary solution to reduce human contact with impacted soils/sediment. Restoring dam is a long-term solution to control contaminant migration. Cap integrity will need to be monitored under PRSC.	Capping is a temporary solution to reduce human contact with impacted soils/sediment. Contaminant migration from un-capped areas is not addressed. Cap integrity will need to be monitored under PRSC.	Excavation will be a permanent solution to impacted soils/sediment. Restoring dam is a long-term solution to control contaminant migration. Stability of backfilled areas will need to be monitored under PRSC.	Excavation will be a permanent solution to impacted soils/sediment. Contaminant migration is not addressed. Stability of backfilled areas will need to be monitored under PRSC.
Reduction of Toxicity, Mobility, or Volume Through Treatment	Toxicity and volume not reduced, but mobility will be reduced.	Same as Alt. 1.	Toxicity, mobility, and volume reduced under Disposal Option 3. Other disposal options only reduce mobility.	Same as Alt 3.
Short-term Effectiveness	No unacceptable short-term impacts are anticipated.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
	Time on-site 6-9 months	Same as Alt. 1	Same as Alt. 1	On-site 9-18 months
IMPLEMENTABILITY				
Technical Feasibility	Technically feasible and non-complex, common construction techniques and equipment will be used.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
Administrative Feasibility	No permits required for on-site work. Permits required for off-site disposal of soil and debris. Coordination with RIDEM necessary for site activities. Difficult to enforce institutional controls for caps located on residential use property.	No permits required for on-site work. No disposal permits required since no off-site disposal is expected so Permits required for off-site disposal of soil and debris. Coordination with RIDEM necessary for site activities. Difficult to enforce institutional controls for caps located on residential use property.	No permits required for on-site work. Permits required for off-site disposal of soil and debris. Coordination with RIDEM necessary for site activities. Difficult to enforce institutional controls for caps located on residential use property.	No permits required for on-site work. Permits required for off-site disposal of soil and debris. Coordination with RIDEM necessary for site activities. Difficult to enforce institutional controls for caps located on residential use property.

TABLE 4-4 (continued)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND
PAGE 3 OF 3

CRITERION	ALTERNATIVE 1: CAP RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 2: CAP RESIDENTIAL SOILS	ALTERNATIVE 3: EXCAVATE RESIDENTIAL SOILS, RESTORE DAM	ALTERNATIVE 4: EXCAVATE RESIDENTIAL SOILS
Availability of Services and Materials	Qualified contractors for on-site activities would be available for competitive bidding. Providers of services for Disposal Options 2 & 3 have been identified and adequate capacity is available.	Qualified contractors for on-site activities would be available for competitive bidding. No off-site disposal services are required.	Same as Alt. 1	Same as Alt. 1.
State Acceptance	To be addressed after close of public comment period.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Community Acceptance	To be addressed after close of public comment period.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
COST				
Capital Costs ($)	Disposal Opt 1: $1,627,711 Disposal Opt 2: $1,711,876 Disposal Opt 3: $1,760,926	$2,519,123	Disposal Opt 1: $1,791,058 Disposal Opt 2: $2,270,699 Disposal Opt 3: $2,550,225	Disposal Opt 1: $4,480,170 Disposal Opt 2: $10,283,524 Disposal Opt 3: $13,665,611
O& M Costs, Present Worth ($)	$29,796	$84,807	$25,685	$0.00
Total Present Worth Costs ($)	Disposal Opt 1: $1,657,507 Disposal Opt 2: $1,741,672 Disposal Opt 3: $1,790,722	$2,603,930	Disposal Opt 1: $1,816,743 Disposal Opt 2: $2,296,384 Disposal Opt 3: $2,575,910	Disposal Opt 1: $4,480,170 Disposal Opt 2: $10,283,524 Disposal Opt 3: $13,665,611

Alternatives 1 and 2 will result in a reduction of the flood storage capacity of the River, although the reduction could be mitigated if necessary by creating flood storage capacity at other locations along the River. Alternatives 3 and 4 will result in no net change in flood storage capacity.

All alternatives could be performed to comply with State hazardous waste management requirements, including testing and waste identification requirements.

All alternatives would be consistent with the EPA Off-Site Rule regarding the selection of off-site disposal facilities when applicable.

Long-Term Effectiveness and Permanence

The long-term effectiveness of Alternatives 1 and 2 is less than that of Alternatives 3 and 4 based on the fact that both rely on a cap to prevent human exposure to contaminated soils and sediment. Effectiveness will be negated if the cap is disturbed or damaged. Alternatives 3 and 4 propose removal of impacted soil which is a permanent solution.

Institutional controls may not be effective in the long term, as such controls may not be enforced due to political or fiscal restraints. Use of proprietary controls may also not be effective as many parcels on the Site have little or no potential liability in relation to the Site, and owners may not be willing to transfer property rights readily. Such difficulties will further reduce the effectiveness of Alternatives 1 and 2.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 1 and 2 do not propose treatment for impacted soils and sediments, so there will be no reduction in toxicity or volume of contaminants under these alternatives. However, because the impacted soil and sediment will be capped, a reduction in contaminant mobility will be achieved.

Alternatives 3 and 4 propose excavation of impacted residential use soils and flood plain sediments which will require either on-site consolidation or disposal as hazardous waste.

Alternatives 1 and 3 call for the restoration of Allendale Dam which will result in the generation of soil and sediment that will need to be handled in the same manner. A reduction of toxicity, mobility, and/or volume of these soils (through treatment) may be achieved depending on the disposal option selected. The proposed disposal options include consolidation at the source area of the Site followed by capping (Disposal Option 1), off-site stabilization and landfilling (Disposal Option 2), and off-site incineration (Disposal Option 3).

Disposal Option 1 does not include treatment, but since the soil and sediment will be capped, the mobility of the contaminants will be reduced if this option is used. Disposal Option 2 will result in reduced toxicity and mobility of contaminants. With Disposal Option 3, the soil and sediment will be fully treated resulting in the elimination of toxicity and therefore the volume of contaminated material.

Short-Term Effectiveness

There would be limited impacts to the local community, on-site removal workers, and the environment during implementation of any of the alternatives. For all alternatives, monitoring for potential fugitive dusts would be performed, and appropriate engineering controls would be used to minimize or prevent adverse impacts. All alternatives also include the use of erosion and sediment controls, and other management controls to minimize the amount of debris and contaminated soils/sediment migrating into the Woonasquatucket River during implementation.

There would be fewer potential emissions under Alternative 2 because this alternative involves less on-site handling of contaminated soils and sediment.

A temporary increase in noise and vehicular traffic would be anticipated under each of the four alternatives. All four alternatives have the same approximate removal action duration.

4.3.2 Implementability

Technical Feasibility

All the alternatives are technically feasible. No technical difficulties are anticipated for site preparation, demolition, excavation, and site restoration activities since common construction techniques and equipment are required. Decontamination techniques and equipment anticipated to be used are also fairly common. Access and spatial limitations could be managed by a well-developed site management plan.

Winter weather and spring flooding conditions could limit the implementation of all alternatives. Most decontamination and dewatering activities would be limited to the period between March and November, due to potential freezing.

Evaluations indicate that Alternative 3 would have a lesser impact on wetlands and the floodplain in comparison to the other alternatives. Alternative 1 involves capping a portion of wetlands, which will permanently destroy certain wetland habitat and may adversely affect flooding patterns in the area of the Site.

Alternative 2 involves capping a much larger portion of the wetlands in the area, thereby increasing wetland habitat and floodplain problems. Alternative 4 involves excavating 14 times the volume of contaminated sediments/soils which would be excavated under Alternative 3. This would clearly disrupt a much larger portion of the wetlands and floodplain. Therefore, it appears that Alternative 3, while impacting wetlands and the floodplain, is the least disruptive alternative.

Alternative 1 is somewhat supportive of a long-term remedial solution at the Site as it calls for the restoration of Allendale Dam. This will control the spread of contamination and allow the pond to be drained should the need to access pond sediments develop. However, capping impacted residential use soils and flood plain sediments under this alternative is not supportive of a long term solution as these soils will likely need to be addressed again in the future.

Alternative 2 is not supportive of a long-term remedial solution at the Site. The impacted residential use soils and flood plain sediments will remain at the Site and will likely need to be addressed again in the future.

Alternative 3 contributes most to a long-term remedial solution at the Site. Impacted residential use soils and flood plain sediments will be removed and will not have to be addressed again in the future. This Alternative calls for the restoration of Allendale Dam which will control the spread of contamination and allow the pond to be drained should the need to access pond sediments develop.

Alternative 4 is somewhat supportive of a long term remedial solution at the Site as it calls for removal of impacted residential use soils and flood plain sediments. However, the dam is not restored under this alternative which may result in further migration of contaminants. Also, without restoration of the dam, there would be no means to control water levels in the pond which would be necessary if a need to access pond sediments develops in the future.

Administrative Feasibility

Actual permits are not required for on-site work but the requirements of any ARARs need to be addressed and met. Work in flood plain areas and any on-site backfilling or disposal of soil will be conducted with input from RIDEM and other appropriate State Agencies.

Institutional controls set on cap areas may present an administrative feasibility issue, further complicating alternatives 1 and 2. Use of governmental controls (e.g. zoning, building permit restrictions, advisories) will be difficult to enforce over the long term. Use of proprietary controls will also prove difficult over the long term, since these controls are essentially property rights that must be transferred by a willing property owner.

Permits would be required for off-site transport and disposal of contaminated soils and sediment. Alternatives 1, 3, and 4 may involve off-site transportation and disposal of dioxin-bearing waste. Facilities have been identified which are capable and willing to accept this type of waste. TtNUS has found the most viable off-site disposal options involve transporting the

soil to Canada. Obtaining permits for international transport and disposal of hazardous waste may be administratively difficult and time consuming, but it can be done.

Coordination with the State and local DOT and town representatives might be required so that traffic controls (speed limits, caution signs, etc.) could be implemented to ensure the safety of the public and site workers during heavy vehicular traffic conditions.

Availability of Services and Materials

Qualified contractors with trained personnel, equipment, and hazardous waste site experience would be readily available to perform the site preparation, decontamination, excavation, capping, and site restoration services under all alternatives.

Off-site disposal capacity is available to receive contaminated soils and sediments.

State Acceptance

This factor will be addressed after the close of the public comment period.

Community Acceptance

This factor will be addressed after the close of the public comment period.

4.3.3 Cost

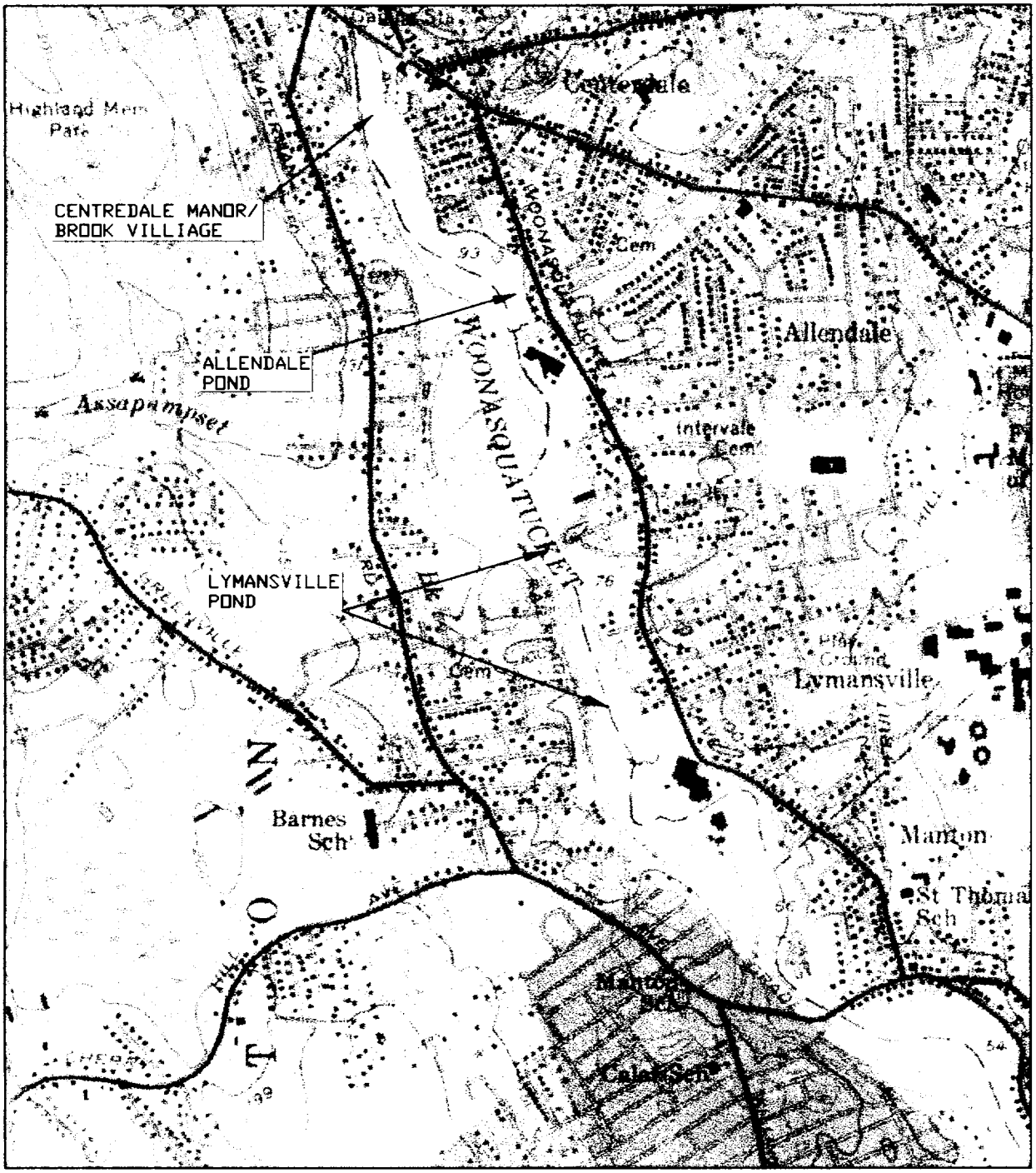
Summaries of the costs for each alternative are presented in Table 4-4. Alternative 1 (with Disposal Option 1) would be the least costly to implement. Total present worth costs for implementing Alternative 4 are approximately two to eight times the costs for implementing the other three alternatives, depending on the disposal option selected. Present worth PRSC costs range from $25,685 to $84,807 for Alternatives 1, 2, and 3. No PRSC costs are anticipated under Alternative 4.

4.4 Recommended Removal Alternative

Based on the comparative analysis of the four alternatives, Alternative 3 with Disposal Option 3 was selected as the recommended removal alternative. Of the four alternatives, Alternative 3 will be most effective at meeting the removal action objectives. Alternative 3 is equally implementable when compared to the other alternatives. The cost of Alternative 3 is slightly more than the cost of Alternatives 1 and 2, but it offers a more effective approach and contributes to a permanent solution to contamination at the Site. The cost of Alternative 3 is much lower than that of Alternative 4. Additionally, Alternative 3 with Disposal Option 3 satisfies the statutory preference for treatment with regard to residential use soils and flood plain sediments, while Alternatives 1 and 2 do not.

Disposal Option 3, off-site incineration and disposal, is selected as a component of the recommended alternative because it is the only permanent treatment option for the impacted soil and sediment and because the cost was not prohibitive when compared to the other options.

FIGURES



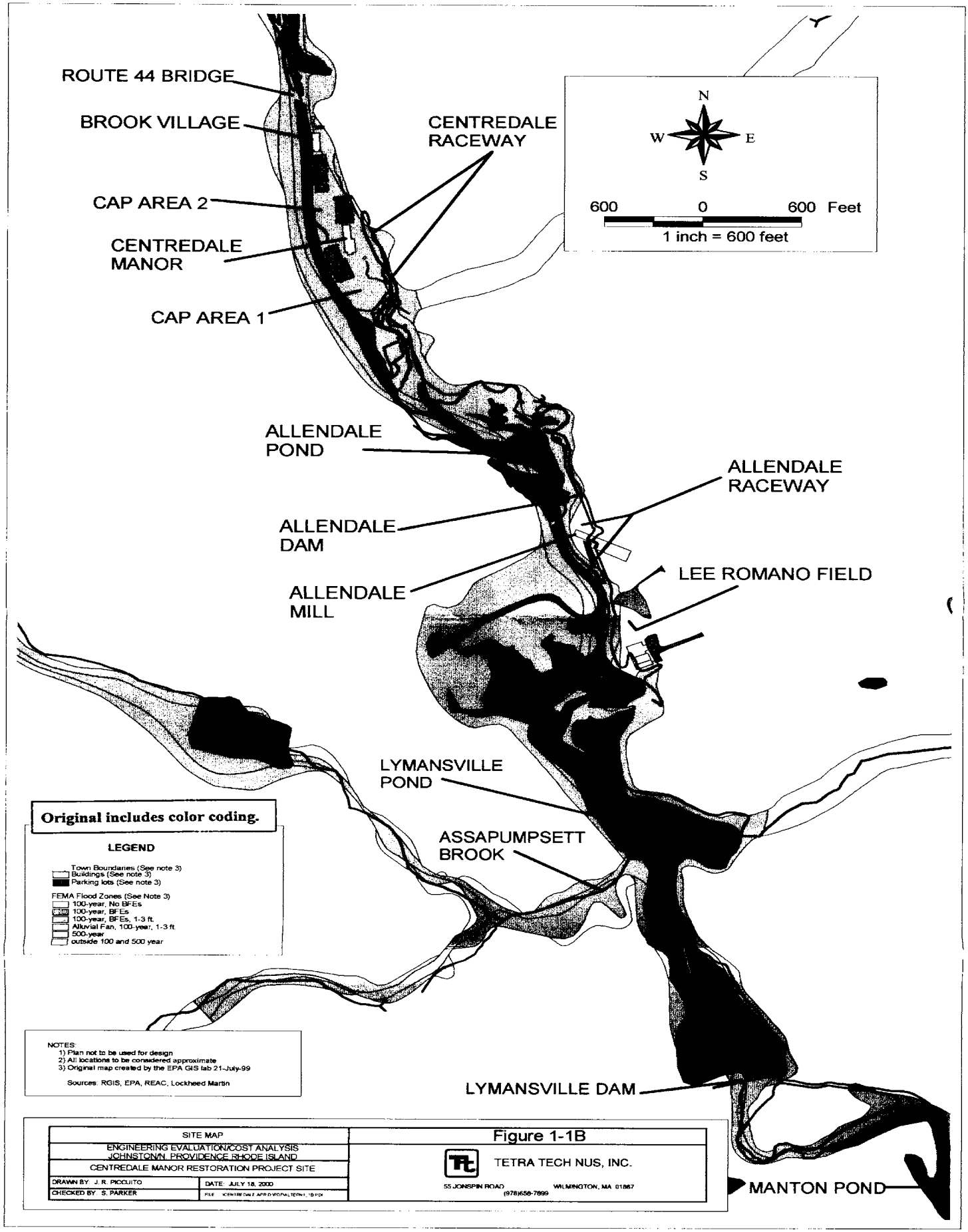
BASEMAP: PORTION OF THE FOLLOWING U.S.G.S. QUADRANGLE MAP: PROVIDENCE, RI, 1957, PHOTOREVISED 1970 AND 1975.

GRAPHIC SCALE
0 0.5 MILE 1 MILE

QUADRANGLE LOCATION

SITE LOCUS FIGURE	FIGURE 1-1A
CENTREDALE MANOR RESTORATION PROJECT SITE	
NORTH PROVIDENCE, RHODE ISLAND	
DRAWN BY: J. R. PICCUITO	REV.: 0
CHECKED BY: K. O'NIELL	DATE: SEPTEMBER 15, 2000
SCALE: AS NOTED	ACAD NAME: DWG\0400\0630\LOCUS_1.DWG

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899


ROUTE 44 BRIDGE
BROOK VILLAGE
CENTREDALE RACEWAY
CAP AREA 2
CENTREDALE MANOR
CAP AREA 1
N
W
E
S
600
0
600 Feet
1 inch = 600 feet
ALLENDALE POND
ALLENDALE RACEWAY
ALLENDALE DAM
LEE ROMANO FIELD
ALLENDALE MILL
LYMANSVILLE POND
ASSAPUMPSETT BROOK
LYMANSVILLE DAM
MANTON POND
Original includes color coding.
LEGEND
Town Boundaries (See note 3)
Buildings (See note 3)
Parking lots (See note 3)
FEMA Flood Zones (See Note 3)
100-year, No BFEs
100-year, BFEs
100-year, BFEs, 1-3 ft.
Alluvial Fan, 100-year, 1-3 ft.
500-year
outside 100 and 500 year
NOTES:
1) Plan not to be used for design
2) All locations to be considered approximate
3) Original map created by the EPA GIS lab 21-July-99
Sources: RGIS, EPA, REAC, Lockheed Martin
SITE MAP
ENGINEERING EVALUATION/COST ANALYSIS
JOHNSTON/N. PROVIDENCE RHODE ISLAND
CENTREDALE MANOR RESTORATION PROJECT SITE
DRAWN BY: J. R. PICCUITO
DATE: JULY 18, 2000
CHECKED BY: S. PARKER
Figure 1-1B
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01867
(978)658-7899

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 1-2A, SOIL AND SEDIMENT SAMPLES, FROM UPSTREAM AREAS TO SOURCE AREA.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 1-2B, SOIL AND SEDIMENT SAMPLES,
ALLENDALE POND AND ALLENDALE DAM.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 1-2C, SOIL AND SEDIMENT SAMPLES
IN LYMANSVILLE POND.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 3-1, SOIL AND SEDIMENT AREAS
IN ALLENDALE POND AND WETLANDS
DEFINED FOR REMOVAL ACTION
ALTERNATIVES 1 AND 3.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 3-2, SOIL AND SEDIMENT AREAS
IN LYMANSVILLE POND DEFINED FOR
REMOVAL ACTION ALTERNATIVES 1, 2, 3 AND 4.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

FIGURE 3-3

KEY COMPONENTS OF ALTERNATIVE 1
CAP SOILS/SEDIMENT, RESTORE DAM

PRE-DESIGN AND DESIGN STEPS
- Conduct sampling and immunoassay screening analysis to better define work areas with >1 µg/kg dioxin
- Finalize design drawings and specifications for restoration of Allendale Dam
- Define extent of sediments and soils containing >1µg/kg dioxin within the dam restoration work

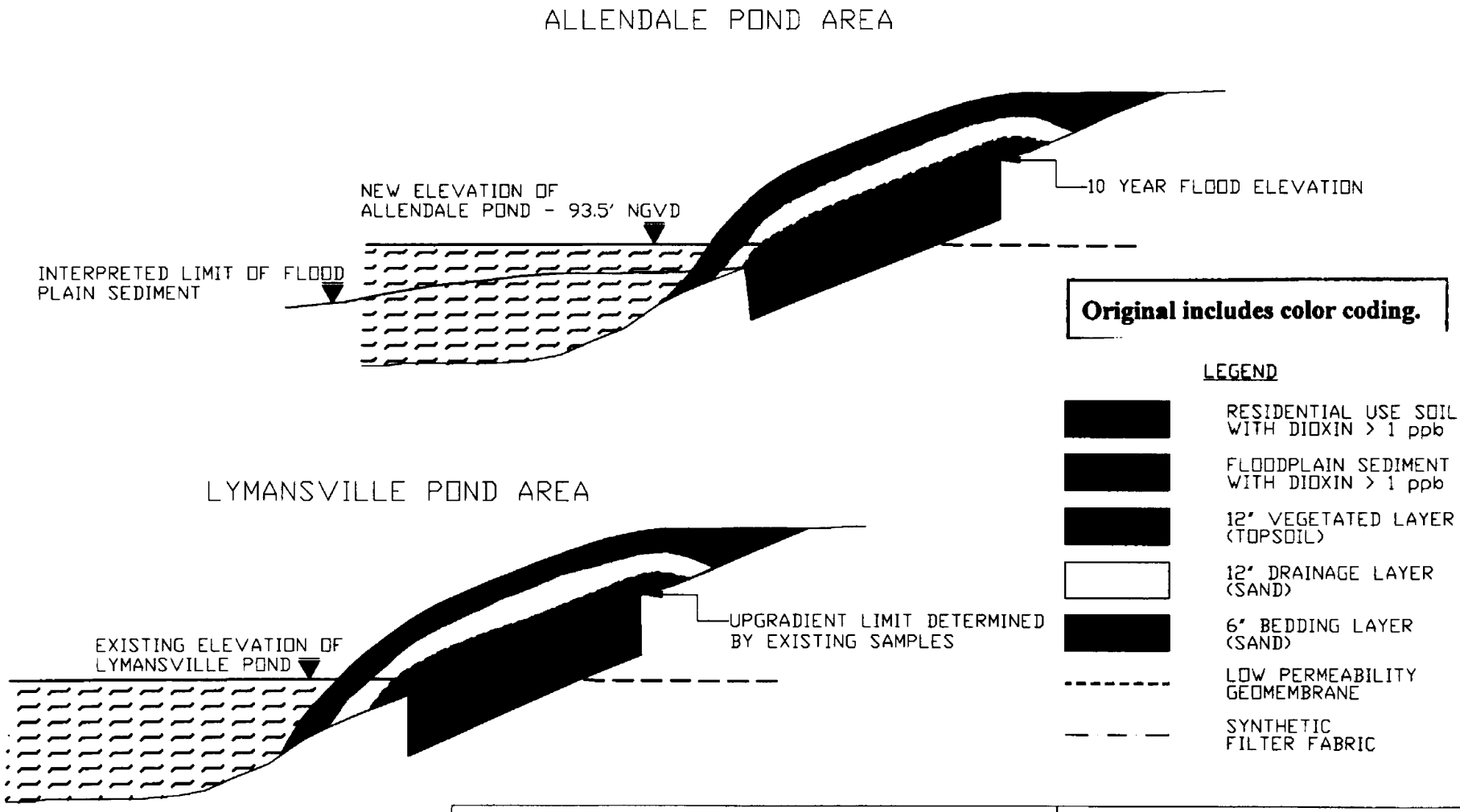
SITE PREPARATION
- Clear and grub appropriate work areas and access points
- Dismantle fence around work areas
- Improve route to work areas as needed
- Establish erosion and sediment controls

RESTORE ALLENDALE DAM
- Excavate soil and sediment from dam work area as necessary
- Restore dam according to drawings and specifications
- Install flow control structure
- Improve Allendale raceway gate
- Remove trees from berm area
- Restore work area
- Dispose of excavated material

EXCAVATION / SITE WORK
- Cap impacted residential use soils and sediments from 92.5' to 96' (approx. 17,500 ft^2)
- Slope edges of cap to meet existing ground contours

SITE RESTORATION
- Hydroseed capped areas
- Grade and hydroseed disturbed areas

POST-REMOVAL SITE CONTROL MEASURES
- Inspect and repair cap, erosion controls, and slope reinforcements quarterly for 30 years



CONCEPTUAL CROSS-SECTION OF SITE - ALTERNATIVE 1

CENTERDALE MANOR

PROVIDENCE, RHODE ISLAND

DRAWN BY:	B. FENNELLY	REV.:	0
CHECKED BY:	D.W. MACDOUGALL	DATE:	JULY 12, 2000
SCALE:	NOT TO SCALE	FILE NO.:	DWG\0553\0910\FIG_3-4.DWG

FIGURE 3-4

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 3-5, SOIL AND SEDIMENT AREAS
IN ALLENDALE POND DEFINED FOR
REMOVAL ACTION ALTERNATIVES 2 AND 4.

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

FIGURE 3-6

KEY COMPONENTS OF ALTERNATIVE 2
CAP SOILS/SEDIMENT

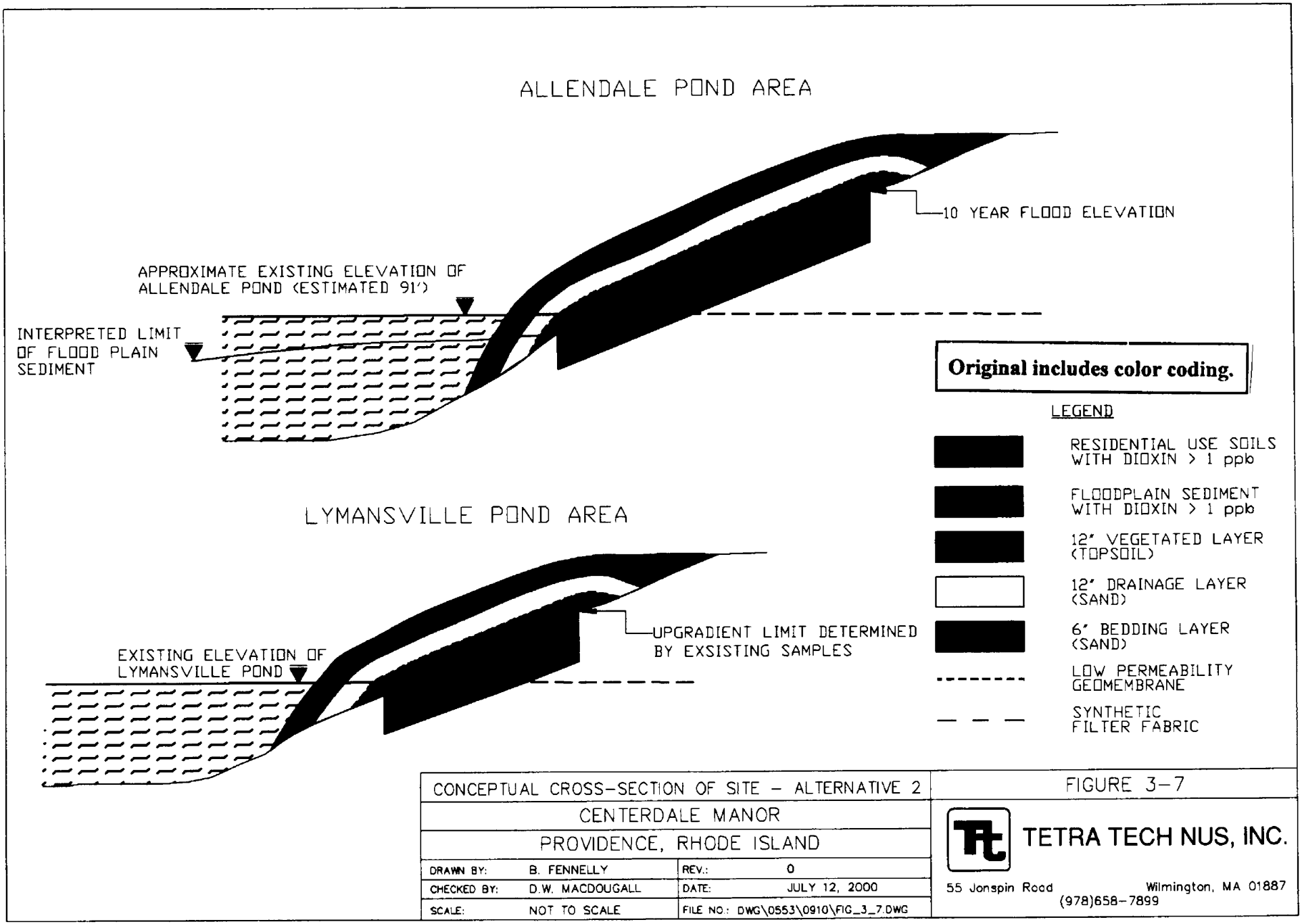
PRE-DESIGN AND DESIGN STEPS
- Conduct sampling and immunoassay screening analysis to better define work areas with >1 µg/kg dioxin

SITE RESTORATION
- Hydroseed capped areas
- Grade and hydroseed disturbed areas

SITE PREPARATION
- Clear and grub appropriate work areas and access points
- Dismantle fence around work areas
- Improve route to work areas as needed
- Establish erosion and sediment controls

POST-REMOVAL SITE CONTROL MEASURES
- Inspect and repair cap, erosion controls, and slope reinforcements quarterly for 30 years

EXCAVATION / SITE WORK
- Cap impacted residential use soils and sediments from 90' to 96' (approx. 257,500 ft^2 or 6 acres)
- Slope edges of cap to meet existing ground contours



CONCEPTUAL CROSS-SECTION OF SITE - ALTERNATIVE 2

CENTERDALE MANOR

PROVIDENCE, RHODE ISLAND

FIGURE 3-7

DRAWN BY:	B. FENNELLY	REV.:	0
CHECKED BY:	D.W. MACDOUGALL	DATE:	JULY 12, 2000
SCALE:	NOT TO SCALE	FILE NO.:	DWG\0553\0910\FIG_3_7.DWG

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899

FIGURE 3-8

KEY COMPONENTS OF ALTERNATIVE 3
EXCAVATE SOILS/SEDIMENTS, RESTORE DAM

PRE-DESIGN AND DESIGN STEPS
- Conduct sampling and immunoassay screening analysis to better define work areas with >1 µg/kg dioxin
- Finalize design drawings and specifications for restoration of Allendale Dam
- Define extent of sediments and soils containing >1 µg/kg dioxin within the dam restoration work area

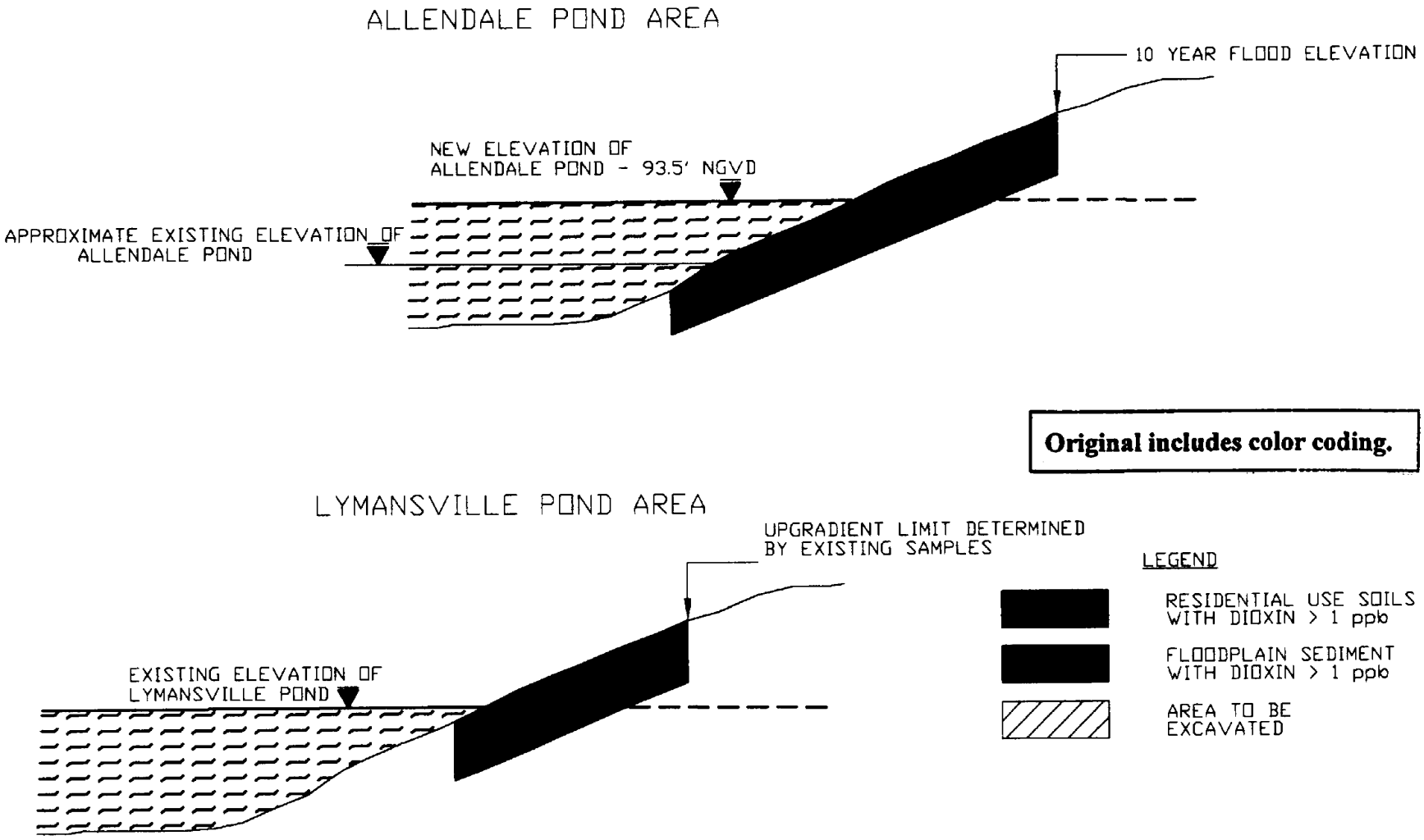
SITE PREPARATION
- Clear and grub appropriate work areas and access points
- Dismantle fence around work areas
- Improve route to work areas as needed
- Establish erosion and sediment controls

RESTORE ALLENDALE DAM
- Excavate soil and sediment from dam work area as necessary
- Restore dam according to drawings and specifications
- Install flow control structure
- Improve raceway gate
- Remove trees from berm area
- Restore work area
- Transport and disposal of excavated material found to be contaminated

EXCAVATION / SITE WORK
- Excavate impacted residential use soils and sediments from 92.5' to 96' using a combination of efforts including hand-labor and heavy equipment (approx. 17,500 ft^2 and 1,300 yd^3)
- Backfill and compact excavated areas
- Transport and disposal of excavated material

SITE RESTORATION
- Grade and hydroseed disturbed areas
- Replace damaged or lost fencing, gardens, etc.

POST-REMOVAL SITE CONTROL MEASURES
- Inspect and repair backfilled areas, erosion controls, and slope reinforcements annually for 30 years



CONCEPTUAL CROSS-SECTION OF SITE - ALTERNATIVE 3			FIGURE 3-9
CENTERDALE MANOR			
PROVIDENCE, RHODE ISLAND			
DRAWN BY:	B. FENNELLY	REV.:	0
CHECKED BY:	D.W. MACDOUGALL	DATE:	JULY 12, 2000
SCALE:	NOT TO SCALE	FILE NO.:	DWG\0553\0910\FIG_3_9.DWG

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FIGURE 3-10

KEY COMPONENTS OF ALTERNATIVE 4
EXCAVATE SOILS/SEDIMENT

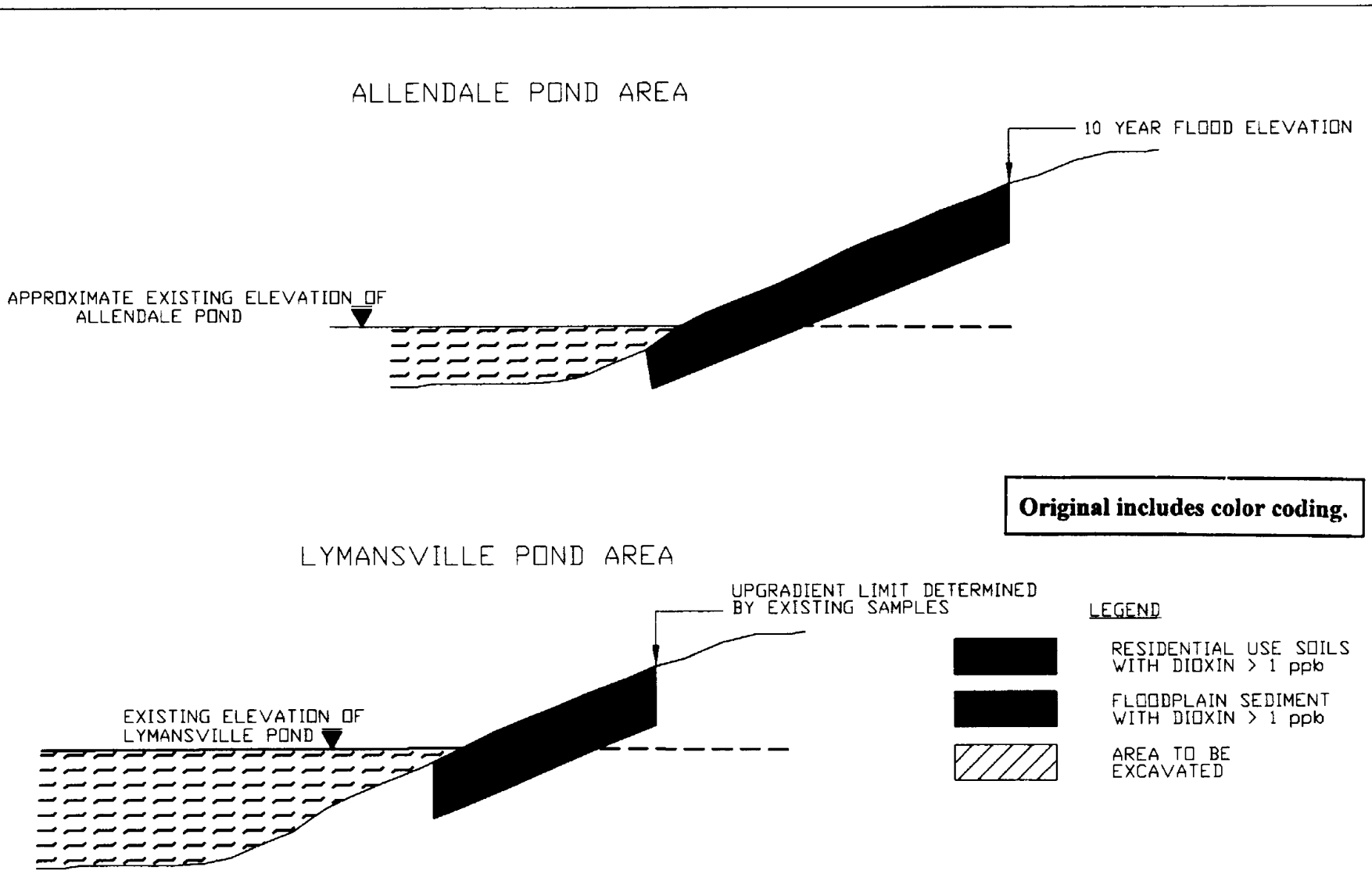
PRE-DESIGN AND DESIGN STEPS
- Conduct sampling and immunoassay screening analysis to better define work areas with >1 µg/kg dioxin
- Define extent of sediments and soils containing >1 µg/kg dioxin within the dam restoration work area

SITE PREPARATION
- Clear and grub appropriate work areas and access points
- Dismantle fence around work areas
- Improve route to work areas as needed
- Establish erosion and sediment controls

EXCAVATION / SITE WORK
- Excavate impacted residential use soils and sediments from 90' to 96' using a combination of efforts including hand-labor and heavy equipment (approx. 6 acres and 19,075 yd^3)
- Backfill and compact excavated areas

SITE RESTORATION
- Grade and hydroseed disturbed areas

POST-REMOVAL SITE CONTROL MEASURES
- Inspect and repair backfilled areas, erosion controls, and slope reinforcements annually for 30 years



CONCEPTUAL CROSS-SECTION OF SITE – ALTERNATIVE 4			FIGURE 3-11
CENTERDALE MANOR			
PROVIDENCE, RHODE ISLAND			
DRAWN BY:	B. FENNELLY	REV.:	0
CHECKED BY:	D.W. MACDOUGALL	DATE:	JULY 12, 2000
SCALE:	NOT TO SCALE	FILE NO.:	DWG\0553\0910\FIG_3-11.DWG

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APPENDIX A

SAMPLE GROUPS AND STATISTICAL SUMMARIES

Appendix A-1

Residential Soil Sample Groups and

Statistical Summaries

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Allendale 01	CMS-193	CMS-193-A-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	CMS-193	3428-CMS-193	RES	Sediment/Soil	A	0	0.25
RES, Allendale 01	CMS-202	CMS-202-A	RES	Sediment/Soil	A	0	1
RES, Allendale 01	CMS-202	3428-CMS-202	RES	Sediment/Soil	A	0	0.25
RES, Allendale 01	CMS-205	CMS-205-A	RES	Sediment/Soil	A	0	1
RES, Allendale 01	CMS-205	3428-CMS-205	RES	Sediment/Soil	A	0	0.25
RES, Allendale 01	CMS-206	3428-CMS-206	RES	Sediment/Soil	A	0	0.25
RES, Allendale 01	CMS-206	CMS-206-A	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-239-01	RES-SS-12-239-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-240-01	RES-SS-12-240-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-550-01	RES-SS-12-550-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-551-01	RES-SS-12-551-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-552-01	RES-SS-12-552-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-553-01	RES-SS-12-553-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-554-01	RES-SS-12-554-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-555-01	RES-SS-12-555-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-556-01	RES-SS-12-556-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-12-560-01	RES-SS-12-560-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-210-01	RES-SS-14-210-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-271-01	RES-SS-14-271-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-271-01A	RES-SS-14-271-01A	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-272-01	RES-SS-14-272-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-302-01	RES-SS-14-302-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-303-01	RES-SS-14-303-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-333-01	RES-SS-14-333-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-334-01	RES-SS-14-334-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-365-01	RES-SS-14-365-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-366-01	RES-SS-14-366-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-398-01	RES-SS-14-398-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-399-01	RES-SS-14-399-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-419-01	RES-SS-14-419-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-420-01	RES-SS-14-420-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-421-01	RES-SS-14-421-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-422-01	RES-SS-14-422-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-424-01	RES-SS-14-424-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-425-01	RES-SS-14-425-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-430-01	RES-SS-14-430-01-MAX	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-448-01	RES-SS-14-448-01	RES	Sediment/Soil	A	0	1
RES, Allendale 01	RES-14-449-01	RES-SS-14-449-01	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res Allendale, 01	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	15	15	941	941	31.8	J	4420	J&	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	15	15	279	279	15.6		684	J	RES-14-449-01
Res Allendale, 01	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	14	15	15.8	16.9	0.68	EMPC	44.7	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	13	15	17.9	20.4	1.4	J	74.5	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	12	15	36.1	44.9	6		172	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	13	15	50.2	57.8	5.3	J	199	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	14	15	24.5	26.2	2.1	J	70.4	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	15	15	51.9	51.9	2.7	J	238	J	RES-14-303-01
Res Allendale, 01	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	7	15	1.1	1.5	0.42	EMPC	3.8	EMPC	RES-14-449-01
Res Allendale, 01	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	11	15	14.6	19.5	1	J	54.8		RES-12-240-01
Res Allendale, 01	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	12	15	18.7	23.3	0.83	EMPC	116		RES-12-555-01
Res Allendale, 01	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	13	13	450	450	3.14	J	1852.8		RES-12-240-01
Res Allendale, 01	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	15	15	29.6	29.6	2.3	J	73.1	J	RES-14-303-01
Res Allendale, 01	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	13	15	18.4	21	2.8	J	62.5	J	RES-14-303-01
Res Allendale, 01	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	23	23	3260	3260	8.5		15050		RES-12-240-01
Res Allendale, 01	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	14	15	42.1	44.9	4.7	J	111	J	RES-14-448-01
Res Allendale, 01	DIOXI	OCDD	3268879	NG/KG	15	15	5710	5710	126	J	29200	J&	RES-14-303-01
Res Allendale, 01	DIOXI	OCDF	39001020	NG/KG	15	15	320	320	11.2	J	866	J	RES-14-333-01
Res Allendale, 01	DIOXI	PCDD/Fs	GTI500081	NG/KG	15	15	13000	13000	466		47000		RES-14-303-01
Res Allendale, 01	DIOXI	Total HpCDD	37871004	NG/KG	15	15	1680	1680	61.8	J	7030	J&	RES-14-303-01
Res Allendale, 01	DIOXI	Total HpCDF	38998753	NG/KG	15	15	564	564	35.2	J	1340	J	RES-14-448-01
Res Allendale, 01	DIOXI	Total HxCDD	34465468	NG/KG	12	15	408	506	70.9	J	1710	J	RES-14-303-01
Res Allendale, 01	DIOXI	Total HxCDF	55684941	NG/KG	15	15	489	489	33.9	J	1370	J	RES-14-303-01
Res Allendale, 01	DIOXI	Total PeCDD	36088229	NG/KG	15	15	103	103	10	EMPC	332		RES-12-240-01
Res Allendale, 01	DIOXI	Total PeCDF	30402154	NG/KG	15	15	418	418	30	J	1510		RES-12-240-01
Res Allendale, 01	DIOXI	Total TCDD	41903575	NG/KG	15	15	2750	2750	16.5	J	15650		RES-12-240-01
Res Allendale, 01	DIOXI	Total TCDF	55722275	NG/KG	14	14	606	606	40.4	J	2130		RES-12-240-01
Res Allendale, 01	DIOXI	Toxicity Equivalency	TEQ	NG/KG	23	23	3300	3300	18		15200		RES-12-240-01
Res Allendale, 01	M	Aluminum	7429905	MG/KG	30	30	9010	9010	2160		19100		RES-14-425-01
Res Allendale, 01	M	Antimony	7440360	MG/KG	9	30	2.8	6.2	1.7	J	13.7	J	RES-14-419-01
Res Allendale, 01	M	Arsenic	7440382	MG/KG	29	30	6.1	6.3	1.9		14.7	J	RES-14-449-01
Res Allendale, 01	M	Barium	7440393	MG/KG	30	30	129	129	25.6		320	J	RES-14-449-01
Res Allendale, 01	M	Beryllium	7440417	MG/KG	13	29	0.64	1.2	0.36		2.9	J	RES-14-448-01
Res Allendale, 01	M	Cadmium	7440439	MG/KG	13	29	1.1	2.2	0.49	J	7.9		RES-14-303-01
Res Allendale, 01	M	Calcium	7440702	MG/KG	30	30	3040	3040	841	J	14700		RES-14-302-01
Res Allendale, 01	M	Chromium	7440473	MG/KG	30	30	126	126	5.4		536	J	RES-14-449-01
Res Allendale, 01	M	Cobalt	7440484	MG/KG	30	30	6.6	6.6	1.9		20.4		RES-14-271-01
Res Allendale, 01	M	Copper	7440508	MG/KG	30	30	126	126	8.2		419	J	RES-14-449-01
Res Allendale, 01	M	Iron	7439896	MG/KG	30	30	18200	18200	6160		52400	J	RES-14-333-01
Res Allendale, 01	M	Lead	7439921	MG/KG	30	30	343	343	35.2		946		RES-14-303-01
Res Allendale, 01	M	Magnesium	7439954	MG/KG	30	30	2530	2530	886	J	10100		RES-14-271-01
Res Allendale, 01	M	Manganese	7439965	MG/KG	30	30	332	332	90.5		1250	J	RES-14-333-01
Res Allendale, 01	M	Mercury	7439976	MG/KG	11	28	0.31	0.64	0.05	J	2.2	J	RES-14-449-01
Res Allendale, 01	M	Nickel	7440020	MG/KG	30	30	21.3	21.3	4.9		71.6		RES-12-240-01
Res Allendale, 01	M	Potassium	7440097	MG/KG	30	30	880	880	324		4380		RES-14-271-01
Res Allendale, 01	M	Selenium	7782492	MG/KG	12	28	1.6	2.6	0.58	J	4.7		RES-12-240-01
Res Allendale, 01	M	Silver	7440224	MG/KG	17	30	1.2	1.9	0.47	J	6.4	J	RES-14-449-01
Res Allendale, 01	M	Sodium	7440235	MG/KG	24	30	220	265	94.8		845	J	RES-14-333-01
Res Allendale, 01	M	Thallium	7440280	MG/KG	2	28	1.4	4.6	2.4	J	6.8	J	RES-14-333-01
Res Allendale, 01	M	Vanadium	7440622	MG/KG	30	30	33.5	33.5	8.7		79.3		RES-12-551-01
Res Allendale, 01	M	Zinc	7440666	MG/KG	30	30	232	232	38.5		826	J	RES-14-448-01
Res Allendale, 01	OS	Acenaphthene	83329	UG/KG	3	27	1800	780	330	J	1200	J	RES-14-366-01
Res Allendale, 01	OS	Acenaphthylene	208968	UG/KG	3	28	1800	270	170	J	430	J	RES-14-449-01
Res Allendale, 01	OS	Anthracene	120127	UG/KG	16	29	1000	510	68	J	1800	J	RES-14-334-01
Res Allendale, 01	OS	BAPEQ	BAPEQ	UG/KG	28	32	2400	2700	64		14000		RES-14-334-01
Res Allendale, 01	OS	Benzaldehyde	100527	UG/KG	3	27	1700	370	150	J	780		RES-14-272-01
Res Allendale, 01	OS	Benzo(a)anthracene	56553	UG/KG	27	30	1500	1700	280	J	8400		RES-14-334-01
Res Allendale, 01	OS	Benzo(a)pyrene	50328	UG/KG	28	30	1800	1900	64	J	9200		RES-14-334-01
Res Allendale, 01	OS	Benzo(b)fluoranthene	205992	UG/KG	27	30	2100	2300	380	J	9500		RES-14-334-01
Res Allendale, 01	OS	Benzo(g,h,i)perylene	191242	UG/KG	25	30	1500	1600	160	J	7000		RES-14-334-01
Res Allendale, 01	OS	Benzo(k)fluoranthene	207089	UG/KG	27	30	2100	2300	380	J	9200		RES-14-334-01
Res Allendale, 01	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	12	30	2300	2300	160	J	10000		RES-14-303-01
Res Allendale, 01	OS	Butylbenzylphthalate	85687	UG/KG	3	28	1800	360	140	J	510	J	RES-14-449-01
Res Allendale, 01	OS	Carbazole	86748	UG/KG	6	28	1700	830	77	J	1800	J	RES-14-334-01
Res Allendale, 01	OS	Chrysene	218019	UG/KG	28	30	2200	2300	72	J	11000		RES-14-334-01
Res Allendale, 01	OS	Di-n-Butylphthalate	84742	UG/KG	2	27	1900	320	37	J	610	EB	RES-14-366-01
Res Allendale, 01	OS	Di-n-octylphthalate	117840	UG/KG	1	28	1900	800	800	J	800	J	RES-14-303-01
Res Allendale, 01	OS	Dibenzo(a,h)anthracene	53703	UG/KG	10	29	1600	930	77	J	2600	J	RES-14-334-01
Res Allendale, 01	OS	Dibenzofuran	132649	UG/KG	1	27	1800	640	640	J	640	J	RES-14-366-01

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res Allendale, 01	OS	Fluoranthene	206440	UG/KG	29	30	3700	3800	51	J	20000		RES-14-334-01
Res Allendale, 01	OS	Fluorene	86737	UG/KG	3	27	1800	690	350	J	930	J	RES-14-366-01
Res Allendale, 01	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	29	32	18000	20000	110		100000		RES-14-334-01
Res Allendale, 01	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	24	30	1500	1600	200	J	6800		RES-14-334-01
Res Allendale, 01	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	25	32	2500	2800	330		16000		RES-14-366-01
Res Allendale, 01	OS	Pentachlorophenol	87865	UG/KG	1	28	5200	18000	18000	J	18000	J	RES-14-333-01
Res Allendale, 01	OS	Phenanthrene	85018	UG/KG	25	29	2200	2300	280	J	12000		RES-14-366-01
Res Allendale, 01	OS	Pyrene	129000	UG/KG	29	30	3400	3400	55	J	16000		RES-14-334-01, RES-14-366-01
Res Allendale, 01	OS	Total PAH	TOTPAH	UG/KG	29	33	20000	22000	110		110000		RES-14-334-01
Res Allendale, 01	PESTP	4,4'-DDD	72548	UG/KG	8	27	7	11	4.4		23	J	RES-14-334-01
Res Allendale, 01	PESTP	4,4'-DDE	72559	UG/KG	19	28	110	160	3.6	J	1100		RES-14-303-01
Res Allendale, 01	PESTP	4,4'-DDT	50293	UG/KG	15	28	56	98	4.3		1300		RES-12-556-01
Res Allendale, 01	PESTP	alpha-Chlordane	5103719	UG/KG	18	29	13	18	3.2		62		RES-14-398-01
Res Allendale, 01	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	26	30	2600	3000	60		48000		RES-14-303-01
Res Allendale, 01	PESTP	Aroclor-1242	53469219	UG/KG	2	28	430	5600	190	J	11000		RES-14-303-01
Res Allendale, 01	PESTP	Aroclor-1254	11097691	UG/KG	26	30	2200	2600	60		37000	*	RES-14-303-01
Res Allendale, 01	PESTP	Aroclor-1260	11096825	UG/KG	2	27	52	70	30	J	110		RES-14-302-01
Res Allendale, 01	PESTP	Dieldrin	60571	UG/KG	3	27	8.3	34	6.3		81		RES-12-240-01
Res Allendale, 01	PESTP	Endosulfan II	33213659	UG/KG	12	29	180	430	25		3400	*	RES-14-303-01
Res Allendale, 01	PESTP	Endosulfan Sulfate	1031078	UG/KG	1	27	5	6.4	6.4		6.4		RES-12-240-01
Res Allendale, 01	PESTP	Endrin Ketone	53494705	UG/KG	3	28	7	23	15		34		RES-14-334-01
Res Allendale, 01	PESTP	gamma-Chlordane	5103742	UG/KG	19	29	24	36	2.5		260		RES-14-303-01
Res Allendale, 01	PESTP	Heptachlor	76448	UG/KG	2	27	2.7	3.2	2.1		4.4		RES-12-551-01
Res Allendale, 01	PESTP	Heptachlor Epoxide	1024573	UG/KG	1	27	2.7	6.3	6.3		6.3		RES-12-240-01
Res Allendale, 01	PESTP	Methoxychlor	72435	UG/KG	2	27	26	30	26		35	J	RES-12-551-01

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Allendale 02	RES-12-240-02	RES-SS-12-240-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-12-556-02	RES-SS-12-556-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-12-560-02	RES-SS-12-560-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-210-02	RES-SS-14-210-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-303-02	RES-SS-14-303-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-333-02	RES-SS-14-333-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-365-02	RES-SS-14-365-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-366-02	RES-SS-14-366-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-399-02	RES-SS-14-399-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-422-02	RES-SS-14-422-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-424-02	RES-SS-14-424-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-425-02	RES-SS-14-425-02	RES	Sediment/Soil	A	0	1
RES, Allendale 02	RES-14-449-02	RES-SS-14-449-02	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res Allendale, 02	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	11	12	812	885	21.7	J	2410	J$	RES-14-366-02
Res Allendale, 02	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	12	12	183	183	7.7		523	J	RES-14-449-02
Res Allendale, 02	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	12	12	10.2	10.2	1	J	29.3	J	RES-14-366-02, RES-14-449-02
Res Allendale, 02	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	11	12	17.9	19.5	1.7	J	56	J	RES-12-240-02
Res Allendale, 02	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	10	12	27.1	32.2	4.2	J	73.6	J	RES-14-449-02
Res Allendale, 02	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	11	12	44.9	48.9	4.8	J	116	J	RES-12-240-02
Res Allendale, 02	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	11	12	18.8	20.4	2.1	J	54.2	J	RES-14-449-02
Res Allendale, 02	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	11	12	50.6	55.1	4	J	157	J	RES-12-240-02
Res Allendale, 02	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	4	12	1	1.8	0.23	J	3.4	J	RES-14-449-02
Res Allendale, 02	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	10	12	15.4	18.4	0.44	EMPC	63	J	RES-12-240-02
Res Allendale, 02	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	9	12	9.3	12.3	0.83	EMPC	38.1	EMPC	RES-14-449-02
Res Allendale, 02	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	9	9	405	405	1.54	J	922	J	RES-14-449-02
Res Allendale, 02	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	12	12	23.5	23.5	2.4	J	51.5	J	RES-14-449-02
Res Allendale, 02	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	10	12	15.2	18	2.9	J	40.8	J	RES-14-449-02
Res Allendale, 02	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	12	12	2910	2910	3	EB	10590	JEB$	RES-12-240-02
Res Allendale, 02	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	9	12	36.7	48.2	4.7		110	J	RES-14-449-02
Res Allendale, 02	DIOXI	OCDD	3268879	NG/KG	12	12	3940	3940	88.2	J	15940	J$EB	RES-14-366-02
Res Allendale, 02	DIOXI	OCDF	39001020	NG/KG	12	12	224	224	9	J	930	J	RES-14-366-02
Res Allendale, 02	DIOXI	PCDD/Fs	GT1500081	NG/KG	12	12	10900	10900	218		30200		RES-14-366-02
Res Allendale, 02	DIOXI	Total HpCDD	37871004	NG/KG	10	12	1470	1760	120	J	4390	J$	RES-14-366-02
Res Allendale, 02	DIOXI	Total HpCDF	38998753	NG/KG	11	12	365	398	17.6	J	1010	J	RES-14-366-02
Res Allendale, 02	DIOXI	Total HxCDD	34465468	NG/KG	11	12	366	397	17.3	EMPC	1080	J	RES-12-240-02
Res Allendale, 02	DIOXI	Total HxCDF	55684941	NG/KG	12	12	427	427	20	EMPC	959	J	RES-14-449-02
Res Allendale, 02	DIOXI	Total PeCDD	36088229	NG/KG	12	12	89.8	89.8	12.1	EMPC	359	J	RES-12-240-02
Res Allendale, 02	DIOXI	Total PeCDF	30402154	NG/KG	11	11	469	469	28.3	J	1190	J	RES-12-240-02
Res Allendale, 02	DIOXI	Total TCDD	41903575	NG/KG	12	12	2940	2940	12.2	EMPC	10650	J$	RES-12-240-02
Res Allendale, 02	DIOXI	Total TCDF	55722275	NG/KG	12	12	670	670	24.3	J	2070	J	RES-12-240-02
Res Allendale, 02	DIOXI	Toxicity Equivalency	TEQ	NG/KG	12	12	2970	2970	9.7		10700		RES-12-240-02
Res Allendale, 02	M	Aluminum	7429905	MG/KG	1	1	6540	6540	6540		6540		RES-12-560-02
Res Allendale, 02	M	Arsenic	7440382	MG/KG	1	1	10.9	10.9	10.9		10.9		RES-12-560-02
Res Allendale, 02	M	Barium	7440393	MG/KG	1	1	85.9	85.9	85.9		85.9		RES-12-560-02
Res Allendale, 02	M	Calcium	7440702	MG/KG	1	1	6810	6810	6810		6810		RES-12-560-02
Res Allendale, 02	M	Chromium	7440473	MG/KG	1	1	12	12	12		12		RES-12-560-02
Res Allendale, 02	M	Cobalt	7440484	MG/KG	1	1	5.4	5.4	5.4		5.4		RES-12-560-02
Res Allendale, 02	M	Copper	7440508	MG/KG	1	1	41.4	41.4	41.4		41.4		RES-12-560-02
Res Allendale, 02	M	Iron	7439896	MG/KG	1	1	16500	16500	16500		16500		RES-12-560-02
Res Allendale, 02	M	Lead	7439921	MG/KG	1	1	192	192	192		192		RES-12-560-02
Res Allendale, 02	M	Magnesium	7439954	MG/KG	1	1	2170	2170	2170		2170		RES-12-560-02
Res Allendale, 02	M	Manganese	7439965	MG/KG	1	1	277	277	277		277		RES-12-560-02
Res Allendale, 02	M	Nickel	7440020	MG/KG	1	1	14	14	14		14		RES-12-560-02
Res Allendale, 02	M	Potassium	7440097	MG/KG	1	1	591	591	591		591		RES-12-560-02
Res Allendale, 02	M	Sodium	7440235	MG/KG	1	1	159	159	159		159		RES-12-560-02
Res Allendale, 02	M	Vanadium	7440622	MG/KG	1	1	34.1	34.1	34.1		34.1		RES-12-560-02
Res Allendale, 02	M	Zinc	7440666	MG/KG	1	1	163	163	163		163		RES-12-560-02
Res Allendale, 02	OS	Acenaphthene	83329	UG/KG	1	1	240	240	240	J	240	J	RES-12-560-02
Res Allendale, 02	OS	Anthracene	120127	UG/KG	1	1	630	630	630	J	630	J	RES-12-560-02
Res Allendale, 02	OS	BAPEQ	BAPEQ	UG/KG	1	1	2500	2500	2500		2500		RES-12-560-02
Res Allendale, 02	OS	Benzo(a)anthracene	56553	UG/KG	1	1	2300	2300	2300		2300		RES-12-560-02
Res Allendale, 02	OS	Benzo(a)pyrene	50328	UG/KG	1	1	2000	2000	2000	J	2000	J	RES-12-560-02
Res Allendale, 02	OS	Benzo(b)fluoranthene	205992	UG/KG	1	1	1800	1800	1800	J	1800	J	RES-12-560-02
Res Allendale, 02	OS	Benzo(g,h,i)perylene	191242	UG/KG	1	1	1300	1300	1300	J	1300	J	RES-12-560-02
Res Allendale, 02	OS	Benzo(k)fluoranthene	207089	UG/KG	1	1	2300	2300	2300		2300		RES-12-560-02
Res Allendale, 02	OS	Carbazole	86748	UG/KG	1	1	320	320	320	J	320	J	RES-12-560-02
Res Allendale, 02	OS	Chrysene	218019	UG/KG	1	1	2300	2300	2300		2300		RES-12-560-02
Res Allendale, 02	OS	Fluoranthene	206440	UG/KG	1	1	5000	5000	5000		5000		RES-12-560-02
Res Allendale, 02	OS	Fluorene	86737	UG/KG	1	1	250	250	250	J	250	J	RES-12-560-02
Res Allendale, 02	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	1	1	23000	23000	23000		23000		RES-12-560-02
Res Allendale, 02	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	1	1	1100	1100	1100	J	1100	J	RES-12-560-02
Res Allendale, 02	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	1	1	4700	4700	4700		4700		RES-12-560-02
Res Allendale, 02	OS	Phenanthrene	85018	UG/KG	1	1	3600	3600	3600		3600		RES-12-560-02
Res Allendale, 02	OS	Pyrene	129000	UG/KG	1	1	4900	4900	4900		4900		RES-12-560-02
Res Allendale, 02	OS	Total PAH	TOTPAH	UG/KG	1	1	28000	28000	28000		28000		RES-12-560-02
Res Allendale, 02	PESTP	4,4'-DDE	72559	UG/KG	1	1	5.4	5.4	5.4		5.4		RES-12-560-02
Res Allendale, 02	PESTP	4,4'-DDT	50293	UG/KG	1	1	5.3	5.3	5.3		5.3		RES-12-560-02

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Allendale 03	RES-14-210-03	RES-SS-14-210-03	RES	Sediment/Soil	A	0	1
RES, Allendale 03	RES-14-333-03	RES-SS-14-333-03	RES	Sediment/Soil	A	0	1
RES, Allendale 03	RES-14-365-03	RES-SS-14-365-03	RES	Sediment/Soil	A	0	1
RES, Allendale 03	RES-14-366-03	RES-SS-14-366-03	RES	Sediment/Soil	A	0	1
RES, Allendale 03	RES-14-425-03	RES-SS-14-425-03	RES	Sediment/Soil	A	0	1
RES, Allendale 03	RES-14-449-03	RES-SS-14-449-03-MAX	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res Allendale, 03	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	6	6	996	996	19.4	J	5300		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	6	6	116	116	9.7	J	521		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	3	6	9.3	18.1	2.4	JEB	45.5		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	3	6	22.4	44.2	2.4	J	123		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	4	6	28.5	41.8	5.7		117		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	3	6	49.2	97	8.1		262		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	5	6	15	17.9	3.4	J	60.3		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	2	6	58.3	172	7.9		337		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	2	6	1.1	3	0.77	J	5.2		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	3	6	33.6	66.8	2.1	J	181		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	3	6	9.2	17.3	6.5	EMPC	30.3		RES-14-449-03
Res Allendale, 03	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	3	3	1830	1830	1.47	J	5150		RES-14-449-03
Res Allendale, 03	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	5	6	22.2	26.5	4.7	J	90.8		RES-14-449-03
Res Allendale, 03	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	3	6	21.7	41.4	3.5	J	97.8		RES-14-449-03
Res Allendale, 03	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	6	6	9960	9960	4.1	J	57310		RES-14-449-03
Res Allendale, 03	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	4	6	54.7	81.5	4.4		300		RES-14-449-03
Res Allendale, 03	DIOXI	OCDD	3268879	NG/KG	6	6	4980	4980	122	J	25020		RES-14-449-03
Res Allendale, 03	DIOXI	OCDF	39001020	NG/KG	6	6	112	112	9	J	433		RES-14-449-03
Res Allendale, 03	DIOXI	PCDD/Fs	GTI500081	NG/KG	6	6	20600	20600	431		111000		RES-14-449-03
Res Allendale, 03	DIOXI	Total HpCDD	37871004	NG/KG	6	6	1840	1840	38.7	J	9750		RES-14-449-03
Res Allendale, 03	DIOXI	Total HpCDF	38998753	NG/KG	6	6	286	286	17.9	J	1350		RES-14-449-03
Res Allendale, 03	DIOXI	Total HxCDD	34465468	NG/KG	4	6	449	667	25.9	EMPC	2290		RES-14-449-03
Res Allendale, 03	DIOXI	Total HxCDF	55684941	NG/KG	5	6	393	469	48.8	J	1730		RES-14-449-03
Res Allendale, 03	DIOXI	Total PeCDD	36088229	NG/KG	6	6	218	218	11.1	J	1090		RES-14-449-03
Res Allendale, 03	DIOXI	Total PeCDF	30402154	NG/KG	5	6	642	769	54.3	J	2840		RES-14-449-03
Res Allendale, 03	DIOXI	Total TCDD	41903575	NG/KG	6	6	10400	10400	8.9	EMPC	59560		RES-14-449-03
Res Allendale, 03	DIOXI	Total TCDF	55722775	NG/KG	6	6	1360	1360	36.2	J	6810		RES-14-449-03
Res Allendale, 03	DIOXI	Toxicity Equivalency	TEQ	NG/KG	6	6	10000	10000	8.1		57700		RES-14-449-03

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Lymansville 01	RES-10-004-01	RES-SS-10-004-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-005-01	RES-SS-10-005-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-042-01	RES-SS-10-042-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-044-01	RES-SS-10-044-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-053-01	RES-SS-10-053-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-068-01	RES-SS-10-068-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-074-01	RES-SS-10-074-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-075-01	RES-SS-10-075-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-076-01	RES-SS-10-076-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-10-604-01	RES-SS-10-604-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-011-01	RES-SS-11-011-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-012-01	RES-SS-11-012-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-328-01	RES-SS-11-328-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-396-01	RES-SS-11-396-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-419-01	RES-SS-11-419-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-420-01	RES-SS-11-420-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-422-01	RES-SS-11-422-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-423-01	RES-SS-11-423-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-424-01	RES-SS-11-424-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-425-01	RES-SS-11-425-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-426-01	RES-SS-11-426-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-427-01	RES-SS-11-427-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-428-01	RES-SS-11-428-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-429-01	RES-SS-11-429-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-430-01	RES-SS-11-430-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-430-01	RES-SS-11-430-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-431-01	RES-SS-11-431-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-432-01	RES-SS-11-432-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-433-01	RES-SS-11-433-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-486-01	RES-SS-11-486-01-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-497-01	RES-SS-11-497-01	RES	Sediment/Soil	A	0	1
RES, Lymansville 01	RES-11-577-01	RES-SS-11-577-01-MAX	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res, Lymansville 01	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	28	31	227	251	5.2		2520	$	RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	26	31	149	177	0.96	EMPC	2920	$	RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	21	31	27	39.5	0.36	EMPC	694		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	23	31	8.2	11	0.44	JEB	167		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	22	31	73.8	104	0.6	EMPC	1720	EB$	RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	22	31	16.6	23.1	0.94	EMPC	284		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	25	31	35.2	43.5	0.22	EMPC	797		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	22	31	27.4	38.2	0.63	EMPC	580		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	5	30	2.3	11.7	0.26	EMPC	51.8		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	20	31	6.3	9.5	0.36	J	112		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	24	31	13.8	17.7	0.28	EMPC	239		RES-11-433-01
Res, Lymansville 01	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	24	24	52.2	52.2	0.66	J	407.35		RES-10-044-01
Res, Lymansville 01	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	26	31	52.7	62.7	0.43	JEB	1260		RES-11-433-01
Res, Lymansville 01	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	21	31	34	49.9	0.5	EMPC	745		RES-11-433-01
Res, Lymansville 01	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	31	31	180	180	0.26	JEB	1490		RES-11-425-01
Res, Lymansville 01	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	21	31	52.1	76.5	1.7	EB	811	$	RES-11-433-01
Res, Lymansville 01	DIOXI	OCDD	3268879	NG/KG	30	31	1150	1190	39.7		9780	&	RES-11-396-01
Res, Lymansville 01	DIOXI	OCDF	39001020	NG/KG	29	31	156	167	1.7	JEB	2240	J	RES-11-433-01
Res, Lymansville 01	DIOXI	PCDD/Fs	GT1500081	NG/KG	31	31	3550	3550	22.7		37700		RES-11-433-01
Res, Lymansville 01	DIOXI	Total HpCDD	37871004	NG/KG	29	31	446	476	8.1	EMPC	4760	J$	RES-11-433-01
Res, Lymansville 01	DIOXI	Total HpCDF	38998753	NG/KG	27	31	270	310	0.96	EMPC	4540	J$	RES-11-433-01
Res, Lymansville 01	DIOXI	Total HxCDD	34465468	NG/KG	25	31	185	226	4.2	EMPC	3360	J$	RES-11-433-01
Res, Lymansville 01	DIOXI	Total HxCDF	55684941	NG/KG	29	31	286	305	2.6	EMPC	4950	J$	RES-11-433-01
Res, Lymansville 01	DIOXI	Total PeCDD	36088229	NG/KG	28	31	121	134	2	EMPC	2620	J	RES-11-433-01
Res, Lymansville 01	DIOXI	Total PeCDF	30402154	NG/KG	29	31	398	425	0.99	EMPC	7370	J	RES-11-433-01
Res, Lymansville 01	DIOXI	Total TCDD	41903575	NG/KG	29	31	249	266	0.78	EMPC	1490		RES-11-425-01
Res, Lymansville 01	DIOXI	Total TCDF	55722275	NG/KG	29	30	299	309	1.4	EMPC	3220	J$	RES-11-433-01
Res, Lymansville 01	DIOXI	Toxicity Equivalency	TEQ	NG/KG	31	31	236	236	0.96		1500		RES-11-425-01
Res, Lymansville 01	M	Aluminum	7429905	MG/KG	31	31	13600	13600	2430		213000		RES-10-076-01
Res, Lymansville 01	M	Antimony	7440360	MG/KG	12	31	3.3	7.5	1.6	J	38.2	J	RES-10-042-01
Res, Lymansville 01	M	Arsenic	7440382	MG/KG	30	31	7.9	8.1	1.7	J	55.6		RES-10-042-01
Res, Lymansville 01	M	Barium	7440393	MG/KG	31	31	126	126	16.9		874		RES-10-075-01
Res, Lymansville 01	M	Beryllium	7440417	MG/KG	11	30	0.36	0.67	0.39		0.94		RES-10-044-01
Res, Lymansville 01	M	Cadmium	7440439	MG/KG	13	30	0.83	1.8	0.32	J	5.2		RES-11-433-01
Res, Lymansville 01	M	Calcium	7440702	MG/KG	28	31	6220	6830	714		48700		RES-11-429-01
Res, Lymansville 01	M	Chromium	7440473	MG/KG	31	31	44.2	44.2	1.8		404		RES-11-486-01
Res, Lymansville 01	M	Cobalt	7440484	MG/KG	30	31	4.7	4.9	1.8		21.7		RES-10-042-01
Res, Lymansville 01	M	Copper	7440508	MG/KG	30	31	962	994	10		25500		RES-11-433-01
Res, Lymansville 01	M	Iron	7439896	MG/KG	31	31	18200	18200	4440		89700		RES-10-076-01
Res, Lymansville 01	M	Lead	7439921	MG/KG	31	31	390	390	8.1		2460		RES-11-012-01
Res, Lymansville 01	M	Magnesium	7439954	MG/KG	31	31	1660	1660	752		4260		RES-11-429-01
Res, Lymansville 01	M	Manganese	7439965	MG/KG	31	31	328	328	61		2880		RES-10-076-01
Res, Lymansville 01	M	Mercury	7439976	MG/KG	13	30	0.34	0.66	0.09		3		RES-10-044-01
Res, Lymansville 01	M	Nickel	7440020	MG/KG	31	31	17.5	17.5	3.2		64.6		RES-11-433-01
Res, Lymansville 01	M	Potassium	7440097	MG/KG	31	31	617	617	313		2530		RES-10-042-01
Res, Lymansville 01	M	Selenium	7782492	MG/KG	4	30	0.8	1.3	0.63	J	1.9		RES-11-577-01
Res, Lymansville 01	M	Silver	7440224	MG/KG	9	31	0.95	2.6	0.26	J	5.7	J	RES-11-012-01
Res, Lymansville 01	M	Sodium	7440235	MG/KG	16	31	244	417	112		2010		RES-10-042-01
Res, Lymansville 01	M	Vanadium	7440622	MG/KG	31	31	19.3	19.3	4.1		51.2		RES-10-044-01
Res, Lymansville 01	M	Zinc	7440666	MG/KG	31	31	330	330	17.9		1730		RES-10-075-01
Res, Lymansville 01	OS	1,1'-Biphenyl	92524	UG/KG	1	30	3000	120	120	J	120	J	RES-10-042-01
Res, Lymansville 01	OS	2-Methylnaphthalene	91576	UG/KG	2	30	2900	570	44	J	1100		RES-10-075-01
Res, Lymansville 01	OS	Acenaphthene	83329	UG/KG	3	30	1600	4700	80	J	14000	J	RES-11-424-01
Res, Lymansville 01	OS	Acenaphthylene	208968	UG/KG	3	30	2900	1200	160	J	3100		RES-10-075-01
Res, Lymansville 01	OS	Anthracene	120127	UG/KG	15	30	2000	3100	17	J	40000	J	RES-11-424-01
Res, Lymansville 01	OS	BAPEQ	BAPEQ	UG/KG	27	31	7300	8400	7		170000		RES-11-424-01
Res, Lymansville 01	OS	Benzaldehyde	100527	UG/KG	8	31	2800	380	52	J	800	J	RES-11-396-01
Res, Lymansville 01	OS	Benzo(a)anthracene	56553	UG/KG	24	31	5800	7200	30	J	140000		RES-11-424-01
Res, Lymansville 01	OS	Benzo(a)pyrene	50328	UG/KG	21	31	5100	7100	62	J	110000	J	RES-11-424-01
Res, Lymansville 01	OS	Benzo(b)fluoranthene	205992	UG/KG	26	31	5400	6300	38	J	120000		RES-11-424-01
Res, Lymansville 01	OS	Benzo(g,h,i)perylene	191242	UG/KG	13	31	3300	6400	71	J	58000	J	RES-11-424-01
Res, Lymansville 01	OS	Benzo(k)fluoranthene	207089	UG/KG	26	31	4800	5600	36	J	100000	J	RES-11-424-01
Res, Lymansville 01	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	18	31	3100	930	49	JEB	4200		RES-10-044-01
Res, Lymansville 01	OS	Butylbenzylphthalate	85687	UG/KG	1	30	3000	620	620	J	620	J	RES-11-012-01
Res, Lymansville 01	OS	Carbazole	86748	UG/KG	6	30	2000	5700	110	J	26000	J	RES-11-424-01
Res, Lymansville 01	OS	Chrysene	218019	UG/KG	26	31	6700	7800	42	J	150000		RES-11-424-01
Res, Lymansville 01	OS	Di-n-Butylphthalate	84742	UG/KG	4	31	2900	59	46	JEB	93	JEB	RES-11-012-01
Res, Lymansville 01	OS	Dibenzo(a,h)anthracene	53703	UG/KG	6	31	1900	5600	130	J	26000	J	RES-11-424-01
Res, Lymansville 01	OS	Dibenzofuran	132649	UG/KG	4	30	2900	1700	77	J	5200		RES-10-075-01

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res, Lymansville 01	OS	Fluoranthene	206440	UG/KG	27	31	13000	15000	72	J	300000	J	RES-11-424-01
Res, Lymansville 01	OS	Fluorene	86737	UG/KG	7	30	1500	3400	59	J	16000	J	RES-11-424-01
Res, Lymansville 01	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	29	32	56000	61000	280		1300000		RES-11-424-01
Res, Lymansville 01	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	14	31	3200	5900	56	J	56000	J	RES-11-424-01
Res, Lymansville 01	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	20	31	12000	18000	91		250000		RES-11-424-01
Res, Lymansville 01	OS	Naphthalene	91203	UG/KG	3	30	2900	850	65	J	2300		RES-10-075-01
Res, Lymansville 01	OS	Phenanthrene	85018	UG/KG	20	31	9100	14000	72	J	180000	J	RES-11-424-01
Res, Lymansville 01	OS	Pyrene	129000	UG/KG	27	31	12000	14000	57	J	280000	J	RES-11-424-01
Res, Lymansville 01	OS	Total PAH	TOTPAH	UG/KG	29	32	69000	76000	280		1600000		RES-11-424-01
Res, Lymansville 01	PESTP	4,4'-DDD	72548	UG/KG	5	30	4.5	14	5.9		38		RES-11-328-01
Res, Lymansville 01	PESTP	4,4'-DDE	72559	UG/KG	13	30	10	20	4.6		56		RES-11-486-01
Res, Lymansville 01	PESTP	4,4'-DDT	50293	UG/KG	13	30	6.3	11	2.9	J	27		RES-11-012-01
Res, Lymansville 01	PESTP	Aldrin	309002	UG/KG	1	30	1.5	3.4	3.4	P	3.4	P	RES-11-012-01
Res, Lymansville 01	PESTP	alpha-Chlordane	5103719	UG/KG	16	31	5.5	9.4	1.6	J	26		RES-11-486-01
Res, Lymansville 01	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	11	30	92	160	30		380		RES-10-044-01
Res, Lymansville 01	PESTP	Aroclor-1242	53469219	UG/KG	1	30	31	140	140		140		RES-11-328-01
Res, Lymansville 01	PESTP	Aroclor-1254	11097691	UG/KG	11	30	66	130	30	J	350		RES-11-396-01
Res, Lymansville 01	PESTP	Aroclor-1260	11096825	UG/KG	1	30	30	140	140		140		RES-10-044-01
Res, Lymansville 01	PESTP	Dieldrin	60571	UG/KG	1	30	3.1	15	15		15		RES-11-328-01
Res, Lymansville 01	PESTP	Endosulfan II	33213659	UG/KG	2	30	3.4	13	12		14		RES-11-577-01
Res, Lymansville 01	PESTP	Endosulfan Sulfate	1031078	UG/KG	2	30	3.7	17	16		18		RES-11-424-01
Res, Lymansville 01	PESTP	Endrin Ketone	53494705	UG/KG	4	30	7.8	40	16		62		RES-10-075-01
Res, Lymansville 01	PESTP	gamma-Chlordane	5103742	UG/KG	14	31	3.5	6.2	2.4		18	J	RES-11-433-01
Res, Lymansville 01	PESTP	Heptachlor Epoxide	1024573	UG/KG	4	30	2.8	10	3		26		RES-11-012-01

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Lymansville 02	RES-10-004-02	RES-SS-10-004-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-005-02	RES-SS-10-005-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-042-02	RES-SS-10-042-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-044-02	RES-SS-10-044-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-053-02	RES-SS-10-053-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-068-02	RES-SS-10-068-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-074-02	RES-SS-10-074-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-075-02	RES-SS-10-075-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-076-02	RES-SS-10-076-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-10-604-02	RES-SS-10-604-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-011-02	RES-SS-11-011-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-012-02	RES-SS-11-012-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-328-02	RES-SS-11-328-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-396-02	RES-SS-11-396-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-419-02	RES-SS-11-419-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-420-02	RES-SS-11-420-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-422-02	RES-SS-11-422-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-423-02	RES-SS-11-423-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-424-02	RES-SS-11-424-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-425-02	RES-SS-11-425-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-426-02	RES-SS-11-426-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-427-02	RES-SS-11-427-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-428-02	RES-SS-11-428-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-429-02	RES-SS-11-429-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-430-02	RES-SS-11-430-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-431-02	RES-SS-11-431-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-432-02	RES-SS-11-432-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-433-02	RES-SS-11-433-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-486-02	RES-SS-11-486-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-497-02	RES-SS-11-497-02	RES	Sediment/Soil	A	0	1
RES, Lymansville 02	RES-11-577-02	RES-SS-11-577-02	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Res, Lymansville 02	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	28	31	49.6	54.5	4	J	455	J	RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	26	31	24.1	28.4	3.7	EMPC	305		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	18	31	2.7	4.2	0.64	EMPC	43.7		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	19	31	1.5	2.3	0.42	J	15		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	16	31	9.8	18	1.7	J	138	EB	RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	17	31	3.1	4.8	0.42	EMPC	28.6		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	17	31	4.4	7.5	0.63	JEB	42.5		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	18	31	4	6.4	0.85	EMPC	45.2		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	8	29	0.5	1.2	0.34	EMPC	3.8	J	RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	16	31	1.3	2.1	0.43	EMPC	7.4		RES-11-433-02
Res, Lymansville 02	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	18	31	2.9	4.7	0.36	EMPC	24.9	EMPC	RES-10-074-02
Res, Lymansville 02	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	12	12	21.5	21.5	0.59	J	184.05	J	RES-11-419-02
Res, Lymansville 02	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	25	31	8.2	10.1	0.53	JEB	83.4		RES-11-424-02
Res, Lymansville 02	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	17	31	4.3	7.4	0.64	J	31.4		RES-11-433-02
Res, Lymansville 02	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	31	31	21.2	21.2	0.32	JEB	144		RES-11-419-02
Res, Lymansville 02	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	20	31	9.4	13.8	0.73	EMPC	65.7		RES-10-074-02
Res, Lymansville 02	DIOXI	OCDD	3268879	NG/KG	30	31	367	379	41.4		2560	JEB	RES-11-433-02
Res, Lymansville 02	DIOXI	OCDF	39001020	NG/KG	31	31	24.4	24.4	1.3	EMPC	237	J	RES-11-433-02
Res, Lymansville 02	DIOXI	PCDD/Fs	GTI500081	NG/KG	31	31	867	867	13.5		5920		RES-11-433-02
Res, Lymansville 02	DIOXI	Total HpCDD	37871004	NG/KG	24	31	100	125	16.2	J	857	J	RES-11-433-02
Res, Lymansville 02	DIOXI	Total HpCDF	38998753	NG/KG	25	31	44.7	54.4	2.4	EMPC	532	J	RES-11-433-02
Res, Lymansville 02	DIOXI	Total HxCDD	34465468	NG/KG	24	30	37.6	44.4	3	J	350	J	RES-11-433-02
Res, Lymansville 02	DIOXI	Total HxCDF	55684941	NG/KG	22	31	84.5	117	7.9	EMPC	1180	J	RES-11-424-02
Res, Lymansville 02	DIOXI	Total PeCDD	36088229	NG/KG	26	31	23.7	27.9	0.83	EMPC	207	J	RES-11-577-02
Res, Lymansville 02	DIOXI	Total PeCDF	30402154	NG/KG	28	31	90	99	1.5	EMPC	1270	J	RES-11-424-02
Res, Lymansville 02	DIOXI	Total TCDD	41903575	NG/KG	27	31	37.2	42.3	1.4	EMPC	187	J	RES-11-577-02
Res, Lymansville 02	DIOXI	Total TCDF	55722275	NG/KG	26	29	72.6	80.6	1.2	EMPC	382	J	RES-11-424-02
Res, Lymansville 02	DIOXI	Toxicity Equivalency	TEQ	NG/KG	31	31	29.7	29.7	0.81		148		RES-11-419-02

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
RES, Lymansville 03	RES-10-004-03	RES-SS-10-004-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-005-03	RES-SS-10-005-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-042-03	RES-SS-10-042-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-044-03	RES-SS-10-044-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-053-03	RES-SS-10-053-03-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-068-03	RES-SS-10-068-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-074-03	RES-SS-10-074-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-075-03	RES-SS-10-075-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-076-03	RES-SS-10-076-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-10-604-03	RES-SS-10-604-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-011-03	RES-SS-11-011-03-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-012-03	RES-SS-11-012-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-328-03	RES-SS-11-328-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-396-03	RES-SS-11-396-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-419-03	RES-SS-11-419-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-420-03	RES-SS-11-420-03-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-422-03	RES-SS-11-422-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-423-03	RES-SS-11-423-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-424-03	RES-SS-11-424-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-425-03	RES-SS-11-425-03-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-426-03	RES-SS-11-426-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-427-03	RES-SS-11-427-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-428-03	RES-SS-11-428-03-MAX	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-430-03	RES-SS-11-430-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-431-03	RES-SS-11-431-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-432-03	RES-SS-11-432-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-433-03	RES-SS-11-433-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-486-03	RES-SS-11-486-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-497-03	RES-SS-11-497-03	RES	Sediment/Soil	A	0	1
RES, Lymansville 03	RES-11-577-03	RES-SS-11-577-03	RES	Sediment/Soil	A	0	1

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
RES, Lymansville 03	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	26	30	36.2	41	2.5		212	EB	RES-11-433-03
RES, Lymansville 03	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	25	30	14.4	16.9	1.2	EMPC	100		RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	11	30	1.6	3.7	0.6	JEB	13.8	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	13	30	0.94	1.8	0.41	EMPC	5.8		RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	17	30	6.1	10	0.71	EMPC	65.1		RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	15	30	2	3.6	0.78	J	15.1		RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	21	29	2.7	3.6	0.32	EMPC	29.8	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	14	30	2.4	4.6	0.88	JEB	20.3	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	4	30	0.42	1.6	0.69	JEB	2.9	JEB	RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	10	30	0.89	2	0.38	J	9		RES-11-486-03
RES, Lymansville 03	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	18	30	1.7	2.7	0.51		9.1	EMPC	RES-10-074-03
RES, Lymansville 03	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	23	30	4.3	5.6	0.72	JEB	44.8	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	19	30	3.1	4.6	0.42	EMPC	37.2	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	25	30	3.8	4.4	0.31	EMPC	24.1		RES-11-424-03
RES, Lymansville 03	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	20	30	7.6	10.7	0.7	EMPC	87.1	EB	RES-11-486-03
RES, Lymansville 03	DIOXI	OCDD	3268879	NG/KG	29	30	287	297	19.1		1190	J	RES-11-433-03
RES, Lymansville 03	DIOXI	OCDF	39001020	NG/KG	30	30	16.8	16.8	1.5	JEB	72.9	JEB	RES-11-433-03
RES, Lymansville 03	DIOXI	PCDD/Fs	GTI500081	NG/KG	30	30	592	592	20.5		3150		RES-11-486-03
RES, Lymansville 03	DIOXI	Total HpCDD	37871004	NG/KG	26	30	72.9	81.1	6.8		416	JEB	RES-11-433-03
RES, Lymansville 03	DIOXI	Total HpCDF	38998753	NG/KG	26	30	28.3	32.2	1.8	EMPC	184	J	RES-11-486-03
RES, Lymansville 03	DIOXI	Total HxCDD	34465468	NG/KG	25	30	30	34.9	2		315	J	RES-11-486-03
RES, Lymansville 03	DIOXI	Total HxCDF	55684941	NG/KG	27	30	37.4	41	1.7	EMPC	388	JEB	RES-11-486-03
RES, Lymansville 03	DIOXI	Total PeCDD	36088229	NG/KG	28	30	18.5	19.8	0.95	EMPC	214	J	RES-11-486-03
RES, Lymansville 03	DIOXI	Total PeCDF	30402154	NG/KG	29	29	43	43	1.7	EMPC	519	JEB	RES-11-486-03
RES, Lymansville 03	DIOXI	Total TCDD	41903575	NG/KG	27	30	17.7	19.5	0.96		220	JEB	RES-11-486-03
RES, Lymansville 03	DIOXI	Total TCDF	55722275	NG/KG	26	29	48.2	53.4	0.7	EMPC	582	JEB	RES-11-486-03
RES, Lymansville 03	DIOXI	Toxicity Equivalency	TEQ	NG/KG	30	30	9.5	9.5	0.81		66.5		RES-11-486-03

Appendix A-2

Flood Plain Sediment Sample Groups and

Statistical Summaries

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Flood Plain Surface Allendale	APB-FP-2028	APB-FP-2028-000.5-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	APB-FP-2030	APB-SD-2030-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	APB-FP-2031	APB-FP-2031-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	APB-FP-2032	APB-FP-2032-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	APB-FP-2033	APB-FP-2033-000.5-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	CMS-023	3428-CMS-023	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-023	CMS-023-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-024	3428-CMS-024	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-024	CMS-024-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-025	CMS-025-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-025	3428-CMS-025	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-073	3428-CMS-073	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-078	3428-CMS-078-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-079	3428-CMS-079	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-084	3428-CMS-084-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-085	3428-CMS-085	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-091	3428-CMS-091	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-099	3428-CMS-099	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-100	3428-CMS-100	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-107	3428-CMS-107	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-108	3428-CMS-108	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-114	3428-CMS-114-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-115	3428-CMS-115	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-116	3428-CMS-116	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-121	3428-CMS-121	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-123	3428-CMS-123	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-123	CMS-123-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-130	3428-CMS-130	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-136	3428-CMS-136	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-137	3428-CMS-137	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-143	3428-CMS-143	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-144	3428-CMS-144	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-151	3428-CMS-151	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-159	3428-CMS-159	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-159	CMS-159-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-174	3428-CMS-174	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-178	3428-CMS-178-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-179	3428-CMS-179	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-180	3428-CMS-180	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-181	3428-CMS-181	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-182	CMS-182-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-182	3428-CMS-182-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-183	3428-CMS-183	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-184	3428-CMS-184	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-185	3428-CMS-185	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-186	CMS-186-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-186	3428-CMS-186	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-187	3428-CMS-187	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-187	CMS-187-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-188	CMS-188-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-188	3428-CMS-188	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-189	3428-CMS-189	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-191	3428-CMS-191-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-191	CMS-191-A-MAX	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-192	CMS-192-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-192	3428-CMS-192	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-195	CMS-195-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-195	3428-CMS-195	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-196	CMS-196-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-196	3428-CMS-196	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-197	3428-CMS-197	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-200	3428-CMS-200	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-200	CMS-200-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-201	3428-CMS-201	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-203	3428-CMS-203	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-203	CMS-203-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-204	CMS-204-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-204	3428-CMS-204-MAX	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-226	3428-CMS-226	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-227	3428-CMS-227	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-228	3428-CMS-228	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-229	3428-CMS-229	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-230	3428-CMS-230	FP	Sediment/Soil	A	0	0.25
Flood Plain Surface Allendale	CMS-434	CMS-434-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-435	CMS-435-A-MAX	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-436	CMS-436-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-437	CMS-437-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-438	CMS-438-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-439	CMS-439-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-440	CMS-440-A	FP	Sediment/Soil	A	0	1

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Flood Plain Surface Allendale	CMS-441	CMS-441-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-442	CMS-442-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-443	CMS-443-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-444	CMS-444-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-445	CMS-445-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-456	CMS-456-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMS-472	CMS-472-A	FP	Sediment/Soil	A	0	1
Flood Plain Surface Allendale	CMW-FP-2026	CMW-FP-2026-000.5-01-MAX	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	CMW-FP-2027	CMW-FP-2027-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	CMW-SD-2017	CMW-SD-2017-01-MAX	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	CMW-SD-2021	CMW-SD-2021-01	FP	Sediment/Soil	A	0	0.5
Flood Plain Surface Allendale	CMW-SD-2022	CMW-SD-2022-0.502-01	FP	Sediment/Soil	A	0.5	2

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Floodplain, Surf Allendale	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	7	7	1130	1130	380		2140	$	CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	7	7	277	277	106		397		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	7	7	16.2	16.2	6		23.7		CMS-472
Floodplain, Surf Allendale	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	7	7	18	18	7.4		30.8		CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	7	7	33.1	33.1	6.7		56		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	7	7	56.8	56.8	21.1		104		CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	7	7	23.7	23.7	5.7		37.5		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	7	7	50.4	50.4	23.1		91.3		CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	6	7	21.9	25.5	4.45		46.3	J	APB-FP-2033
Floodplain, Surf Allendale	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	7	7	14.2	14.2	5.3		22.8		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	7	7	22.6	22.6	6.7		50.5	EMPC	CMW-FP-2027
Floodplain, Surf Allendale	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	5	5	1850	1850	17.46	J	6341.4	J$	CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	2	7	10	33	28.6		37.5		CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	7	7	17.4	17.4	2.4		26.8	J	APB-FP-2033
Floodplain, Surf Allendale	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	84	88	3690	3870	0.988		52000	J	CMS-023
Floodplain, Surf Allendale	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	7	7	30.8	30.8	3.7		60.5	J	APB-FP-2033
Floodplain, Surf Allendale	DIOXI	OCDD	3268879	NG/KG	7	7	7540	7540	2560	EB	13200	J	CMS-472
Floodplain, Surf Allendale	DIOXI	OCDF	39001020	NG/KG	7	7	520	520	163	EB	990		CMS-472
Floodplain, Surf Allendale	DIOXI	PCDD/Fs	GTI500081	NG/KG	7	7	16900	16900	5090		29300		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	Total HpCDD	37871004	NG/KG	7	7	2160	2160	768	J	3640	J	CMS-472
Floodplain, Surf Allendale	DIOXI	Total HpCDF	38998753	NG/KG	7	7	641	641	244		913	J	CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	Total HxCDD	34465468	NG/KG	7	7	407	407	158		644	J	CMW-SD-2021
Floodplain, Surf Allendale	DIOXI	Total HxCDF	55684941	NG/KG	7	7	534	534	129		850		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	Total PeCDD	36088229	NG/KG	7	7	85.3	85.3	20.2		170		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	Total PeCDF	30402154	NG/KG	7	7	391	391	51.6		697	J	APB-FP-2033
Floodplain, Surf Allendale	DIOXI	Total TCDD	41903575	NG/KG	7	7	4260	4260	5		16890		CMW-FP-2026
Floodplain, Surf Allendale	DIOXI	Total TCDF	55722275	NG/KG	7	7	404	404	23.4		912	J	APB-FP-2033
Floodplain, Surf Allendale	DIOXI	Toxicity Equivalency	TEQ	NG/KG	88	88	3700	3700	0.99		52000		CMS-023
Floodplain, Surf Allendale	HERB	Dalapon	75990	UG/KG	1	3	65	66	66		66		CMS-456
Floodplain, Surf Allendale	M	Aluminum	7429905	MG/KG	13	13	9630	9630	3210		15400		APB-FP-2033
Floodplain, Surf Allendale	M	Antimony	7440360	MG/KG	9	13	2.1	2.9	0.83	J	6.3	J	APB-FP-2028
Floodplain, Surf Allendale	M	Arsenic	7440382	MG/KG	13	13	6.5	6.5	1.8		18	J	CMS-192
Floodplain, Surf Allendale	M	Barium	7440393	MG/KG	13	13	158	158	34.4	J	301		CMS-192
Floodplain, Surf Allendale	M	Beryllium	7440417	MG/KG	11	13	1.6	1.8	0.41	J	3.3		APB-FP-2031
Floodplain, Surf Allendale	M	Cadmium	7440439	MG/KG	9	12	1.7	2.3	0.51		4.9		APB-FP-2033
Floodplain, Surf Allendale	M	Calcium	7440702	MG/KG	13	13	1820	1820	666	J	4690	J	CMS-159
Floodplain, Surf Allendale	M	Chromium	7440473	MG/KG	13	13	161	161	16.4		472		CMS-192
Floodplain, Surf Allendale	M	Cobalt	7440484	MG/KG	13	13	6.1	6.1	2.4	J	10.1		APB-FP-2033
Floodplain, Surf Allendale	M	Copper	7440508	MG/KG	13	13	150	150	21.7		260		CMS-159
Floodplain, Surf Allendale	M	Cyanide	57125	MG/KG	1	3	1.2	2.4	2.4		2.4		CMS-192
Floodplain, Surf Allendale	M	Iron	7439896	MG/KG	13	13	20800	20800	4960		51300		CMS-159
Floodplain, Surf Allendale	M	Lead	7439921	MG/KG	13	13	484	484	138		1090		APB-FP-2033
Floodplain, Surf Allendale	M	Magnesium	7439954	MG/KG	13	13	2140	2140	701	J	4820	J	APB-FP-2033
Floodplain, Surf Allendale	M	Manganese	7439965	MG/KG	13	13	420	420	52.1		1700	J	CMS-456
Floodplain, Surf Allendale	M	Mercury	7439976	MG/KG	13	13	0.69	0.69	0.18		2	J	CMS-159
Floodplain, Surf Allendale	M	Molybdenum	7439987	MG/KG	3	3	5.3	5.3	1.9	J	8.2	J	CMS-192
Floodplain, Surf Allendale	M	Nickel	7440020	MG/KG	13	13	30.4	30.4	3.7		66.4		APB-FP-2031
Floodplain, Surf Allendale	M	Potassium	7440097	MG/KG	13	13	824	824	369	J	1340	J	APB-FP-2033
Floodplain, Surf Allendale	M	Selenium	7782492	MG/KG	2	13	2.5	3.8	2.8	J	4.9	J	CMS-159
Floodplain, Surf Allendale	M	Silver	7440224	MG/KG	11	13	4.8	5.6	0.6	J	8.4		CMW-FP-2026
Floodplain, Surf Allendale	M	Sodium	7440235	MG/KG	8	13	164	230	34.4	J	352	J	CMS-159
Floodplain, Surf Allendale	M	Thallium	7440280	MG/KG	1	13	61.2	0.6	0.6	J	0.6	J	APB-FP-2030
Floodplain, Surf Allendale	M	Vanadium	7440622	MG/KG	13	13	42.2	42.2	10.3		93.8		CMW-FP-2026
Floodplain, Surf Allendale	M	Zinc	7440666	MG/KG	13	13	381	381	154		828		CMS-159
Floodplain, Surf Allendale	OS	2,4,5-Trichlorophenol	95954	UG/KG	1	13	3700	170	170	J	170	J	CMS-456
Floodplain, Surf Allendale	OS	2-Methylnaphthalene	91576	UG/KG	1	13	1600	80	80	J	80	J	CMS-456
Floodplain, Surf Allendale	OS	2-Nitrophenol	88755	UG/KG	1	13	1800	5000	5000		5000		CMW-FP-2026
Floodplain, Surf Allendale	OS	Acenaphthene	83329	UG/KG	1	13	1600	160	160	J	160	J	CMS-456
Floodplain, Surf Allendale	OS	Acenaphthylene	208968	UG/KG	3	13	1600	670	280	J	970	J	CMS-192
Floodplain, Surf Allendale	OS	Anthracene	120127	UG/KG	5	13	1500	370	180		510		CMS-456
Floodplain, Surf Allendale	OS	BAPEQ	BAPEQ	UG/KG	13	13	2000	2000	65		3900		APB-FP-2030
Floodplain, Surf Allendale	OS	Benzo(a)anthracene	56553	UG/KG	12	13	1500	1400	370	J	2400	J	APB-FP-2030
Floodplain, Surf Allendale	OS	Benzo(a)pyrene	50328	UG/KG	12	13	1600	1500	380	J	2600	J	APB-FP-2030
Floodplain, Surf Allendale	OS	Benzo(b)fluoranthene	205992	UG/KG	11	13	1500	1600	520	J	3300		CMS-456
Floodplain, Surf Allendale	OS	Benzo(g,h,i)perylene	191242	UG/KG	7	13	1700	1300	950		1700	J	CMW-SD-2021
Floodplain, Surf Allendale	OS	Benzo(k)fluoranthene	207089	UG/KG	12	13	1800	1900	450	J	5000	J	CMS-192
Floodplain, Surf Allendale	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	4	13	3200	6100	770	J	20000		CMS-159
Floodplain, Surf Allendale	OS	Butylbenzylphthalate	85687	UG/KG	4	13	1300	460	240		660	J	CMW-SD-2021
Floodplain, Surf Allendale	OS	Carbazole	86748	UG/KG	3	13	1500	320	270	J	360	J	CMS-456

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Floodplain, Surf Allendale	OS	Chrysene	218019	UG/KG	13	13	1900	1900	540	J	3600	J	APB-FP-2030
Floodplain, Surf Allendale	OS	Di-n-Butylphthalate	84742	UG/KG	2	13	1500	120	120		130	J	CMS-456
Floodplain, Surf Allendale	OS	Dibenzo(a,h)anthracene	53703	UG/KG	6	13	1300	530	320	J	840	J	CMW-SD-2021
Floodplain, Surf Allendale	OS	Dibenzofuran	132649	UG/KG	1	13	1600	200	200	J	200	J	CMS-456
Floodplain, Surf Allendale	OS	Fluoranthene	206440	UG/KG	13	13	3100	3100	840	J	5800		APB-FP-2030
Floodplain, Surf Allendale	OS	Fluorene	86737	UG/KG	4	13	1400	230	200	J	270	J	CMS-456
Floodplain, Surf Allendale	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	13	13	16000	16000	3400		28000		APB-FP-2030
Floodplain, Surf Allendale	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	12	13	1100	1000	320	J	1700	J	APB-FP-2030
Floodplain, Surf Allendale	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	12	13	2000	1900	350		4200		CMS-456
Floodplain, Surf Allendale	OS	Phenanthrene	85018	UG/KG	12	13	1600	1500	350	J	2900	J	APB-FP-2030, CMS-456
Floodplain, Surf Allendale	OS	Pyrene	129000	UG/KG	13	13	2900	2900	630	J	5000		CMW-SD-2022
Floodplain, Surf Allendale	OS	Total PAH	TOTPAH	UG/KG	13	13	17000	17000	3400		31000		APB-FP-2030
Floodplain, Surf Allendale	OS	Total Semi-Volatile Organics	GTI500035	UG/KG	3	3	33000	33000	27000		43000	J	CMS-159
Floodplain, Surf Allendale	OV	1,2,4-Trichlorobenzene	120821	UG/KG	1	3	8	2	1.8	J	1.8	J	CMS-456
Floodplain, Surf Allendale	OV	Chlorobenzene	108907	UG/KG	1	3	9	3	3.1	J	3.1	J	CMS-456
Floodplain, Surf Allendale	OV	cis-1,2-Dichloroethene	156592	UG/KG	1	3	8	7	7.3	J	7.3	J	CMS-159
Floodplain, Surf Allendale	OV	Tetrachloroethene	127184	UG/KG	1	3	39	100	100		100		CMS-159
Floodplain, Surf Allendale	OV	Toluene	108883	UG/KG	1	3	8	2	2.2	J	2.2	J	CMS-456
Floodplain, Surf Allendale	OV	Total Volatile Organics	GTI500034	UG/KG	3	3	58	58	7.1		120		CMS-159
Floodplain, Surf Allendale	OV	Trichloroethene	79016	UG/KG	1	3	8	8	7.7	J	7.7	J	CMS-159
Floodplain, Surf Allendale	PESTP	4,4'-DDD	72548	UG/KG	2	11	2.9	5.6	5.6	J	5.6	J	APB-FP-2032, CMW-FP-2027
Floodplain, Surf Allendale	PESTP	4,4'-DDE	72559	UG/KG	4	13	6	11	5.2		18	J	CMS-192
Floodplain, Surf Allendale	PESTP	4,4'-DDT	50293	UG/KG	1	11	2.6	4.7	4.7		4.7		CMW-SD-2021
Floodplain, Surf Allendale	PESTP	alpha-Chlordane	5103719	UG/KG	7	10	7.8	11	3.4		18		APB-FP-2032
Floodplain, Surf Allendale	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	12	13	860	930	130		4100		CMS-159
Floodplain, Surf Allendale	PESTP	Aroclor-1248	12672296	UG/KG	3	13	160	540	330		720		CMS-456
Floodplain, Surf Allendale	PESTP	Aroclor-1254	11097691	UG/KG	12	13	740	800	130		4100		CMS-159
Floodplain, Surf Allendale	PESTP	beta-BHC	319857	UG/KG	2	12	3.9	17	1.4	J	32		CMW-SD-2021
Floodplain, Surf Allendale	PESTP	Dieldrin	60571	UG/KG	7	12	16	28	9.7	J	47		APB-FP-2032
Floodplain, Surf Allendale	PESTP	Endosulfan II	33213659	UG/KG	4	11	23	59	4.1	J	170	*	CMW-SD-2022
Floodplain, Surf Allendale	PESTP	Endosulfan sulfate	1031078	UG/KG	4	12	3.2	5	3.6	J	5.7		CMW-SD-2022
Floodplain, Surf Allendale	PESTP	Endrin	72208	UG/KG	5	11	7.7	14	7.7		28		APB-FP-2032
Floodplain, Surf Allendale	PESTP	Endrin aldehyde	7421934	UG/KG	2	12	3.5	9.6	8.2	J	11	J	CMS-192
Floodplain, Surf Allendale	PESTP	gamma-Chlordane	5103742	UG/KG	9	10	11	12	3.8		22		CMW-SD-2021
Floodplain, Surf Allendale	PESTP	Heptachlor Epoxide	1024573	UG/KG	1	11	1.6	3.8	3.8	J	3.8	J	CMW-FP-2027
Floodplain, Surf Allendale	PESTP	Methoxychlor	72435	UG/KG	1	12	11	6	6	J	6	J	CMS-456
Floodplain, Surf Allendale	TOC	Total Organic Carbon	7440440	MG/KG	9	9	73000	73000	19300		105000		CMW-SD-2021

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Flood Plain Deep Allendale	APB-FP-2028	APB-FP-2028-023.5-01	FP	Sediment/Soil	B	2	3.5
Flood Plain Deep Allendale	APB-FP-2028	APB-FP-2028-0.502-01	FP	Sediment/Soil	B	0.5	2
Flood Plain Deep Allendale	APB-FP-2033	APB-FP-2033-0.502-01	FP	Sediment/Soil	B	0.5	2
Flood Plain Deep Allendale	CMS-023	CMS-023-B-MAX	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-023	CMS-023-C	FP	Sediment/Soil	B	2	3
Flood Plain Deep Allendale	CMS-024	CMS-024-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-025	CMS-025-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-186	CMS-186-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-187	CMS-187-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-195	CMS-195-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-436	CMS-436-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-437	CMS-437-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-437	CMS-437-C	FP	Sediment/Soil	B	2	3
Flood Plain Deep Allendale	CMS-437	CMS-437-D	FP	Sediment/Soil	B	3	4
Flood Plain Deep Allendale	CMS-438	CMS-438-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-439	CMS-439-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-441	CMS-441-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMS-456	CMS-456-B	FP	Sediment/Soil	B	1	2
Flood Plain Deep Allendale	CMW-FP-2026	CMW-FP-2026-0204-01	FP	Sediment/Soil	B	2	4
Flood Plain Deep Allendale	CMW-FP-2026	CMW-FP-2026-0.502-01	FP	Sediment/Soil	B	0.5	2
Flood Plain Deep Allendale	CMW-SD-2022	CMW-SD-2022-022.5-01	FP	Sediment/Soil	B	2	2.5

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Floodplain, Deep, Allendale	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	6	6	173	173	6.5		665	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	6	6	505	505	7		2470	$	CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	3	6	8.9	16.8	1.9	J	30.1		CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	3	6	4.4	7.9	1.2	J	14.5	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	6	6	30.9	30.9	2.1	J	95.3		CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	4	6	14.6	21.4	1	EMPC	46.5	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	6	6	26.9	26.9	1.2	J	92.5		CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	4	6	14.3	20.9	1.4	J	49	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	6	6	31.9	31.9	0.84	J	99.2	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	3	6	6	11.5	1.5	J	25.2	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	5	6	45.1	54	1.8	EMPC	133	EMPC	CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	4	4	164	164	0.93	J	585.93	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	6	6	12.9	12.9	1.2	J	44.8	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	17	21	5550	6850	8.9	J	75000	J	CMS-024
Floodplain, Deep, Allendale	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	6	6	20.7	20.7	2.3		79.3	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	OCDD	3268879	NG/KG	6	6	838	838	32.8	EB	3190	$JEB	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	OCDF	39001020	NG/KG	6	6	302	302	7.2	EB	1310	JEB	CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	PCDD/Fs	GTI500081	NG/KG	6	6	4700	4700	140		15400		APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total HpCDD	37871004	NG/KG	6	6	359	359	8.1	J	1400	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total HpCDF	38998753	NG/KG	6	6	791	791	10.8	J	3750	$J	CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	Total HxCDD	34465468	NG/KG	6	6	147	147	5.1	JEB	480	JEB	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total HxCDF	55684941	NG/KG	6	6	650	650	8.3	J	2210	J	CMW-FP-2026
Floodplain, Deep, Allendale	DIOXI	Total PeCDD	36088229	NG/KG	5	6	49.2	58.9	7	J	178	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total PeCDF	30402154	NG/KG	6	6	434	434	5.3	J	1680	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total TCDD	41903575	NG/KG	6	6	761	761	8.9	J	3950	$J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Total TCDF	55722275	NG/KG	6	6	358	358	11.9	J	1660	J	APB-FP-2033
Floodplain, Deep, Allendale	DIOXI	Toxicity Equivalency	TEQ	NG/KG	21	21	5560	5560	6		75000		CMS-024
Floodplain, Deep, Allendale	HERB	Dalapon	75990	UG/KG	1	1	120	120	120		120		CMS-456
Floodplain, Deep, Allendale	HERB	MCPA	94746	UG/KG	1	1	5800	5800	5800	J	5800	J	CMS-456
Floodplain, Deep, Allendale	HERB	MCPP	93652	UG/KG	1	1	11000	11000	11000	J	11000	J	CMS-456
Floodplain, Deep, Allendale	M	Aluminum	7429905	MG/KG	7	7	7770	7770	2160		15100		APB-FP-2033
Floodplain, Deep, Allendale	M	Antimony	7440360	MG/KG	5	7	2.5	3.4	0.73	J	10.7	J	CMW-FP-2026
Floodplain, Deep, Allendale	M	Arsenic	7440382	MG/KG	6	7	4.6	5.3	1.1	J	13.3		CMW-FP-2026
Floodplain, Deep, Allendale	M	Barium	7440393	MG/KG	7	7	76	76	15.5		186		APB-FP-2033
Floodplain, Deep, Allendale	M	Beryllium	7440417	MG/KG	6	7	1.1	1.3	0.57		2		CMW-FP-2026
Floodplain, Deep, Allendale	M	Cadmium	7440439	MG/KG	2	7	1.1	3.6	3.5		3.7		CMS-456
Floodplain, Deep, Allendale	M	Calcium	7440702	MG/KG	6	7	1200	1360	496	J	2370	J	APB-FP-2033
Floodplain, Deep, Allendale	M	Chromium	7440473	MG/KG	7	7	110	110	10.3		331		CMW-FP-2026
Floodplain, Deep, Allendale	M	Cobalt	7440484	MG/KG	7	7	4.5	4.5	1.4	J	13.4		APB-FP-2033
Floodplain, Deep, Allendale	M	Copper	7440508	MG/KG	7	7	69.4	69.4	5.4		193		CMW-FP-2026
Floodplain, Deep, Allendale	M	Iron	7439896	MG/KG	7	7	9890	9890	3590		21400		APB-FP-2033
Floodplain, Deep, Allendale	M	Lead	7439921	MG/KG	7	7	300	300	11.9		854		APB-FP-2033
Floodplain, Deep, Allendale	M	Magnesium	7439954	MG/KG	7	7	1550	1550	358	J	4820	J	APB-FP-2033
Floodplain, Deep, Allendale	M	Manganese	7439965	MG/KG	7	7	197	197	35.7		373		APB-FP-2033
Floodplain, Deep, Allendale	M	Mercury	7439976	MG/KG	7	7	0.53	0.53	0.03		1.1		CMW-FP-2026
Floodplain, Deep, Allendale	M	Molybdenum	7439987	MG/KG	1	1	5	5	5	J	5	J	CMS-456
Floodplain, Deep, Allendale	M	Nickel	7440020	MG/KG	6	7	28.5	33.1	3.7		83.2		APB-FP-2033
Floodplain, Deep, Allendale	M	Potassium	7440097	MG/KG	6	7	892	786	193	J	2010	J	APB-FP-2033
Floodplain, Deep, Allendale	M	Selenium	7782492	MG/KG	3	7	0.86	1.3	0.77	J	1.8	J	CMW-FP-2026
Floodplain, Deep, Allendale	M	Silver	7440224	MG/KG	6	7	2.4	2.7	0.74	J	5.8		APB-FP-2033
Floodplain, Deep, Allendale	M	Sodium	7440235	MG/KG	2	7	95.6	236	191	J	280	J	APB-FP-2033
Floodplain, Deep, Allendale	M	Thallium	7440280	MG/KG	1	7	25.8	0.53	0.53		0.53		CMW-FP-2026
Floodplain, Deep, Allendale	M	Vanadium	7440622	MG/KG	7	7	29.1	29.1	6.3		72.5		CMS-456
Floodplain, Deep, Allendale	M	Zinc	7440666	MG/KG	7	7	333	333	39.4	J	1270	J	APB-FP-2033
Floodplain, Deep, Allendale	OS	1,2,4-Trichlorobenzene	120821	UG/KG	1	7	1000	110	110	J	110	J	CMS-456
Floodplain, Deep, Allendale	OS	1,2-Dichlorobenzene	95501	UG/KG	1	7	1000	160	160	J	160	J	CMS-456
Floodplain, Deep, Allendale	OS	2,4,5-Trichlorophenol	95954	UG/KG	1	7	2300	560	560	J	560	J	CMS-456
Floodplain, Deep, Allendale	OS	2-Methylnaphthalene	91576	UG/KG	1	7	1000	90	90	J	90	J	CMS-456
Floodplain, Deep, Allendale	OS	4-Chloroaniline	106478	UG/KG	1	7	1100	730	730	J	730	J	CMS-456
Floodplain, Deep, Allendale	OS	Acenaphthene	83329	UG/KG	1	7	1000	180	180	J	180	J	CMS-456
Floodplain, Deep, Allendale	OS	Acenaphthylene	208968	UG/KG	1	7	1100	530	530	J	530	J	CMS-456
Floodplain, Deep, Allendale	OS	Anthracene	120127	UG/KG	2	7	1000	300	100	J	500	J	CMS-456
Floodplain, Deep, Allendale	OS	BAPEQ	BAPEQ	UG/KG	4	7	1000	1700	1000		2500		CMS-456
Floodplain, Deep, Allendale	OS	Benzo(a)anthracene	56553	UG/KG	4	7	880	1100	700	J	1800		CMS-456
Floodplain, Deep, Allendale	OS	Benzo(a)pyrene	50328	UG/KG	4	7	920	1200	810	J	1600		CMS-456
Floodplain, Deep, Allendale	OS	Benzo(b)fluoranthene	205992	UG/KG	4	7	1000	1400	620	J	2900		CMS-456
Floodplain, Deep, Allendale	OS	Benzo(g,h,i)perylene	191242	UG/KG	2	7	1200	800	590	J	1000	J	CMS-456
Floodplain, Deep, Allendale	OS	Benzo(k)fluoranthene	207089	UG/KG	3	7	790	1100	900	J	1500	J	APB-FP-2033
Floodplain, Deep, Allendale	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	1	7	3000	14000	14000		14000		CMS-456

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Flood Plain, Surface Lymansville	SD-10	SD-10	FP	Sediment/Soil	A	0	0.5
Flood Plain, Surface Lymansville	SD-11	SD-11	FP	Sediment/Soil	A	0	1
Flood Plain, Surface Lymansville	SD-12	SD-12	FP	Sediment/Soil	A	0	1
Flood Plain, Surface Lymansville	SD-13	SD-13	FP	Sediment/Soil	A	0	1
Flood Plain, Surface Lymansville	SD-14	SD-14	FP	Sediment/Soil	A	0	0.5
Flood Plain, Surface Lymansville	SD-15	SD-15	FP	Sediment/Soil	A	0	0.5
Flood Plain, Surface Lymansville	SD-16	SD-16	FP	Sediment/Soil	A	0	0.5
Flood Plain, Surface Lymansville	SD-17	SD-17	FP	Sediment/Soil	A	0	0.5
Flood Plain, Surface Lymansville	SD-18	SD-18	FP	Sediment/Soil	A	0	0.25
Flood Plain, Surface Lymansville	SD-19	SD-19	FP	Sediment/Soil	A	0	0.25

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Floodplain, Deep, Allendale	OS	Chrysene	218019	UG/KG	4	7	1000	1400	890	J	2000		CMS-456
Floodplain, Deep, Allendale	OS	Di-n-Butylphthalate	84742	UG/KG	1	7	1000	190	190	J	190	J	CMS-456
Floodplain, Deep, Allendale	OS	Di-n-octylphthalate	117840	UG/KG	1	7	1100	870	870	J	870	J	CMS-456
Floodplain, Deep, Allendale	OS	Dibenzo(a,h)anthracene	53703	UG/KG	2	7	1000	290	220	J	360	J	CMS-456
Floodplain, Deep, Allendale	OS	Dibenzofuran	132649	UG/KG	1	7	1000	120	120	J	120	J	CMS-456
Floodplain, Deep, Allendale	OS	Fluoranthene	206440	UG/KG	4	7	1500	2200	1200	J	3500		CMS-456
Floodplain, Deep, Allendale	OS	Fluorene	86737	UG/KG	1	7	1000	280	280	J	280	J	CMS-456
Floodplain, Deep, Allendale	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	4	7	7300	12000	7200		19000		CMS-456
Floodplain, Deep, Allendale	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	4	7	670	760	550	J	950	J	APB-FP-2033
Floodplain, Deep, Allendale	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	4	7	1000	1400	410		3700		CMS-456
Floodplain, Deep, Allendale	OS	Naphthalene	91203	UG/KG	1	7	1000	100	100	J	100	J	CMS-456
Floodplain, Deep, Allendale	OS	Phenanthrene	85018	UG/KG	4	7	750	910	310	J	2000		CMS-456
Floodplain, Deep, Allendale	OS	Pyrene	129000	UG/KG	4	7	1800	2700	1400	J	4500		CMS-456
Floodplain, Deep, Allendale	OS	Total PAH	TOTPAH	UG/KG	4	7	8000	14000	7700		23000		CMS-456
Floodplain, Deep, Allendale	OS	Total Semi-Volatile Organics	GTI500035	UG/KG	1	1	39000	39000	39000		39000		CMS-456
Floodplain, Deep, Allendale	OV	Chlorobenzene	108907	UG/KG	1	1	8	8	8.2	J	8.2	J	CMS-456
Floodplain, Deep, Allendale	OV	cis-1,2-Dichloroethene	156592	UG/KG	1	1	93	93	93	J	93	J	CMS-456
Floodplain, Deep, Allendale	OV	Ethylbenzene	100414	UG/KG	1	1	3	3	2.9	J	2.9	J	CMS-456
Floodplain, Deep, Allendale	OV	m&p-Xylene	108383/1	UG/KG	1	1	4	4	4.5	J	4.5	J	CMS-456
Floodplain, Deep, Allendale	OV	Tetrachloroethene	127184	UG/KG	1	1	120	120	120		120		CMS-456
Floodplain, Deep, Allendale	OV	Toluene	108883	UG/KG	1	1	4	4	4.2	J	4.2	J	CMS-456
Floodplain, Deep, Allendale	OV	Total Volatile Organics	GTI500034	UG/KG	1	1	350	350	350		350		CMS-456
Floodplain, Deep, Allendale	OV	Total Xylenes	1330207	UG/KG	1	1	4	4	4.5	J	4.5	J	CMS-456
Floodplain, Deep, Allendale	OV	Trichloroethene	79016	UG/KG	1	1	39	39	39		39		CMS-456
Floodplain, Deep, Allendale	OV	Vinyl chloride	75014	UG/KG	1	1	70	70	70		70		CMS-456
Floodplain, Deep, Allendale	PESTP	4,4'-DDD	72548	UG/KG	2	6	10	26	13	J	40	J	APB-FP-2033
Floodplain, Deep, Allendale	PESTP	4,4'-DDE	72559	UG/KG	2	6	10	26	10	J	43		APB-FP-2033
Floodplain, Deep, Allendale	PESTP	4,4'-DDT	50293	UG/KG	1	6	5.1	6.2	6.2	J	6.2	J	APB-FP-2033
Floodplain, Deep, Allendale	PESTP	Aldrin	309002	UG/KG	1	6	120	710	710		710		CMS-456
Floodplain, Deep, Allendale	PESTP	alpha-Chlordane	5103719	UG/KG	1	5	2.7	8.7	8.7		8.7		APB-FP-2033
Floodplain, Deep, Allendale	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	4	6	1500	2200	22		7000	J	CMS-456
Floodplain, Deep, Allendale	PESTP	Aroclor-1248	12672296	UG/KG	2	6	490	1400	57		2800	J	CMS-456
Floodplain, Deep, Allendale	PESTP	Aroclor-1254	11097691	UG/KG	4	6	990	1500	22	J	4200	J	CMS-456
Floodplain, Deep, Allendale	PESTP	Dieldrin	60571	UG/KG	2	6	37	110	100	*	110		CMS-456
Floodplain, Deep, Allendale	PESTP	Endosulfan II	33213659	UG/KG	1	6	7	18	18		18		APB-FP-2033
Floodplain, Deep, Allendale	PESTP	Endrin Aldehyde	7421934	UG/KG	1	6	7.3	19	19		19		CMW-SD-2022
Floodplain, Deep, Allendale	PESTP	gamma-Chlordane	5103742	UG/KG	1	5	6	25	25		25		APB-FP-2033
Floodplain, Deep, Allendale	PESTP	Heptachlor Epoxide	1024573	UG/KG	1	6	4.2	5.4	5.4		5.4		APB-FP-2033

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Floodplain Surf, Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	1	10	108	710	709.87	J	709.87	J	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	7	10	58.8	83.6	4.6	EMPC	353.98	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	3	10	1.2	1.7	1.02	J	2.33	EMPC	SD-10
Floodplain Surf, Lymansville	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	4	10	1.5	3	1.28	J	7.66	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	6	8	10.6	10.6	1.4	J	33.56	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	8	8	9.7	9.7	1.97	EMPC	42.16	J	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	7	7	5.4	5.4	0.64	EMPC	23.64	J	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	9	10	8.5	9.4	0.48	EMPC	42.19	J	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	5	10	1.5	2.4	0.84	EMPC	7.22	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	7	7	2	2	0.22	EMPC	7.45	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	3	10	20500	65700	15011	J	166500	J	SD-18
Floodplain Surf, Lymansville	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	6	6	3.8	3.8	0.98	EMPC, J	12.11	J	SD-18
Floodplain Surf, Lymansville	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	7	10	2.4	3.2	0.64	EMPC	12.58	EMPC	SD-18
Floodplain Surf, Lymansville	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	9	10	967	1070	18.11	J	7987.02	J	SD-18
Floodplain Surf, Lymansville	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	6	10	5.4	8.7	0.7	EMPC	24.96	J	SD-18
Floodplain Surf, Lymansville	DIOXI	OCDD	3268879	NG/KG	1	10	706	4570	4568.52	J	4568.52	J	SD-18
Floodplain Surf, Lymansville	DIOXI	PCDD/Fs	GTI500081	NG/KG	1	10	590	4570	4570		4570		SD-18
Floodplain Surf, Lymansville	DIOXI	Toxicity Equivalency	TEQ	NG/KG	10	10	975	975	0.89		8030		SD-18
Floodplain Surf, Lymansville	OS	Acenaphthene	83329	UG/KG	1	5	250	150	150	J	150	J	SD-14
Floodplain Surf, Lymansville	OS	Anthracene	120127	UG/KG	2	5	260	260	75	J	440		SD-14
Floodplain Surf, Lymansville	OS	BAPEQ	BAPEQ	UG/KG	4	5	420	510	140		1400		SD-14
Floodplain Surf, Lymansville	OS	Benzo(a)anthracene	56553	UG/KG	4	5	340	370	93	J	1000		SD-14
Floodplain Surf, Lymansville	OS	Benzo(a)pyrene	50328	UG/KG	4	5	330	360	110	J	940		SD-14
Floodplain Surf, Lymansville	OS	Benzo(b)fluoranthene	205992	UG/KG	4	5	440	500	170	J	1200		SD-14
Floodplain Surf, Lymansville	OS	Benzo(g,h,i)perylene	191242	UG/KG	4	5	170	160	64	J	400		SD-14
Floodplain Surf, Lymansville	OS	Benzo(k)fluoranthene	207089	UG/KG	4	5	180	180	66	J	440		SD-14
Floodplain Surf, Lymansville	OS	Bis(2-ethylhexyl)phthalate	117817	UG/KG	5	5	210	210	43	J	700		SD-10
Floodplain Surf, Lymansville	OS	Carbazole	86748	UG/KG	2	5	220	180	80	J	280	J	SD-14
Floodplain Surf, Lymansville	OS	Chrysene	218019	UG/KG	4	5	360	400	120	J	990		SD-14
Floodplain Surf, Lymansville	OS	Di-n-octylphthalate	117840	UG/KG	1	5	250	140	140	J	140	J	SD-14
Floodplain Surf, Lymansville	OS	Dibenzo(a,h)anthracene	53703	UG/KG	1	5	250	140	140	J	140	J	SD-14
Floodplain Surf, Lymansville	OS	Dibenzofuran	132649	UG/KG	1	5	230	66	66	J	66	J	SD-14
Floodplain Surf, Lymansville	OS	Fluoranthene	206440	UG/KG	5	5	790	790	49	J	2600		SD-14
Floodplain Surf, Lymansville	OS	Fluorene	86737	UG/KG	1	5	260	190	190	J	190	J	SD-14
Floodplain Surf, Lymansville	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	5	5	3000	3000	49		9900		SD-14
Floodplain Surf, Lymansville	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	4	5	200	200	74	J	500		SD-14
Floodplain Surf, Lymansville	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	4	5	860	1000	140		3100		SD-14
Floodplain Surf, Lymansville	OS	Phenanthrene	85018	UG/KG	4	5	690	810	140	J	2300		SD-14
Floodplain Surf, Lymansville	OS	Pyrene	129000	UG/KG	4	5	560	650	190	J	1700		SD-14
Floodplain Surf, Lymansville	OS	Total PAH	TOTPAH	UG/KG	5	5	3900	3900	49		13000		SD-14
Floodplain Surf, Lymansville	PESTP	4,4'-DDD	72548	UG/KG	4	10	2.7	2.8	1.4	J	4.1		SD-14
Floodplain Surf, Lymansville	PESTP	4,4'-DDE	72559	UG/KG	9	10	3.1	3.2	0.31	J	6.8	J	SD-17
Floodplain Surf, Lymansville	PESTP	4,4'-DDT	50293	UG/KG	3	10	3.8	1.9	1.6	J	2.3	J	SD-13
Floodplain Surf, Lymansville	PESTP	Aldrin	309002	UG/KG	1	10	1.4	0.58	0.58	J	0.58	J	SD-12
Floodplain Surf, Lymansville	PESTP	alpha-Chlordane	5103719	UG/KG	9	10	7.9	8.6	0.21	J	25	J	SD-14
Floodplain Surf, Lymansville	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	3	10	54	67	23		120		SD-18
Floodplain Surf, Lymansville	PESTP	Aroclor-1254	11097691	UG/KG	3	10	37	67	23	J	120		SD-18
Floodplain Surf, Lymansville	PESTP	Dieldrin	60571	UG/KG	1	10	2.7	1.4	1.4	J, EB	1.4	J, EB	SD-12
Floodplain Surf, Lymansville	PESTP	Endosulfan Sulfate	1031078	UG/KG	2	9	4.5	2	1.7	J	2.3	J	SD-17
Floodplain Surf, Lymansville	PESTP	Endrin	72208	UG/KG	1	10	3.9	1.4	1.4	J	1.4	J	SD-12
Floodplain Surf, Lymansville	PESTP	gamma-Chlordane	5103742	UG/KG	6	8	7.4	9.5	3.5		21		SD-14
Floodplain Surf, Lymansville	PESTP	Heptachlor	76448	UG/KG	2	10	1.3	0.52	0.43	J	0.62	J	SD-12
Floodplain Surf, Lymansville	PESTP	Methoxychlor	72435	UG/KG	2	9	13	4	2.7	J	5.3	J	SD-18
Floodplain Surf, Lymansville	TOC	Total Organic Carbon	7440440	MG/KG	10	10	48000	48000	1010		128000		SD-10

Appendix A-3

Bank Sediment Sample Groups and

Statistical Summaries

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Bank Allendale	APB-BK-2003	APB-BK-2003Z-01	BK	Sediment/Soil	A	0	0.5
Bank Allendale	APB-BK-2003	APB-BK-2003Y-01	BK	Sediment/Soil	A	0	0.5
Bank Allendale	APB-BK-2003	APB-BK-2003X-01-MAX	BK	Sediment/Soil	A	0	0.5
Bank Allendale	CMS-190	3428-CMS-190	BK	Sediment/Soil	A	0	0.25
Bank Allendale	CMS-194	3428-CMS-194	BK	Sediment/Soil	A	0	0.25
Bank Allendale	CMS-199	3428-CMS-199	BK	Sediment/Soil	A	0	0.25

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Bank Allendale Pond	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	2	3	20.9	30.3	21.7		38.9		APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	2	3	7	9.6	7.2		12		APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	1	3	0.31	0.53	0.53	J	0.53	J	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	1	3	0.41	0.92	0.92	J	0.92	J	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	1	3	1.4	3	3	J	3	J	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	2	3	1.7	2.2	0.9	J	3.5	J	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	3	3	0.83	0.83	0.55	J	1.1	J	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	1	3	1.2	2.7	2.7	EMPC	2.7	EMPC	APB-BK-2003
Bank Allendale Pond	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	2	2	2.5	2.5	2.14	J	2.84		APB-BK-2003
Bank Allendale Pond	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	2	3	1.2	1.5	1.4	J	1.7	J	APB-BK-2003
Bank Allendale Pond	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	1	3	1.1	1.7	1.7	EMPC	1.7	EMPC	APB-BK-2003
Bank Allendale Pond	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	6	6	507	507	0.88	J	1410		CMS-190
Bank Allendale Pond	DIOXI	OCDD	3268879	NG/KG	3	3	176	176	32.9		256		APB-BK-2003
Bank Allendale Pond	DIOXI	OCDF	39001020	NG/KG	1	3	6	13.4	13.4		13.4		APB-BK-2003
Bank Allendale Pond	DIOXI	PCDD/Fs	GTI500081	NG/KG	3	3	406	406	57		659		APB-BK-2003
Bank Allendale Pond	DIOXI	Total HpCDD	37871004	NG/KG	2	3	39.2	56.8	40.4		73.1	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Total HpCDF	38998753	NG/KG	3	3	13.5	13.5	5.4	EMPC	21.2	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Total HxCDD	34465468	NG/KG	1	3	9.5	12.6	12.6		12.6		APB-BK-2003
Bank Allendale Pond	DIOXI	Total HxCDF	55684941	NG/KG	3	3	22.2	22.2	13.6	EMPC	28.1	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Total PeCDD	36088229	NG/KG	3	3	7.9	7.9	5.1	EMPC	11.3	EMPC	APB-BK-2003
Bank Allendale Pond	DIOXI	Total PeCDF	30402154	NG/KG	2	3	23.8	31.8	20.7		42.9	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Total TCDD	41903575	NG/KG	2	3	102	152	123		182	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Total TCDF	55722275	NG/KG	2	3	19.2	25.5	20.1		30.9	J	APB-BK-2003
Bank Allendale Pond	DIOXI	Toxicity Equivalency	TEQ	NG/KG	6	6	508	508	2.9		1410		CMS-190
Bank Allendale Pond	M	Aluminum	7429905	MG/KG	3	3	4160	4160	3450		5530		APB-BK-2003
Bank Allendale Pond	M	Arsenic	7440382	MG/KG	3	3	4.1	4.1	0.89		10.5		APB-BK-2003
Bank Allendale Pond	M	Barium	7440393	MG/KG	3	3	103	103	22.3		262		APB-BK-2003
Bank Allendale Pond	M	Beryllium	7440417	MG/KG	3	3	0.36	0.36	0.26		0.5		APB-BK-2003
Bank Allendale Pond	M	Calcium	7440702	MG/KG	3	3	1220	1220	631		2200	J	APB-BK-2003
Bank Allendale Pond	M	Chromium	7440473	MG/KG	3	3	10.5	10.5	8.5		12.1		APB-BK-2003
Bank Allendale Pond	M	Copper	7440508	MG/KG	3	3	23.5	23.5	13.4		37.4		APB-BK-2003
Bank Allendale Pond	M	Iron	7439896	MG/KG	3	3	10200	10200	6260		14600		APB-BK-2003
Bank Allendale Pond	M	Lead	7439921	MG/KG	3	3	154	154	35.6		373		APB-BK-2003
Bank Allendale Pond	M	Magnesium	7439954	MG/KG	3	3	1130	1130	911	J	1380	J	APB-BK-2003
Bank Allendale Pond	M	Manganese	7439965	MG/KG	3	3	172	172	125		262		APB-BK-2003
Bank Allendale Pond	M	Mercury	7439976	MG/KG	3	3	0.073	0.073	0.03	J	0.15	J	APB-BK-2003
Bank Allendale Pond	M	Potassium	7440097	MG/KG	3	3	586	586	475	J	756	J	APB-BK-2003
Bank Allendale Pond	M	Sodium	7440235	MG/KG	1	3	49.3	28.5	28.5		28.5		APB-BK-2003
Bank Allendale Pond	M	Vanadium	7440622	MG/KG	3	3	26	26	8.5		55.1		APB-BK-2003
Bank Allendale Pond	M	Zinc	7440666	MG/KG	3	3	96	96	70.5		144	J	APB-BK-2003
Bank Allendale Pond	OS	Acenaphthene	83329	UG/KG	1	3	560	530	530	J	530	J	APB-BK-2003
Bank Allendale Pond	OS	Anthracene	120127	UG/KG	2	3	600	800	210	J	1400	J	APB-BK-2003
Bank Allendale Pond	OS	BAPEQ	BAPEQ	UG/KG	3	3	2000	2000	250		5300		APB-BK-2003
Bank Allendale Pond	OS	Benzo(a)anthracene	56553	UG/KG	3	3	1500	1500	160		3800		APB-BK-2003
Bank Allendale Pond	OS	Benzo(a)pyrene	50328	UG/KG	3	3	1300	1300	150		3400	J	APB-BK-2003
Bank Allendale Pond	OS	Benzo(b)fluoranthene	205992	UG/KG	3	3	1400	1400	180		3600	J	APB-BK-2003
Bank Allendale Pond	OS	Benzo(g,h,i)perylene	191242	UG/KG	3	3	820	820	120		2100	J	APB-BK-2003
Bank Allendale Pond	OS	Benzo(k)fluoranthene	207089	UG/KG	3	3	960	960	120		2400	J	APB-BK-2003
Bank Allendale Pond	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	1	3	980	96	96		96		APB-BK-2003
Bank Allendale Pond	OS	Carbazole	86748	UG/KG	1	3	640	790	790	J	790	J	APB-BK-2003
Bank Allendale Pond	OS	Chrysene	218019	UG/KG	3	3	1600	1600	190		4100		APB-BK-2003
Bank Allendale Pond	OS	Dibenzo(a,h)anthracene	53703	UG/KG	2	3	650	510	54		960	J	APB-BK-2003
Bank Allendale Pond	OS	Fluoranthene	206440	UG/KG	3	3	3700	3700	380		9500		APB-BK-2003
Bank Allendale Pond	OS	Fluorene	86737	UG/KG	1	3	570	560	560	J	560	J	APB-BK-2003
Bank Allendale Pond	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	3	3	16000	16000	1800		40000		APB-BK-2003
Bank Allendale Pond	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	3	3	880	880	130		2200	J	APB-BK-2003
Bank Allendale Pond	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	3	3	3600	3600	220		9500		APB-BK-2003
Bank Allendale Pond	OS	Phenanthrene	85018	UG/KG	3	3	2700	2700	220		7000		APB-BK-2003
Bank Allendale Pond	OS	Pyrene	129000	UG/KG	3	3	3100	3100	320		8100		APB-BK-2003
Bank Allendale Pond	OS	Total PAH	TOTPAH	UG/KG	3	3	19000	19000	2000		50000		APB-BK-2003
Bank Allendale Pond	PESTP	4,4'-DDT	50293	UG/KG	1	3	3	5.1	5.1	P	5.1	P	APB-BK-2003
Bank Allendale Pond	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	2	3	44	48	45		50		APB-BK-2003
Bank Allendale Pond	PESTP	Aroclor-1254	11097691	UG/KG	2	3	38	48	45		50	P	APB-BK-2003
Bank Allendale Pond	PESTP	Dieldrin	60571	UG/KG	1	3	5.6	13	13		13		APB-BK-2003
Bank Allendale Pond	PESTP	Endosulfan II	33213659	UG/KG	1	3	2.6	4	4		4		APB-BK-2003

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Bank W, River	WRL-BK-2004	WRL-BK-2004X-01	BK	Sediment/Soil	A	0	0.5
Bank W, River	WRL-BK-2004	WRL-BK-2004Y-01	BK	Sediment/Soil	A	0	0.5
Bank W, River	WRL-BK-2004	WRL-BK-2004Z-01	BK	Sediment/Soil	A	0	0.5
Bank W, River	WRL-BK-2005	WRL-BK-2005X-01	BK	Sediment/Soil	A	0	0.5
Bank W, River	WRL-BK-2005	WRL-BK-2005Y-01	BK	Sediment/Soil	A	0	0.5
Bank W, River	WRL-BK-2005	WRL-BK-2005Z-01	BK	Sediment/Soil	A	0	0.5

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Bank W River	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	6	6	164	164	14.3		375	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	6	6	53	53	10.6		107	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	6	6	2.9	2.9	0.63	EMPC	6.1	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	6	6	2.8	2.8	0.81	J	5.3	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	6	6	9.8	9.8	4.2	J	18.6	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	5	6	7.6	9	1.3	J	15.7	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	6	6	5.7	5.7	2.2	J	10.9	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	6	6	9.2	9.2	1.5	EMPC	20	J	WRL-BK-2004
Bank W River	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	5	6	0.39	0.41	0.18	J	0.67	EMPC	WRL-BK-2004
Bank W River	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	6	6	2.5	2.5	0.8	J	4.7	EMPC	WRL-BK-2004
Bank W River	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	6	6	5	5	2.3	J	11.7	EMPC	WRL-BK-2004
Bank W River	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	5	5	334	334	1.46	J	1198.35	J	WRL-BK-2004
Bank W River	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	6	6	6.7	6.7	2.6	J	12.5	J	WRL-BK-2004
Bank W River	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	6	6	5.5	5.5	3.2	J	8.8		WRL-BK-2004
Bank W River	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	6	6	885	885	10.5		2930	J&	WRL-BK-2004
Bank W River	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	6	6	12	12	5.9		19.5	J	WRL-BK-2004
Bank W River	DIOXI	OCDD	3268879	NG/KG	6	6	1170	1170	71.9	EBJ	2780	J	WRL-BK-2004
Bank W River	DIOXI	OCDF	39001020	NG/KG	6	6	76.3	76.3	11.8	EBJ	157	J	WRL-BK-2004
Bank W River	DIOXI	PCDD/Fs	GT1500081	NG/KG	6	6	2970	2970	302		7700		WRL-BK-2004
Bank W River	DIOXI	Total HpCDD	37871004	NG/KG	6	6	323	323	35	J	693	J	WRL-BK-2004
Bank W River	DIOXI	Total HpCDF	38998753	NG/KG	6	6	109	109	18.3	J	224	J	WRL-BK-2004
Bank W River	DIOXI	Total HxCDD	34465468	NG/KG	5	6	72.1	84.3	18.5	EMPC	153	J	WRL-BK-2004
Bank W River	DIOXI	Total HxCDF	55684941	NG/KG	6	6	116	116	23	J	284	J	WRL-BK-2004
Bank W River	DIOXI	Total PeCDD	36088229	NG/KG	4	5	25.1	28.2	15.3	EMPC	51.3	J	WRL-BK-2004
Bank W River	DIOXI	Total PeCDF	30402154	NG/KG	6	6	104	104	32.3	J	223	J	WRL-BK-2004
Bank W River	DIOXI	Total TCDD	41903575	NG/KG	6	6	911	911	28.9	J	3020	J&	WRL-BK-2004
Bank W River	DIOXI	Total TCDF	55722275	NG/KG	6	6	80.3	80.3	45.7	J	167	J	WRL-BK-2004
Bank W River	DIOXI	Toxicity Equivalency	TEQ	NG/KG	6	6	899	899	16.6		2960		WRL-BK-2004
Bank W River	M	Aluminum	7429905	MG/KG	6	6	4180	4180	1690		7340		WRL-BK-2004
Bank W River	M	Antimony	7440360	MG/KG	1	6	0.56	1.5	1.5	J	1.5	J	WRL-BK-2004
Bank W River	M	Arsenic	7440382	MG/KG	6	6	3	3	1.5		5.2		WRL-BK-2004
Bank W River	M	Barium	7440393	MG/KG	6	6	33.9	33.9	10		81.1		WRL-BK-2004
Bank W River	M	Beryllium	7440417	MG/KG	5	6	0.52	0.62	0.19	J	0.96		WRL-BK-2004
Bank W River	M	Cadmium	7440439	MG/KG	1	6	0.068	0.21	0.21	J	0.21	J	WRL-BK-2004
Bank W River	M	Calcium	7440702	MG/KG	6	6	931	931	158		2920	J	WRL-BK-2004
Bank W River	M	Chromium	7440473	MG/KG	6	6	34.5	34.5	2.8	J	104		WRL-BK-2004
Bank W River	M	Copper	7440508	MG/KG	5	6	26.4	31.1	8.4		67.6		WRL-BK-2004
Bank W River	M	Iron	7439896	MG/KG	6	6	7800	7800	4890		12700		WRL-BK-2004
Bank W River	M	Lead	7439921	MG/KG	6	6	97.6	97.6	50		187		WRL-BK-2004
Bank W River	M	Magnesium	7439954	MG/KG	6	6	818	818	368		1250	J	WRL-BK-2004
Bank W River	M	Manganese	7439965	MG/KG	6	6	287	287	75.6		885		WRL-BK-2004
Bank W River	M	Mercury	7439976	MG/KG	5	5	0.15	0.15	0.04		0.48	J	WRL-BK-2004
Bank W River	M	Potassium	7440097	MG/KG	6	6	453	453	224		687	J	WRL-BK-2004
Bank W River	M	Selenium	7782492	MG/KG	1	6	0.65	0.97	0.97	J	0.97	J	WRL-BK-2004
Bank W River	M	Sodium	7440235	MG/KG	1	6	45.8	17.4	17.4	J	17.4	J	WRL-BK-2005
Bank W River	M	Thallium	7440280	MG/KG	1	6	0.32	0.59	0.59	J	0.59	J	WRL-BK-2005
Bank W River	M	Vanadium	7440622	MG/KG	6	6	31.6	31.6	15.2		56.1		WRL-BK-2004
Bank W River	M	Zinc	7440666	MG/KG	6	6	66.1	66.1	32.9		105	J	WRL-BK-2004
Bank W River	OS	BAPEQ	BAPEQ	UG/KG	6	6	420	420	85		910		WRL-BK-2005
Bank W River	OS	Benzo(a)anthracene	56553	UG/KG	6	6	340	340	59	J	770	J	WRL-BK-2005
Bank W River	OS	Benzo(a)pyrene	50328	UG/KG	6	6	320	320	65	J	700	J	WRL-BK-2005
Bank W River	OS	Benzo(b)fluoranthene	205992	UG/KG	6	6	380	380	76	J	750	J	WRL-BK-2005
Bank W River	OS	Benzo(g,h,i)perylene	191242	UG/KG	2	6	850	47	43	J	51	J	WRL-BK-2005
Bank W River	OS	Benzo(k)fluoranthene	207089	UG/KG	6	6	370	370	59	J	850	J	WRL-BK-2005
Bank W River	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	4	6	610	220	48	J	460	J	WRL-BK-2004
Bank W River	OS	Chrysene	218019	UG/KG	6	6	430	430	82	J	980	J	WRL-BK-2005
Bank W River	OS	Fluoranthene	206440	UG/KG	6	6	820	820	150	J	1900	J	WRL-BK-2005
Bank W River	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	6	6	3600	3600	730		8000		WRL-BK-2005
Bank W River	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	5	6	400	280	60	J	530	J	WRL-BK-2005
Bank W River	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	6	6	380	380	69		840		WRL-BK-2005
Bank W River	OS	Phenanthrene	85018	UG/KG	6	6	380	380	69	J	840	J	WRL-BK-2005
Bank W River	OS	Pyrene	129000	UG/KG	6	6	680	680	130	J	1500	J	WRL-BK-2005
Bank W River	OS	Total PAH	TOTPAH	UG/KG	6	6	3900	3900	800		8800		WRL-BK-2005
Bank W River	PESTP	4,4'-DDE	72559	UG/KG	1	5	2.6	4.9	4.9		4.9		WRL-BK-2005
Bank W River	PESTP	4,4'-DDT	50293	UG/KG	1	5	2.7	5.5	5.5		5.5		WRL-BK-2005
Bank W River	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	3	5	63	78	13		160		WRL-BK-2004
Bank W River	PESTP	Aroclor-1254	11097691	UG/KG	3	5	55	78	13	JP	160	P	WRL-BK-2004
Bank W River	PESTP	Dieldrin	60571	UG/KG	3	5	6.1	8.8	4.4	P	17	P	WRL-BK-2004
Bank W River	PESTP	Endrin	72208	UG/KG	1	5	2.8	5.6	5.6	P	5.6	P	WRL-BK-2005

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Bank Lymansville	LPX-BK-2006	LPX-BK-2006Y-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2006	LPX-BK-2006X-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2006	LPX-BK-2006Z-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2007	LPX-BK-2007X-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2007	LPX-BK-2007Y-01-MAX	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2007	LPX-BK-2007Z-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2008	LPX-BK-2008Z-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2008	LPX-BK-2008Y-01	BK	Sediment/Soil	A	0	0.5
Bank Lymansville	LPX-BK-2008	LPX-BK-2008X-01	BK	Sediment/Soil	A	0	0.5

Appendix A-4

Aquatic Sediment Sample Groups and

Statistical Summaries

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Bank Lymansville pond	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	7	9	114	146	14.6		418		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	7	9	49.2	63	9.3		192		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	4	9	2.4	3.1	0.29	J	9.8	EMPC	LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	6	9	3	4	0.38	J	9.8		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	7	9	13.8	17.6	5.2		49.8		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	6	9	7.4	10.8	2.5	J	24.4		LPX-BK-2007
Bank Lymansville pond	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	6	9	5.7	8.4	2.5	J	21.4		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	7	8	8.9	10	0.64	J	28.1		LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	1	9	0.73	0.26	0.26	EMPC	0.26	EMPC	LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	5	9	3.3	5.4	0.55	J	12.4		LPX-BK-2007
Bank Lymansville pond	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	6	9	5.9	8.6	3.2	EMPC	20	EMPC	LPX-BK-2006
Bank Lymansville pond	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	3	3	272	272	88.77	J	493.81	J	LPX-BK-2007
Bank Lymansville pond	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	7	9	7	8.8	0.2	EMPC	28.7		LPX-BK-2006
Bank Lymansville pond	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	8	9	6.4	9.4	3.9	J	20.6		LPX-BK-2006
Bank Lymansville pond	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	9	9	249	249	0.59	J	1010	&	LPX-BK-2007
Bank Lymansville pond	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	7	9	15.3	19.4	6.8		38.4		LPX-BK-2007
Bank Lymansville pond	DIOXI	OCDD	3268879	NG/KG	8	9	557	626	18.8		2170		LPX-BK-2006
Bank Lymansville pond	DIOXI	OCDF	39001020	NG/KG	6	9	45.6	67.4	13.9		175		LPX-BK-2006
Bank Lymansville pond	DIOXI	PCDD/Fs	GTI500081	NG/KG	9	9	1630	1630	23.3		5740		LPX-BK-2006
Bank Lymansville pond	DIOXI	Total HpCDD	37871004	NG/KG	7	9	225	289	30		827	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total HpCDF	38998753	NG/KG	8	9	91.3	102	1.4	EMPC	364	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total HxCDD	34465468	NG/KG	7	9	78.2	98.3	5	EMPC	253	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total HxCDF	55684941	NG/KG	9	9	112	112	2.1	EMPC	422	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total PeCDD	36088229	NG/KG	8	9	32.3	35.7	3.4	EMPC	68.8	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total PeCDF	30402154	NG/KG	9	9	105	105	2.9	EMPC	328	J	LPX-BK-2006
Bank Lymansville pond	DIOXI	Total TCDD	41903575	NG/KG	9	9	269	269	3.4	EMPC	1010	J&	LPX-BK-2007
Bank Lymansville pond	DIOXI	Total TCDF	55722275	NG/KG	9	9	118	118	5.1	EMPC	405	J	LPX-BK-2007
Bank Lymansville pond	DIOXI	Toxicity Equivalency	TEQ	NG/KG	9	9	264	264	1.1		1050		LPX-BK-2007
Bank Lymansville pond	M	Aluminum	7429905	MG/KG	9	9	6480	6480	3020		10900		LPX-BK-2006
Bank Lymansville pond	M	Antimony	7440360	MG/KG	3	9	0.72	1.5	1.3	J	1.8	J	LPX-BK-2006
Bank Lymansville pond	M	Arsenic	7440382	MG/KG	9	9	4.5	4.5	1.6		7		LPX-BK-2006
Bank Lymansville pond	M	Barium	7440393	MG/KG	9	9	51.4	51.4	18.7	J	149		LPX-BK-2007
Bank Lymansville pond	M	Beryllium	7440417	MG/KG	9	9	0.43	0.43	0.25	J	0.69		LPX-BK-2007
Bank Lymansville pond	M	Cadmium	7440439	MG/KG	2	8	0.71	2.7	0.37	J	5.1		LPX-BK-2006
Bank Lymansville pond	M	Calcium	7440702	MG/KG	9	9	1260	1260	390	J	2640	J	LPX-BK-2007
Bank Lymansville pond	M	Chromium	7440473	MG/KG	9	9	18.6	18.6	11.1		47.2	J	LPX-BK-2006
Bank Lymansville pond	M	Copper	7440508	MG/KG	9	9	31.5	31.5	12.7		66.7	J	LPX-BK-2006
Bank Lymansville pond	M	Iron	7439896	MG/KG	9	9	8210	8210	5370		12000		LPX-BK-2006
Bank Lymansville pond	M	Lead	7439921	MG/KG	9	9	121	121	17.8		308		LPX-BK-2007
Bank Lymansville pond	M	Magnesium	7439954	MG/KG	9	9	1020	1020	580	J	1520	J	LPX-BK-2007
Bank Lymansville pond	M	Manganese	7439965	MG/KG	9	9	117	117	44.1	J	167		LPX-BK-2007
Bank Lymansville pond	M	Mercury	7439976	MG/KG	9	9	0.12	0.12	0.05	J	0.21	J	LPX-BK-2006
Bank Lymansville pond	M	Potassium	7440097	MG/KG	9	9	516	516	392		694	J	LPX-BK-2006
Bank Lymansville pond	M	Vanadium	7440622	MG/KG	9	9	22.4	22.4	12.2		31.8	J	LPX-BK-2006
Bank Lymansville pond	M	Zinc	7440666	MG/KG	8	9	77.1	84.8	57.5	J	126	J	LPX-BK-2006
Bank Lymansville pond	OS	Anthracene	120127	UG/KG	1	9	720	220	220		220		LPX-BK-2007
Bank Lymansville pond	OS	BAPEQ	BAPEQ	UG/KG	8	10	460	460	0.05		1600		LPX-BK-2006
Bank Lymansville pond	OS	Benzo(a)anthracene	56553	UG/KG	5	9	740	510	62	J	1000	J	LPX-BK-2006
Bank Lymansville pond	OS	Benzo(a)pyrene	50328	UG/KG	5	9	700	440	45	J	940	J	LPX-BK-2006
Bank Lymansville pond	OS	Benzo(b)fluoranthene	205992	UG/KG	5	9	740	500	81	J	1000	J	LPX-BK-2006
Bank Lymansville pond	OS	Benzo(g,h,i)perylene	191242	UG/KG	4	9	590	250	100	J	440	J	LPX-BK-2006
Bank Lymansville pond	OS	Benzo(k)fluoranthene	207089	UG/KG	5	9	700	430	45	J	810	J	LPX-BK-2006
Bank Lymansville pond	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	5	9	550	200	47	J	280	J	LPX-BK-2006
Bank Lymansville pond	OS	Carbazole	86748	UG/KG	1	9	710	150	150		150		LPX-BK-2007
Bank Lymansville pond	OS	Chrysene	218019	UG/KG	7	9	680	470	48	J	1100	J	LPX-BK-2006
Bank Lymansville pond	OS	Di-n-Butylphthalate	84742	UG/KG	2	9	690	88	47	J	130	J	LPX-BK-2006
Bank Lymansville pond	OS	Dibenzo(a,h)anthracene	53703	UG/KG	3	9	620	260	120	J	400	J	LPX-BK-2006
Bank Lymansville pond	OS	Fluoranthene	206440	UG/KG	8	9	770	760	39	J	1900	J	LPX-BK-2006
Bank Lymansville pond	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	9	10	2800	3000	87		10000		LPX-BK-2006
Bank Lymansville pond	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	4	9	670	420	170	J	750	J	LPX-BK-2006
Bank Lymansville pond	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	7	10	600	430	160		1000		LPX-BK-2007
Bank Lymansville pond	OS	Naphthalene	91203	UG/KG	1	9	710	110	110		110		LPX-BK-2007
Bank Lymansville pond	OS	Phenanthrene	85018	UG/KG	6	9	640	450	160	J	1000		LPX-BK-2007
Bank Lymansville pond	OS	Pyrene	129000	UG/KG	6	9	820	880	110	J	1900	J	LPX-BK-2006
Bank Lymansville pond	OS	Total PAH	TOTPAH	UG/KG	9	10	3200	3400	87		11000		LPX-BK-2006
Bank Lymansville pond	PESTP	4,4'-DDT	50293	UG/KG	2	8	3.1	6.5	5.2		7.8		LPX-BK-2007
Bank Lymansville pond	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	2	8	52	84	71		98		LPX-BK-2007
Bank Lymansville pond	PESTP	Aroclor-1254	11097691	UG/KG	2	8	36	84	71		98	P	LPX-BK-2007
Bank Lymansville pond	PESTP	Dieldrin	60571	UG/KG	1	8	2.3	4.6	4.6	P	4.6	P	LPX-BK-2007

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
AQ Sed, Allendale surface	AD-01	AD-01-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	AD-02	AD-02-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	AD-03	AD-03-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	AD-04	AD-04-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	AD-05	AD-05-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	Allendale Dam	DAM002-SD	SD	Sediment/Soil	A	0	0.33
AQ Sed, Allendale surface	APB-SD-2029	APB-SD-2029-000.5-01-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	APB-SD-2034	APB-SD-2034-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	APB-SD-2037	APB-SD-2037-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	APC-SD-2035	APC-SD-2035-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	APC-SD-2036	APC-SD-2036-01-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-208	3428-CMS-208	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-208	CMS-208-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-209	3428-CMS-209	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-209	CMS-209-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-210	CMS-210-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-210	3428-CMS-210	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-211	3428-CMS-211	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-212	3428-CMS-212	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-212	CMS-212-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-213	3428-CMS-213	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-213	CMS-213-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-214	3428-CMS-214	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-214	CMS-214-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-215	3428-CMS-215	SD	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	CMS-215	CMS-215-A-1-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-215	CMS-215-A-MAX	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-600	CMS-600-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-601	CMS-601-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-602	CMS-602-A-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-603	CMS-603-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-604	CMS-604-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-605	CMS-605-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-606	CMS-606-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-607	CMS-607-A-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-608	CMS-608-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-609	CMS-609-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-610	CMS-610-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-611	CMS-611-A-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-612	CMS-612-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-613	CMS-613-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-614	CMS-614-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-615	CMS-615-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-616	CMS-616-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-617	CMS-617-A-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-618	CMS-618-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-619	CMS-619-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-620	CMS-620-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-621	CMS-621-A-MAX	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-622	CMS-622-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-623	CMS-623-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-624	CMS-624-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-625	CMS-625-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-626	CMS-626-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-627	CMS-627-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-628	CMS-628-A	SD	Sediment/Soil	A	0	1
AQ Sed, Allendale surface	CMS-629	CMS-629-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-630	CMS-630-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-631	CMS-631-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-632	CMS-632-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-633	CMS-633-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMS-634	CMS-634-A	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMW-SD-2016	CMW-SD-2016-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMW-SD-2018	CMW-SD-2018-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMW-SD-2023	CMW-SD-2023-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMW-SD-2024	CMW-SD-2024-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	CMW-SD-2025	CMW-SD-2025-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	SD-21	SD-21	FP	Sediment/Soil	A	0.5	2
AQ Sed, Allendale surface	SD-22	SD-22	FP	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	SD-23	SD-23	FP	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	SD-24	SD-24	FP	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	SD-25	SD-25	FP	Sediment/Soil	A	0	0.25
AQ Sed, Allendale surface	SD-26	SD-26	FP	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	SD-27	SD-27	FP	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	SD-28	SD-28	FP	Sediment/Soil	A	0	0.5

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
AQ Sed, Allendale surface	WRC-SD-2009	WRC-SD-2009-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2010	WRC-SD-2010-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2011	WRC-SD-2011-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2012	WRC-SD-2012-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2013	WRC-SD-2013-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2014	WRC-SD-2014-01	SD	Sediment/Soil	A	0	0.5
AQ Sed, Allendale surface	WRC-SD-2015	WRC-SD-2015-01	SD	Sediment/Soil	A	0	0.5

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Surf Allendale	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	26	30	538	619	3.8		2450		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	26	27	118	123	3		392		CMW-SD-2025
AQ SED, Surf Allendale	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	17	29	8.7	14.2	0.91	EMPC	32		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	21	30	9.3	13	0.5	EMPC	35.64	EMPC	SD-23
AQ SED, Surf Allendale	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	25	28	18.1	20.2	0.6	EMPC	90		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	26	29	26.3	29.3	0.61	EMPC	91.1		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	27	27	14.2	14.2	0.33	EMPC	39.3		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	25	30	26.4	31.6	1	J	89.2		CMW-SD-2025
AQ SED, Surf Allendale	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	11	22	3.9	7.6	1.2	J	26.7		CMW-SD-2025
AQ SED, Surf Allendale	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	20	29	6.4	9	0.41	J	44		AD-04
AQ SED, Surf Allendale	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	21	27	8	10.1	0.58	J	58.5	EMPC	WRC-SD-2015
AQ SED, Surf Allendale	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	21	23	40800	44700	1.94	J	364758	J	SD-23
AQ SED, Surf Allendale	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	20	29	11	15.8	0.66	EMPC	51.4		AD-04
AQ SED, Surf Allendale	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	23	30	8.4	10.8	0.57	EMPC	84.5		AD-04
AQ SED, Surf Allendale	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	78	80	5120	5250	0.68		46000	J	CMS-605
AQ SED, Surf Allendale	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	26	30	14.4	16.6	0.8	EMPC	72.3		AD-04
AQ SED, Surf Allendale	DIOXI	3,3',4,4'-Tetrachlorobiphenyl (77)	32598133	NG/KG	1	1	1120	1120	1120		1120		Allendale Dam
AQ SED, Surf Allendale	DIOXI	OCDD	3268879	NG/KG	26	30	3350	3850	17		14900		AD-04
AQ SED, Surf Allendale	DIOXI	OCDF	39001020	NG/KG	22	27	248	303	5.8		1158.08	J	SD-22
AQ SED, Surf Allendale	DIOXI	PCDD/Fs	GTI500081	NG/KG	26	30	7170	8260	48.8		61300		AD-04
AQ SED, Surf Allendale	DIOXI	Total HpCDD	37871004	NG/KG	20	21	848	890	7.7		4210		AD-04
AQ SED, Surf Allendale	DIOXI	Total HpCDF	38998753	NG/KG	21	21	329	329	3		1500		AD-04
AQ SED, Surf Allendale	DIOXI	Total HxCDD	34465468	NG/KG	18	21	167	195	8.6	J	780		AD-04
AQ SED, Surf Allendale	DIOXI	Total HxCDF	55684941	NG/KG	19	21	292	323	4.6		1500		AD-04
AQ SED, Surf Allendale	DIOXI	Total PeCDD	36088229	NG/KG	18	21	36.6	42.7	1.4	EMPC	285		AD-04
AQ SED, Surf Allendale	DIOXI	Total PeCDF	30402154	NG/KG	19	21	207	229	6.1		1500		AD-04
AQ SED, Surf Allendale	DIOXI	Total TCDD	41903575	NG/KG	21	21	3120	3120	0.68		35100		AD-04
AQ SED, Surf Allendale	DIOXI	Total TCDF	55722275	NG/KG	20	20	190	190	0.73		1500		AD-04
AQ SED, Surf Allendale	DIOXI	Toxicity Equivalency	TEQ	NG/KG	80	80	5150	5150	1.3		46000		CMS-605
AQ SED, Surf Allendale	M	Aluminum	7429905	MG/KG	19	19	6980	6980	1260		16200		APC-SD-2036
AQ SED, Surf Allendale	M	Antimony	7440360	MG/KG	6	19	1.4	2.7	1.1		3.5		APB-SD-2037
AQ SED, Surf Allendale	M	Arsenic	7440382	MG/KG	14	24	7.5	4.5	1.1	J	9.9		CMS-215
AQ SED, Surf Allendale	M	Barium	7440393	MG/KG	18	24	95.2	121	9.8		326		APC-SD-2036
AQ SED, Surf Allendale	M	Beryllium	7440417	MG/KG	16	19	1.5	1.7	0.23	J	4.6		APC-SD-2036
AQ SED, Surf Allendale	M	Cadmium	7440439	MG/KG	10	24	0.84	1.7	0.17		4.3		AD-04
AQ SED, Surf Allendale	M	Calcium	7440702	MG/KG	17	19	1790	1970	383		4120		APB-SD-2037
AQ SED, Surf Allendale	M	Chromium	7440473	MG/KG	24	24	96.7	96.7	2.5	J	382		AD-04
AQ SED, Surf Allendale	M	Cobalt	7440484	MG/KG	19	19	6.1	6.1	1	J	16.2		APC-SD-2036
AQ SED, Surf Allendale	M	Copper	7440508	MG/KG	19	19	101	101	5.5		388		APB-SD-2037
AQ SED, Surf Allendale	M	Iron	7439896	MG/KG	19	19	15200	15200	3200		65000		WRC-SD-2012
AQ SED, Surf Allendale	M	Lead	7439921	MG/KG	24	24	199	199	9.2		719		APB-SD-2037
AQ SED, Surf Allendale	M	Magnesium	7439954	MG/KG	19	19	1440	1440	497		3270		CMS-215
AQ SED, Surf Allendale	M	Manganese	7439965	MG/KG	19	19	437	437	39.1		2050		WRC-SD-2012
AQ SED, Surf Allendale	M	Mercury	7439976	MG/KG	22	23	0.45	0.47	0.02	J	3.6		CMW-SD-2023
AQ SED, Surf Allendale	M	Molybdenum	7439987	MG/KG	1	1	12.2	12.2	12.2		12.2		CMS-215
AQ SED, Surf Allendale	M	Nickel	7440020	MG/KG	19	19	24.3	24.3	2	J	90.6		APC-SD-2036
AQ SED, Surf Allendale	M	Potassium	7440097	MG/KG	17	18	658	688	261		1370		CMS-215
AQ SED, Surf Allendale	M	Selenium	7782492	MG/KG	6	24	4.7	1.7	1.1	J	2.2		CMS-215
AQ SED, Surf Allendale	M	Silver	7440224	MG/KG	10	24	3.3	6.6	0.33		16		WRC-SD-2012
AQ SED, Surf Allendale	M	Sodium	7440235	MG/KG	3	18	96.3	228	213	J	238		CMS-215
AQ SED, Surf Allendale	M	Thallium	7440280	MG/KG	1	18	17.1	0.47	0.47	J	0.47	J	APB-SD-2037
AQ SED, Surf Allendale	M	Vanadium	7440622	MG/KG	18	19	26.7	28.1	5.1		89.3		WRC-SD-2015
AQ SED, Surf Allendale	M	Zinc	7440666	MG/KG	17	19	324	360	57.6		943		APC-SD-2036
AQ SED, Surf Allendale	OS	2-Methylnaphthalene	91576	UG/KG	2	23	1400	130	74		190		AD-04
AQ SED, Surf Allendale	OS	Acenaphthene	83329	UG/KG	7	24	1200	440	150		1100	J	WRC-SD-2011
AQ SED, Surf Allendale	OS	Acenaphthylene	208968	UG/KG	4	24	1300	400	120		770		AD-04
AQ SED, Surf Allendale	OS	Anthracene	120127	UG/KG	12	24	1300	880	120	J	3500	J	WRC-SD-2011
AQ SED, Surf Allendale	OS	BAPEQ	BAPEQ	UG/KG	23	24	2900	3100	12		13000		CMW-SD-2018
AQ SED, Surf Allendale	OS	Benzo(a)anthracene	56553	UG/KG	22	24	2200	2200	33		8500		CMW-SD-2018
AQ SED, Surf Allendale	OS	Benzo(a)pyrene	50328	UG/KG	22	24	1900	2100	70		8900		CMW-SD-2018
AQ SED, Surf Allendale	OS	Benzo(b)fluoranthene	205992	UG/KG	22	24	2500	2700	54		9400		Allendale Dam
AQ SED, Surf Allendale	OS	Benzo(g,h,i)perylene	191242	UG/KG	11	24	1700	1700	67		5300		CMW-SD-2018
AQ SED, Surf Allendale	OS	Benzo(k)fluoranthene	207089	UG/KG	22	24	2400	2600	67		8800		CMW-SD-2018
AQ SED, Surf Allendale	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	10	18	2100	2500	170	J	12000		WRC-SD-2015
AQ SED, Surf Allendale	OS	Butylbenzylphthalate	85687	UG/KG	2	18	1500	88	83	J	94	J	CMW-SD-2016
AQ SED, Surf Allendale	OS	Carbazole	86748	UG/KG	8	18	1500	780	110	J	2000	J	CMW-SD-2018
AQ SED, Surf Allendale	OS	Chrysene	218019	UG/KG	22	24	2700	2900	80		11000		CMW-SD-2018
AQ SED, Surf Allendale	OS	Dibenzo(a,h)anthracene	53703	UG/KG	13	24	1200	760	71		2200		CMW-SD-2018
AQ SED, Surf Allendale	OS	Dibenzofuran	132649	UG/KG	3	18	1600	520	120	J	920	J	WRC-SD-2011

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
AQ Sed, Allendale deep	AD-01	AD-01-C-MAX	SD	Sediment/Soil	B	10.7	11.7
AQ Sed, Allendale deep	AD-01	AD-01-B-MAX	SD	Sediment/Soil	B	9	10
AQ Sed, Allendale deep	AD-02	AD-02-C-MAX	SD	Sediment/Soil	B	11	12
AQ Sed, Allendale deep	AD-02	AD-02-B-MAX	SD	Sediment/Soil	B	7	9
AQ Sed, Allendale deep	AD-03	AD-03-C-MAX	SD	Sediment/Soil	B	6	7
AQ Sed, Allendale deep	AD-04	AD-04-B-MAX	SD	Sediment/Soil	B	2	3
AQ Sed, Allendale deep	AD-04	AD-04-C-MAX	SD	Sediment/Soil	B	9	10
AQ Sed, Allendale deep	APB-SD-2029	APB-SD-2029-0203-01	SD	Sediment/Soil	B	2	3
AQ Sed, Allendale deep	APB-SD-2029	APB-SD-2029-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ Sed, Allendale deep	APC-SD-2035	APC-SD-2035-0204-01	SD	Sediment/Soil	B	2	4
AQ Sed, Allendale deep	APC-SD-2035	APC-SD-2035-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ Sed, Allendale deep	APC-SD-2035	APC-SD-2035-0405-01	SD	Sediment/Soil	B	4	5
AQ Sed, Allendale deep	CMS-208	CMS-208-B	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-210	CMS-210-B	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-213	CMS-213-B	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-214	CMS-214-B-MAX	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-215	CMS-215-D-1	SD	Sediment/Soil	B	3	4
AQ Sed, Allendale deep	CMS-215	CMS-215-B-1-MAX	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-215	CMS-215-C-1-MAX	SD	Sediment/Soil	B	2	3
AQ Sed, Allendale deep	CMS-605	CMS-605-D	SD	Sediment/Soil	B	3	4
AQ Sed, Allendale deep	CMS-605	CMS-605-E	SD	Sediment/Soil	B	4	5
AQ Sed, Allendale deep	CMS-605	CMS-605-C	SD	Sediment/Soil	B	2	3
AQ Sed, Allendale deep	CMS-605	CMS-605-B	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-615	CMS-615-B	SD	Sediment/Soil	B	1	1.5
AQ Sed, Allendale deep	CMS-628	CMS-628-C	SD	Sediment/Soil	B	2	3
AQ Sed, Allendale deep	CMS-628	CMS-628-B	SD	Sediment/Soil	B	1	2
AQ Sed, Allendale deep	CMS-628	CMS-628-D	SD	Sediment/Soil	B	3	4
AQ Sed, Allendale deep	CMW-SD-2025	CMW-SD-2025-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ Sed, Allendale deep	WRC-SD-2011	WRC-SD-2011-0.51.5-01	SD	Sediment/Soil	B	0.5	1.5

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Surf Allendale	OS	Fluoranthene	206440	UG/KG	23	24	5300	5500	80		24000	*	CMW-SD-2018
AQ SED, Surf Allendale	OS	Fluorene	86737	UG/KG	9	24	1200	520	58	J	1600	J	WRC-SD-2011
AQ SED, Surf Allendale	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	24	25	23000	23000	290		100000		CMW-SD-2018
AQ SED, Surf Allendale	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	22	24	1500	1500	35		5400		Allendale Dam
AQ SED, Surf Allendale	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	20	25	3600	4400	130		20000		WRC-SD-2011
AQ SED, Surf Allendale	OS	Naphthalene	91203	UG/KG	3	24	1300	170	110		250		AD-04
AQ SED, Surf Allendale	OS	Phenanthrene	85018	UG/KG	20	24	2900	3400	130	J	14000		CMW-SD-2018, WRC-SD-2011
AQ SED, Surf Allendale	OS	Pyrene	129000	UG/KG	22	24	4400	4700	70		23000	*	CMW-SD-2018
AQ SED, Surf Allendale	OS	Total PAH	TOTPAH	UG/KG	24	25	26000	27000	290		120000		CMW-SD-2018
AQ SED, Surf Allendale	OS	Total Semi-Volatile Organics	GTI500035	UG/KG	6	6	15000	15000	290		45000		AD-04
AQ SED, Surf Allendale	OV	Total Volatile Organics	GTI500034	UG/KG	1	1	41	41	41		41		CMS-215
AQ SED, Surf Allendale	PCBC	3,3',4,4'-Tetrachlorobiphenyl (77)	32598133	NG/KG	1	1	1100	1100	1120		1120		Allendale Dam
AQ SED, Surf Allendale	PESTP	4,4'-DDD	72548	UG/KG	3	27	5.4	7.7	2.4	J	16		Allendale Dam
AQ SED, Surf Allendale	PESTP	4,4'-DDE	72559	UG/KG	14	31	12	24	0.38	J	170		AD-04
AQ SED, Surf Allendale	PESTP	4,4'-DDT	50293	UG/KG	4	28	5.8	10	4.6	J	21		WRC-SD-2015
AQ SED, Surf Allendale	PESTP	Aldrin	309002	UG/KG	1	27	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	alpha-BHC	319846	UG/KG	1	27	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	alpha-Chlordane	5103719	UG/KG	14	27	5.2	9.1	1.2	J	34		Allendale Dam
AQ SED, Surf Allendale	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	62	67	2300	2500	11	J	28000		CMS-607
AQ SED, Surf Allendale	PESTP	Aroclor-1016	12674112	UG/KG	1	62	400	46	46	J	46	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Aroclor-1221	11104282	UG/KG	1	62	350	93	93	J	93	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Aroclor-1232	11141165	UG/KG	1	62	670	46	46	J	46	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Aroclor-1242	53469219	UG/KG	1	62	460	46	46	J	46	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Aroclor-1248	12672296	UG/KG	9	63	550	66	16	J	140		WRC-SD-2015
AQ SED, Surf Allendale	PESTP	Aroclor-1254	11097691	UG/KG	61	67	2300	2500	11	J	28000		CMS-607
AQ SED, Surf Allendale	PESTP	Aroclor-1260	11096825	UG/KG	2	62	410	160	46	J	270		WRC-SD-2015
AQ SED, Surf Allendale	PESTP	Aroclor-1268	11100144	UG/KG	1	1	120	120	120		120		Allendale Dam
AQ SED, Surf Allendale	PESTP	beta-BHC	319857	UG/KG	3	25	2.7	3.7	2.4	J	6.2		CMS-215
AQ SED, Surf Allendale	PESTP	delta-BHC	319868	UG/KG	1	27	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Dieldrin	60571	UG/KG	6	28	11	38	4.6	J	170		AD-04
AQ SED, Surf Allendale	PESTP	Endosulfan I	959988	UG/KG	2	27	2.5	12	2.4	J	21		AD-04
AQ SED, Surf Allendale	PESTP	Endosulfan II	33213659	UG/KG	10	28	16	34	7	J	160	*	WRC-SD-2015
AQ SED, Surf Allendale	PESTP	Endosulfan Sulfate	1031078	UG/KG	3	26	4.9	2.9	1.8	J	4.6	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Endrin	72208	UG/KG	2	27	5	5.2	4.6	J	5.7		WRC-SD-2015
AQ SED, Surf Allendale	PESTP	Endrin aldehyde	7421934	UG/KG	5	26	5.6	6.5	0.77	J	22		CMS-215
AQ SED, Surf Allendale	PESTP	Endrin Ketone	53494705	UG/KG	3	27	5.8	11	4.6	J	23		Allendale Dam
AQ SED, Surf Allendale	PESTP	gamma-BHC	58899	UG/KG	1	27	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	gamma-Chlordane	5103742	UG/KG	18	26	5.6	6.4	2.4	J	13		CMW-SD-2023
AQ SED, Surf Allendale	PESTP	Heptachlor	76448	UG/KG	1	27	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Heptachlor Epoxide	1024573	UG/KG	1	26	2.5	2.4	2.4	J	2.4	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Methoxychlor	72435	UG/KG	8	30	22	12	3.5	J	24	J	WRC-SD-2010
AQ SED, Surf Allendale	PESTP	Technical Chlordane	57749	UG/KG	2	6	13	24	17		30		AD-04
AQ SED, Surf Allendale	PESTP	Toxaphene	8001352	UG/KG	1	27	160	240	240	J	240	J	WRC-SD-2010
AQ SED, Surf Allendale	TOC	Total Organic Carbon	7440440	MG/KG	31	31	55000	55000	1120		202000		SD-23

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Deep Allendale	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	8	14	45.6	79.3	5.2		260		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	11	14	54.7	69.6	1.3	J	593		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	3	14	1.8	6.8	1.3	J	15.3		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	4	14	1.1	2.9	0.76	J	5.7		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	5	14	4	10.4	1.7	J	36.9		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	4	14	2.9	9.2	2.2	J	20.1		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	6	8	5.7	7.5	1.1	EMPC	32.5	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	6	14	2.9	6.5	1.7	J	19.4		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	2	14	0.73	3.7	3.1	J	4.3	J	CMW-SD-2025
AQ SED, Deep Allendale	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	2	14	0.89	4.3	2.8	J	5.8		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	5	14	1.6	3.9	0.96	J	12.2		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	6	6	144	144	4	J	717.71	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	4	14	2.9	9.6	1.3	J	33.2		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	4	14	1.5	4.4	1.1	J	12.1		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	23	26	4420	5000	1.4		110000	J	CMS-208
AQ SED, Deep Allendale	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	7	14	2.8	5.5	1.1		23.4		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	OCDD	3268879	NG/KG	13	14	322	347	5.8		1890	EB	CMW-SD-2025
AQ SED, Deep Allendale	DIOXI	OCDF	39001020	NG/KG	7	13	44.3	81.3	3.1	J	353		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	PCDD/Fs	GTI500081	NG/KG	14	14	847	847	6.5		5850		APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total HpCDD	37871004	NG/KG	8	14	87.3	152	9.5	J	536	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total HpCDF	38998753	NG/KG	11	14	98.4	125	3.2	J	1040	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total HxCDD	34465468	NG/KG	4	14	23.2	76.4	15.8	J	192	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total HxCDF	55684941	NG/KG	9	14	65.8	102	0.77	J	699	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total PeCDD	36088229	NG/KG	4	14	5.5	17.6	3	J	48.5	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total PeCDF	30402154	NG/KG	8	14	36.8	64.1	0.96	EMPC	373	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total TCDD	41903575	NG/KG	12	14	139	162	1.4		690	J$	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Total TCDF	55722275	NG/KG	10	14	30.6	42.8	0.95		298	J	APC-SD-2035
AQ SED, Deep Allendale	DIOXI	Toxicity Equivalency	TEQ	NG/KG	26	26	4430	4430	0.52		110000		CMS-208
AQ SED, Deep Allendale	M	Aluminum	7429905	MG/KG	7	7	5100	5100	1790		10800		APC-SD-2035
AQ SED, Deep Allendale	M	Antimony	7440360	MG/KG	1	7	0.71	3	3	J	3	J	APC-SD-2035
AQ SED, Deep Allendale	M	Arsenic	7440382	MG/KG	6	14	8.4	2.7	0.81	J	5.6		APC-SD-2035
AQ SED, Deep Allendale	M	Barium	7440393	MG/KG	11	14	28.6	33.8	10.5		117		APC-SD-2035
AQ SED, Deep Allendale	M	Beryllium	7440417	MG/KG	6	7	0.64	0.71	0.22		1.4		APC-SD-2035
AQ SED, Deep Allendale	M	Cadmium	7440439	MG/KG	1	14	0.24	0.99	0.99		0.99		APC-SD-2035
AQ SED, Deep Allendale	M	Calcium	7440702	MG/KG	7	7	757	757	313		1370	J	CMW-SD-2025
AQ SED, Deep Allendale	M	Chromium	7440473	MG/KG	14	14	20.8	20.8	4.1		147		APC-SD-2035
AQ SED, Deep Allendale	M	Cobalt	7440484	MG/KG	5	7	2.8	3.7	1.7	J	6		APC-SD-2035
AQ SED, Deep Allendale	M	Copper	7440508	MG/KG	7	7	19.3	19.3	1.8	J	86.6		APC-SD-2035
AQ SED, Deep Allendale	M	Iron	7439896	MG/KG	7	7	7950	7950	3550		14300		APC-SD-2035
AQ SED, Deep Allendale	M	Lead	7439921	MG/KG	14	14	29.6	29.6	4.6		199		APC-SD-2035
AQ SED, Deep Allendale	M	Magnesium	7439954	MG/KG	7	7	681	681	396	J	1240		APC-SD-2035
AQ SED, Deep Allendale	M	Manganese	7439965	MG/KG	7	7	135	135	49.9		283		APC-SD-2035
AQ SED, Deep Allendale	M	Mercury	7439976	MG/KG	11	11	0.15	0.15	0.0061		1		CMW-SD-2025
AQ SED, Deep Allendale	M	Nickel	7440020	MG/KG	6	7	4.4	5	1.4	J	15.3		APC-SD-2035
AQ SED, Deep Allendale	M	Potassium	7440097	MG/KG	7	7	400	400	169	J	657	J	APC-SD-2035
AQ SED, Deep Allendale	M	Selenium	7782492	MG/KG	1	14	7.3	0.94	0.94	J	0.94	J	APC-SD-2035
AQ SED, Deep Allendale	M	Vanadium	7440622	MG/KG	7	7	12.9	12.9	5.2		27.7		APC-SD-2035
AQ SED, Deep Allendale	M	Zinc	7440666	MG/KG	3	7	78.1	166	67		316		APC-SD-2035
AQ SED, Deep Allendale	OS	Anthracene	120127	UG/KG	2	14	720	340	49	J	640	J	WRC-SD-2011
AQ SED, Deep Allendale	OS	BAPEQ	BAPEQ	UG/KG	6	14	440	930	11		2500		CMW-SD-2025
AQ SED, Deep Allendale	OS	Benzo(a)anthracene	56553	UG/KG	5	14	750	780	47	J	1900	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Benzo(a)pyrene	50328	UG/KG	5	14	460	900	83	J	2000	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Benzo(b)fluoranthene	205992	UG/KG	6	14	440	730	55	J	1600	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Benzo(g,h,i)perylene	191242	UG/KG	1	14	840	110	110		110		AD-04
AQ SED, Deep Allendale	OS	Benzo(k)fluoranthene	207089	UG/KG	6	14	450	750	68	J	1500	J	CMW-SD-2025, WRC-SD-2011
AQ SED, Deep Allendale	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	2	7	930	550	93	J	1000	J	APC-SD-2035
AQ SED, Deep Allendale	OS	Chrysene	218019	UG/KG	6	14	540	960	66	J	2300	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Fluoranthene	206440	UG/KG	7	14	840	1500	46	J	4800		WRC-SD-2011
AQ SED, Deep Allendale	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	7	14	3300	6300	46		17000		CMW-SD-2025
AQ SED, Deep Allendale	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	3	14	640	610	110		950	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	5	14	840	1000	45		3900		WRC-SD-2011
AQ SED, Deep Allendale	OS	Phenanthrene	85018	UG/KG	5	14	790	890	45	J	3300	J	WRC-SD-2011
AQ SED, Deep Allendale	OS	Pyrene	129000	UG/KG	6	14	780	1500	67	J	3800	J	CMW-SD-2025
AQ SED, Deep Allendale	OS	Total PAH	TOTPAH	UG/KG	7	14	3600	7000	46		20000		WRC-SD-2011
AQ SED, Deep Allendale	OS	Total Semi-Volatile Organics	GTI500035	UG/KG	7	7	500	500	360		1300		AD-04
AQ SED, Deep Allendale	PESTP	4,4'-DDE	72559	UG/KG	1	13	2.2	3.5	3.5		3.5		AD-04
AQ SED, Deep Allendale	PESTP	alpha-Chlordane	5103719	UG/KG	3	13	1.4	2.7	0.49		4.8		CMW-SD-2025
AQ SED, Deep Allendale	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	14	20	260	360	10	J	2700		CMS-605
AQ SED, Deep Allendale	PESTP	Aroclor-1248	12672296	UG/KG	3	20	74	41	26	J	54		CMW-SD-2025

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Deep Allendale	PESTP	Aroclor-1254	11097691	UG/KG	14	20	250	350	10	J	2700		CMS-605
AQ SED, Deep Allendale	PESTP	Dieldrin	60571	UG/KG	1	13	2.1	1.4	1.4		1.4		AD-04
AQ SED, Deep Allendale	PESTP	Endosulfan I	959988	UG/KG	1	13	1	0.55	0.55		0.55		AD-04
AQ SED, Deep Allendale	PESTP	Endosulfan II	33213659	UG/KG	3	13	4.1	11	1.2		22		APC-SD-2035
AQ SED, Deep Allendale	PESTP	Endrin Aldehyde	7421934	UG/KG	1	13	4.8	38	38		38		CMW-SD-2025
AQ SED, Deep Allendale	PESTP	gamma-Chlordane	5103742	UG/KG	3	13	1.8	4.5	2.7		5.5		APC-SD-2035
AQ SED, Deep Allendale	PESTP	Technical Chlordane	57749	UG/KG	1	6	0.88	0.49	0.49		0.49		AD-04
AQ SED, Deep Allendale	TOC	Total Organic Carbon	7440440	MG/KG	7	7	4900	4900	506		9310		AD-02

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
AQ sed, Lymansville Surface	LPX-SD-2045	LPX-SD-2045-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2046	LPX-SD-2046-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2047	LPX-SD-2047-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2048	LPX-SD-2048-000.5-01-MAX	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2049	LPX-SD-2049-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2050	LPX-SD-2050-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2051	LPX-SD-2051-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2052	LPX-SD-2052-000.5-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	LPX-SD-2053	LPX-SD-2053-000.5-01-MAX	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	Lymansville Dam	DAM003-SD	SD	Sediment/Soil	A	0	0.33
AQ sed, Lymansville Surface	WRL-SD-2039	WRL-SD-2039-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	WRL-SD-2040	WRL-SD-2040-01-MAX	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	WRL-SD-2041	WRL-SD-2041-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	WRL-SD-2042	WRL-SD-2042-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	WRL-SD-2043	WRL-SD-2043-01	SD	Sediment/Soil	A	0	0.5
AQ sed, Lymansville Surface	WRL-SD-2044	WRL-SD-2044-000.5-01	SD	Sediment/Soil	A	0	0.5

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Surf Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	16	16	827	827	9.2		1830	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	16	16	271	271	3.2	EMPC	575	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	13	15	16.1	18.4	10.3		32.2	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	14	16	14.6	16.6	5.8		31	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	13	15	29.9	34.4	14.1		56.5	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	15	16	39.1	41.6	0.41		83.6	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	13	14	22.5	24.2	10.4	J	45.4	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	13	15	38.6	44.4	16.6		95.9	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	7	16	1.8	3.4	1.1		9.77		Lymansville Dam
AQ SED, Surf Lymansville	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	13	15	12.1	13.9	3.7	J	39.2	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	13	15	10.7	12.3	2.5	J	24.2	J	LPX-SD-2051
AQ SED, Surf Lymansville	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	15	15	2480	2480	12.56		17500		Lymansville Dam
AQ SED, Surf Lymansville	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	13	15	23.4	26.9	12.8		49.6	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	13	14	13.4	14.4	4.9	J	24.1	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	16	16	3450	3450	28.7	J	7610	J&	LPX-SD-2045
AQ SED, Surf Lymansville	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	14	15	32.3	34.6	1.9	J	73.6	J	WRL-SD-2044
AQ SED, Surf Lymansville	DIOXI	3,3',4,4'-Tetrachlorobiphenyl (77)	32598133	NG/KG	1	1	1500	1500	1500		1500		Lymansville Dam
AQ SED, Surf Lymansville	DIOXI	OCDD	3268879	NG/KG	16	16	4770	4770	48.6		11800		Lymansville Dam
AQ SED, Surf Lymansville	DIOXI	OCDF	39001020	NG/KG	15	16	437	466	4.2		904	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	PCDD/Fs	GTI500081	NG/KG	16	16	11900	11900	110		24600		LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Total HpCDD	37871004	NG/KG	15	15	1670	1670	16.7	J	3710	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Total HpCDF	38998753	NG/KG	15	15	605	605	3.2	EMPC	1280	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	Total HxCDD	34465468	NG/KG	14	15	317	340	3.2		739	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Total HxCDF	55684941	NG/KG	14	15	417	446	6.6		875	J	LPX-SD-2052
AQ SED, Surf Lymansville	DIOXI	Total PeCDD	36088229	NG/KG	14	15	74	79.2	0.92		209	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Total PeCDF	30402154	NG/KG	15	15	313	313	1.4	EMPC	783	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Total TCDD	41903575	NG/KG	15	15	3360	3360	28.7	J	7840	J&	LPX-SD-2045
AQ SED, Surf Lymansville	DIOXI	Total TCDF	55722275	NG/KG	15	15	439	439	3.6	J	1300	J	LPX-SD-2050
AQ SED, Surf Lymansville	DIOXI	Toxicity Equivalency	TEQ	NG/KG	16	16	3500	3500	30.9		7670		LPX-SD-2045
AQ SED, Surf Lymansville	M	Aluminum	7429905	MG/KG	16	16	10600	10600	2260		18300		Lymansville Dam
AQ SED, Surf Lymansville	M	Antimony	7440360	MG/KG	14	16	2.6	2.6	0.87	J	8.2	J	WRL-SD-2044
AQ SED, Surf Lymansville	M	Arsenic	7440382	MG/KG	14	16	6.3	6	2		11.4		WRL-SD-2044
AQ SED, Surf Lymansville	M	Barium	7440393	MG/KG	16	16	156	156	22.6		342		LPX-SD-2052
AQ SED, Surf Lymansville	M	Beryllium	7440417	MG/KG	16	16	2	2	0.25		4.3		LPX-SD-2052
AQ SED, Surf Lymansville	M	Cadmium	7440439	MG/KG	15	16	1.8	1.9	0.17		4.6		Lymansville Dam
AQ SED, Surf Lymansville	M	Calcium	7440702	MG/KG	16	16	3050	3050	338		5860		LPX-SD-2050
AQ SED, Surf Lymansville	M	Chromium	7440473	MG/KG	16	16	109	109	6.9		204		Lymansville Dam
AQ SED, Surf Lymansville	M	Cobalt	7440484	MG/KG	13	16	10.3	12.2	5.5		23.4	J	WRL-SD-2044
AQ SED, Surf Lymansville	M	Copper	7440508	MG/KG	15	16	117	124	20.1		224		LPX-SD-2052
AQ SED, Surf Lymansville	M	Iron	7439896	MG/KG	16	16	18100	18100	5780		39600		WRL-SD-2044
AQ SED, Surf Lymansville	M	Lead	7439921	MG/KG	16	16	264	264	12.2		471		WRL-SD-2044
AQ SED, Surf Lymansville	M	Magnesium	7439954	MG/KG	16	16	2210	2210	597		3620		Lymansville Dam
AQ SED, Surf Lymansville	M	Manganese	7439965	MG/KG	16	16	681	681	183		1970		LPX-SD-2050
AQ SED, Surf Lymansville	M	Mercury	7439976	MG/KG	14	16	0.39	0.44	0.11		1.2		LPX-SD-2048
AQ SED, Surf Lymansville	M	Nickel	7440020	MG/KG	15	16	45.5	48.3	6.5		113		LPX-SD-2050
AQ SED, Surf Lymansville	M	Potassium	7440097	MG/KG	15	15	1150	1150	341		1980	J	LPX-SD-2052
AQ SED, Surf Lymansville	M	Selenium	7782492	MG/KG	4	16	1.2	1.7	1.2	J	2.7	J	LPX-SD-2050
AQ SED, Surf Lymansville	M	Silver	7440224	MG/KG	11	16	6.3	8.3	2.7	J	14.6		WRL-SD-2044
AQ SED, Surf Lymansville	M	Sodium	7440235	MG/KG	4	15	128	130	38.1		301		WRL-SD-2044
AQ SED, Surf Lymansville	M	Thallium	7440280	MG/KG	2	16	0.78	0.76	0.73		0.78	J	WRL-SD-2041
AQ SED, Surf Lymansville	M	Vanadium	7440622	MG/KG	16	16	33.8	33.8	7.3		72.7		WRL-SD-2044
AQ SED, Surf Lymansville	M	Zinc	7440666	MG/KG	16	16	520	520	44.9		1550	J	WRL-SD-2044
AQ SED, Surf Lymansville	OS	Acenaphthene	83329	UG/KG	2	16	1400	110	92	J	120		Lymansville Dam
AQ SED, Surf Lymansville	OS	Acenaphthylene	208968	UG/KG	1	16	1400	280	280		280		Lymansville Dam
AQ SED, Surf Lymansville	OS	Anthracene	120127	UG/KG	4	16	1300	340	60	J	550	J	WRL-SD-2042
AQ SED, Surf Lymansville	OS	BAPEQ	BAPEQ	UG/KG	13	16	1400	1600	62		5300		Lymansville Dam
AQ SED, Surf Lymansville	OS	Benzo(a)anthracene	56553	UG/KG	11	16	1400	1200	300		2900	J	WRL-SD-2042
AQ SED, Surf Lymansville	OS	Benzo(a)pyrene	50328	UG/KG	12	16	1400	1200	310		3500		Lymansville Dam
AQ SED, Surf Lymansville	OS	Benzo(b)fluoranthene	205992	UG/KG	13	16	1500	1500	300		6000		Lymansville Dam
AQ SED, Surf Lymansville	OS	Benzo(g,h,i)perylene	191242	UG/KG	10	16	1200	700	56	J	3000		Lymansville Dam
AQ SED, Surf Lymansville	OS	Benzo(k)fluoranthene	207089	UG/KG	13	16	1200	1200	250		3500	J	WRL-SD-2042
AQ SED, Surf Lymansville	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	11	15	1200	940	110		2500	J	LPX-SD-2052
AQ SED, Surf Lymansville	OS	Butylbenzylphthalate	85687	UG/KG	3	15	1400	340	130	J	660		LPX-SD-2048
AQ SED, Surf Lymansville	OS	Carbazole	86748	UG/KG	2	15	1500	160	79	J	250	J	WRL-SD-2041
AQ SED, Surf Lymansville	OS	Chrysene	218019	UG/KG	13	16	1600	1600	370		4400		Lymansville Dam
AQ SED, Surf Lymansville	OS	Di-n-Butylphthalate	84742	UG/KG	2	15	1500	82	64	J	99	J	WRL-SD-2041
AQ SED, Surf Lymansville	OS	Dibenzo(a,h)anthracene	53703	UG/KG	4	16	1300	480	120	J	920	J	WRL-SD-2042
AQ SED, Surf Lymansville	OS	Dibenzofuran	132649	UG/KG	1	15	1500	54	54	J	54	J	WRL-SD-2041
AQ SED, Surf Lymansville	OS	Fluoranthene	206440	UG/KG	15	16	2500	2600	360	J	7800		WRL-SD-2042

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
AQ sed, Lymansville deep	LPX-SD-2046	LPX-SD-2046-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ sed, Lymansville deep	LPX-SD-2046	LPX-SD-2046-0204-01	SD	Sediment/Soil	B	2	4
AQ sed, Lymansville deep	LPX-SD-2048	LPX-SD-2048-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ sed, Lymansville deep	LPX-SD-2048	LPX-SD-2048-0204-01	SD	Sediment/Soil	B	2	4
AQ sed, Lymansville deep	LPX-SD-2052	LPX-SD-2052-0.504-01	SD	Sediment/Soil	B	0.5	4
AQ sed, Lymansville deep	LPX-SD-2053	LPX-SD-2053-0204-01	SD	Sediment/Soil	B	2	4
AQ sed, Lymansville deep	LPX-SD-2053	LPX-SD-2053-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ sed, Lymansville deep	WRL-SD-2044	WRL-SD-2044-0.502-01	SD	Sediment/Soil	B	0.5	2
AQ sed, Lymansville deep	WRL-SD-2044	WRL-SD-2044-0203-01	SD	Sediment/Soil	B	2	3

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Surf Lymansville	OS	Fluorene	86737	UG/KG	2	16	1400	170	130	J	210		Lymansville Dam
AQ SED, Surf Lymansville	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	15	16	11000	11000	650		40000		Lymansville Dam
AQ SED, Surf Lymansville	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	11	16	1200	980	180		3500		Lymansville Dam
AQ SED, Surf Lymansville	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	11	16	1600	1600	320		3800		Lymansville Dam
AQ SED, Surf Lymansville	OS	Naphthalene	91203	UG/KG	1	16	1400	67	67		67		Lymansville Dam
AQ SED, Surf Lymansville	OS	Phenanthrene	85018	UG/KG	11	16	1500	1400	320	J	3000	J	WRL-SD-2042
AQ SED, Surf Lymansville	OS	Pyrene	129000	UG/KG	14	16	2100	2200	290	J	6500		Lymansville Dam
AQ SED, Surf Lymansville	OS	Total PAH	TOTPAH	UG/KG	15	16	12000	13000	650		44000		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	4,4'-DDD	72548	UG/KG	2	16	3.7	13	6.2		19		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	4,4'-DDE	72559	UG/KG	1	16	4.8	35	35		35		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	alpha-Chlordane	5103719	UG/KG	7	16	7.1	15	2.7		40		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	16	16	220	220	31		1191		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	Aroclor-1248	12672296	UG/KG	10	15	33	37	16	J	87		LPX-SD-2048
AQ SED, Surf Lymansville	PESTP	Aroclor-1254	11097691	UG/KG	15	16	180	190	31		1100		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	Aroclor-1260	11096825	UG/KG	5	15	28	34	29	J	43	J	LPX-SD-2049
AQ SED, Surf Lymansville	PESTP	Aroclor-1268	11100144	UG/KG	1	1	91	91	91		91		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	Dieldrin	60571	UG/KG	1	16	2.9	8.6	8.6		8.6		Lymansville Dam
AQ SED, Surf Lymansville	PESTP	Endosulfan II	33213659	UG/KG	9	15	7.2	10	6.1		17		WRL-SD-2042
AQ SED, Surf Lymansville	PESTP	gamma-Chlordane	5103742	UG/KG	8	16	6.3	11	2.8		31		LPX-SD-2048
AQ SED, Surf Lymansville	TOC	Total Organic Carbon	7440440	MG/KG	16	16	92000	92000	3000		235000		LPX-SD-2053

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Deep Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	NG/KG	8	9	256	287	69.3		702		LPX-SD-2048
AQ SED, Deep Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	NG/KG	8	9	156	175	17.9		407		WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	NG/KG	8	9	7.5	8.4	1.2	J	17.3	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,4,7,8-HxCDD	39227286	NG/KG	9	9	5	5	0.81	EMPC	12.5	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,4,7,8-HxCDF	70648269	NG/KG	8	9	19.4	21.6	2.6	J	52.2	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,6,7,8-HxCDD	57653857	NG/KG	9	9	14.3	14.3	1.8	EMPC	34	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,6,7,8-HxCDF	57117449	NG/KG	9	9	17.1	17.1	1.1	EMPC	38.5		LPX-SD-2053
AQ SED, Deep Lymansville	DIOXI	1,2,3,7,8,9-HxCDD	19408743	NG/KG	9	9	14.8	14.8	2.6	J	36.5	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	1,2,3,7,8,9-HxCDF	72918219	NG/KG	1	9	0.84	2	2	EMPC	2	EMPC	LPX-SD-2053
AQ SED, Deep Lymansville	DIOXI	1,2,3,7,8-PeCDD	40321764	NG/KG	8	9	6.2	6.8	1.1	J	13.5		LPX-SD-2053
AQ SED, Deep Lymansville	DIOXI	1,2,3,7,8-PeCDF	57117416	NG/KG	9	9	8.7	8.7	1.2	J	22.7	EMPC	LPX-SD-2046
AQ SED, Deep Lymansville	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	NG/KG	9	9	163	163	1.42	J	781.76	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	2,3,4,6,7,8-HxCDF	60851345	NG/KG	9	9	14.5	14.5	1	J	35.2	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	2,3,4,7,8-PeCDF	57117314	NG/KG	9	9	8.8	8.8	1.7	J	23.6	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	2,3,7,8-TCDD	1746016	NG/KG	9	9	697	697	14.6		2220	J$	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	2,3,7,8-TCDF	51207319	NG/KG	9	9	24.8	24.8	3.8		74.8	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	OCDD	3268879	NG/KG	9	9	1390	1390	38.3	J	4460	&	LPX-SD-2048
AQ SED, Deep Lymansville	DIOXI	OCDF	39001020	NG/KG	9	9	136	136	5.3	J	286	J	LPX-SD-2048
AQ SED, Deep Lymansville	DIOXI	PCDD/Fs	GTI500081	NG/KG	9	9	4010	4010	165		9630		WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total HpCDD	37871004	NG/KG	9	9	531	531	16.2	EMPC	1630	J	LPX-SD-2048
AQ SED, Deep Lymansville	DIOXI	Total HpCDF	38998753	NG/KG	8	9	287	323	40.4	J	666	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total HxCDD	34465468	NG/KG	9	9	131	131	19.9	EMPC	330	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total HxCDF	55684941	NG/KG	9	9	251	251	8	J	629	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total PeCDD	36088229	NG/KG	9	9	42.8	42.8	2	J	78.3	J	LPX-SD-2053
AQ SED, Deep Lymansville	DIOXI	Total PeCDF	30402154	NG/KG	9	9	214	214	10.9	J	561	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total TCDD	41903575	NG/KG	9	9	711	711	30.7	J	2220	J$	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Total TCDF	55722275	NG/KG	9	9	323	323	23.6	J	929	J	WRL-SD-2044
AQ SED, Deep Lymansville	DIOXI	Toxicity Equivalency	TEQ	NG/KG	9	9	723	723	18.2		2280		WRL-SD-2044
AQ SED, Deep Lymansville	M	Aluminum	7429905	MG/KG	9	9	8580	8580	3660		14200		LPX-SD-2046
AQ SED, Deep Lymansville	M	Antimony	7440360	MG/KG	8	9	3.3	3.6	0.37	J	5.2	J	LPX-SD-2053
AQ SED, Deep Lymansville	M	Arsenic	7440382	MG/KG	9	9	6.9	6.9	2.2		14.8		LPX-SD-2053
AQ SED, Deep Lymansville	M	Barium	7440393	MG/KG	9	9	65.8	65.8	25.3		139		LPX-SD-2046
AQ SED, Deep Lymansville	M	Copper	7440508	MG/KG	9	9	97.2	97.2	3.4		319		LPX-SD-2046
AQ SED, Deep Lymansville	M	Iron	7439896	MG/KG	9	9	12300	12300	5070		21600		WRL-SD-2044
AQ SED, Deep Lymansville	M	Lead	7439921	MG/KG	9	9	205	205	12		447		LPX-SD-2046
AQ SED, Deep Lymansville	M	Magnesium	7439954	MG/KG	9	9	1680	1680	654		3610		LPX-SD-2046
AQ SED, Deep Lymansville	M	Manganese	7439965	MG/KG	9	9	203	203	87.7		340		LPX-SD-2052
AQ SED, Deep Lymansville	M	Mercury	7439976	MG/KG	9	9	0.25	0.25	0.02	J	0.55		LPX-SD-2046
AQ SED, Deep Lymansville	M	Nickel	7440020	MG/KG	9	9	24.5	24.5	4.1		61.7		LPX-SD-2046
AQ SED, Deep Lymansville	M	Potassium	7440097	MG/KG	9	9	804	804	218		1680		LPX-SD-2046
AQ SED, Deep Lymansville	M	Selenium	7782492	MG/KG	2	9	1.1	3.1	1.7	J	4.5	J	WRL-SD-2044
AQ SED, Deep Lymansville	M	Silver	7440224	MG/KG	4	9	3.6	6	3.1		8.5		WRL-SD-2044
AQ SED, Deep Lymansville	M	Beryllium	7440417	MG/KG	9	9	1.3	1.3	0.27	J	3.4		LPX-SD-2046
AQ SED, Deep Lymansville	M	Cadmium	7440439	MG/KG	6	9	1.7	2.5	0.12	J	7	J	WRL-SD-2044
AQ SED, Deep Lymansville	M	Calcium	7440702	MG/KG	9	9	1990	1990	599		3350		LPX-SD-2046
AQ SED, Deep Lymansville	M	Chromium	7440473	MG/KG	9	9	110	110	8.3		200		WRL-SD-2044
AQ SED, Deep Lymansville	M	Cobalt	7440484	MG/KG	8	9	5.8	6.2	2	J	12.7	J	WRL-SD-2044
AQ SED, Deep Lymansville	M	Sodium	7440235	MG/KG	1	9	79.2	225	225		225		WRL-SD-2044
AQ SED, Deep Lymansville	M	Vanadium	7440622	MG/KG	9	9	26.1	26.1	9.3		55.5		LPX-SD-2046
AQ SED, Deep Lymansville	M	Zinc	7440666	MG/KG	9	9	600	600	17.9		2060	J	WRL-SD-2044
AQ SED, Deep Lymansville	OS	Anthracene	120127	UG/KG	1	9	1700	360	360	J	360	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	BAPEQ	BAPEQ	UG/KG	7	9	870	1100	310		2300		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Benzo(a)anthracene	56553	UG/KG	7	9	780	790	250	J	1700	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Benzo(a)pyrene	50328	UG/KG	7	9	810	820	250	J	1800	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Benzo(b)fluoranthene	205992	UG/KG	7	9	900	950	260	J	2200	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Benzo(g,h,i)perylene	191242	UG/KG	4	9	1300	670	530	J	890	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Benzo(k)fluoranthene	207089	UG/KG	6	9	960	980	260	J	1900	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	bis(2-Ethylhexyl)phthalate	117817	UG/KG	4	9	1900	3000	870	J	5600	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Butylbenzylphthalate	85687	UG/KG	1	9	1800	1000	1000	J	1000	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Chrysene	218019	UG/KG	7	9	1000	1100	330	J	2400	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Fluoranthene	206440	UG/KG	8	9	1600	1800	290	J	4600		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Fluorene	86737	UG/KG	1	9	1700	320	320	J	320	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	High Molecular Weight PAHs	HMWPAH	UG/KG	8	9	7000	7900	550		20000		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Indeno(1,2,3-cd)pyrene	193395	UG/KG	4	9	1300	690	530	J	970	J	LPX-SD-2048
AQ SED, Deep Lymansville	OS	Low Molecular Weight PAHs	LMWPAH	UG/KG	6	9	1200	1300	420		3700		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Phenanthrene	85018	UG/KG	6	9	1100	1200	420	J	3000		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Pyrene	129000	UG/KG	8	9	1400	1500	260	J	3800		LPX-SD-2048
AQ SED, Deep Lymansville	OS	Total PAH	TOTPAH	UG/KG	8	9	8000	9000	550		24000		LPX-SD-2048
AQ SED, Deep Lymansville	PESTP	4,4'-DDD	72548	UG/KG	1	9	3.9	15	15		15		LPX-SD-2048

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
AQ SED, Deep Lymansville	PESTP	4,4'-DDT	50293	UG/KG	1	9	2.9	5.9	5.9		5.9		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	alpha-Chlordane	5103719	UG/KG	4	9	5	9.6	4.1		24		LPX-SD-2048
AQ SED, Deep Lymansville	PESTP	Aroclor, Total	AROCLORTOT	UG/KG	8	9	420	470	26		2920		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	Endosulfan Sulfate	1031078	UG/KG	1	9	2.8	5.2	5.2		5.2		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	Endrin	72208	UG/KG	1	9	3.3	9.5	9.5		9.5		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	gamma-Chlordane	5103742	UG/KG	5	9	9	15	3.5		32		LPX-SD-2048
AQ SED, Deep Lymansville	PESTP	Methoxychlor	72435	UG/KG	1	9	16	39	39		39		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	Aroclor-1248	12672296	UG/KG	4	9	40	58	26	J	94		LPX-SD-2048
AQ SED, Deep Lymansville	PESTP	Aroclor-1254	11097691	UG/KG	7	9	360	460	42	J	2600	*	LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	Aroclor-1260	11096825	UG/KG	1	9	58	320	320		320		LPX-SD-2046
AQ SED, Deep Lymansville	PESTP	Dieldrin	60571	UG/KG	1	9	3	6.8	6.8		6.8		LPX-SD-2048
AQ SED, Deep Lymansville	PESTP	Endosulfan II	33213659	UG/KG	5	9	39	68	6.9	EB	290	EB*	LPX-SD-2046

Appendix A-5

Surface Water Sample Groups and

Statistical Summaries

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Suface Water Allendale	Allendale Dam	DAM002-SW	NA	Surface Water	NONE	0	0
Suface Water Allendale	APB-SD-2029	APB-SW-2029-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	APB-SD-2034	APB-SW-2034-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	APC-SD-2035	APC-SW-2035-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	APC-SD-2036	APC-SW-2036-01-MAX	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2016	CMW-SW-2016-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2019	CMW-SW-2019-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2020	CMW-SW-2020-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2021	CMW-SW-2021-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2022	CMW-SW-2022-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2023	CMW-SW-2023-01-MAX	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2024	CMW-SW-2024-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	CMW-SD-2025	CMW-SW-2025-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2009	WRC-SW-2009-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2010	WRC-SW-2010-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2011	WRC-SW-2011-01-MAX	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2012	WRC-SW-2012-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2013	WRC-SW-2013-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2014	WRC-SW-2014-01	NA	Surface Water	NONE	0	0
Suface Water Allendale	WRC-SD-2015	WRC-SW-2015-01	NA	Surface Water	NONE	0	0

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Surface Water Allendale	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	PG/L	11	18	427	697	4.7	J	4780		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	PG/L	10	18	102	182	2.4	J	991		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	PG/L	3	16	10.2	41.7	15.5	J	59.6	EMPC	CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,4,7,8-HxCDD	39227286	PG/L	3	18	8.2	40	10	J	81.7		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,4,7,8-HxCDF	70648269	PG/L	4	18	8.6	33.8	2.8	EMPC	73		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,6,7,8-HxCDD	57653857	PG/L	4	18	21.1	88.8	6.4	EMPC	232		CMW-SD-2019
Surface Water Allendale													
Surface Water Allendale	DIOXI	1,2,3,6,7,8-HxCDF	57117449	PG/L	4	18	7.2	27.6	2.8	J	57.9		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,7,8,9-HxCDD	19408743	PG/L	4	18	19.1	79.7	7.2	J	196		CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,7,8,9-HxCDF	72918219	PG/L	2	17	2	4.2	2.2	J	6.3	J	CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,7,8-PeCDD	40321764	PG/L	2	18	4.4	24.7	14	EMPC	35.4	J	CMW-SD-2019
Surface Water Allendale	DIOXI	1,2,3,7,8-PeCDF	57117416	PG/L	2	18	4.2	25.2	14.1	J	36.4	EMPC	APB-SD-2029
Surface Water Allendale	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	PG/L	3	3	297	297	223.37	J	398	J	CMW-SD-2019
Surface Water Allendale	DIOXI	2,3,4,6,7,8-HxCDF	60851345	PG/L	3	18	8.8	46	16.1	J	78.2		CMW-SD-2019
Surface Water Allendale	DIOXI	2,3,4,7,8-PeCDF	57117314	PG/L	2	18	4.1	23.2	18.3	J	28.2	J	CMW-SD-2019
Surface Water Allendale	DIOXI	2,3,7,8-TCDD	1746016	PG/L	9	18	980	1960	4.9	EMPC	12740	J	CMW-SD-2019
Surface Water Allendale	DIOXI	2,3,7,8-TCDF	51207319	PG/L	3	17	7.5	31.9	11.7		53.1	J	CMW-SD-2019
Surface Water Allendale	DIOXI	OCDD	3268879	PG/L	16	18	2620	2950	9.3	EMPC	27700	J	CMW-SD-2019
Surface Water Allendale	DIOXI	OCDF	39001020	PG/L	11	18	202	327	5.1	J	1950	J	CMW-SD-2019
Surface Water Allendale	DIOXI	PCDD/Fs	GTI500081	PG/L	17	18	5150	5460	9.3		56800		CMW-SD-2019
Surface Water Allendale	DIOXI	Total HpCDD	37871004	PG/L	11	18	750	1230	8.6	J	8090	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total HpCDF	38998753	PG/L	11	17	250	385	2.4	J	2310	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total HxCDD	34465468	PG/L	7	18	122	311	4.7	EMPC	1380	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total HxCDF	55684941	PG/L	8	18	133	298	4.2	J	1370	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total PeCDD	36088229	PG/L	3	18	10.4	54	8.4	EMPC	104	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total PeCDF	30402154	PG/L	4	18	46	201	8.9	EMPC	493	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total TCDD	41903575	PG/L	9	18	994	1990	4.9	EMPC	12870	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Total TCDF	55722275	PG/L	3	18	50	289	78.2	J	555	J	CMW-SD-2019
Surface Water Allendale	DIOXI	Toxicity Equivalency	TEQ	PG/L	18	18	998	998	0.34		12900		CMW-SD-2019
Surface Water Allendale	M	Aluminum	7429905	UG/L	15	19	726	911	35.8	J	6190		CMW-SD-2019
Surface Water Allendale	M	Arsenic	7440382	UG/L	11	19	5.1	8	2.4		12.5		APB-SD-2029
Surface Water Allendale	M	Barium	7440393	UG/L	18	19	46.7	48.8	16		271		WRC-SD-2015
Surface Water Allendale	M	Calcium	7440702	UG/L	19	19	14700	14700	7230		36800		CMW-SD-2025
Surface Water Allendale	M	Chromium	7440473	UG/L	4	19	4.4	19.4	1.6		42		APB-SD-2029
Surface Water Allendale	M	Cobalt	7440484	UG/L	2	19	0.67	3	0.6	J	5.4		APB-SD-2029
Surface Water Allendale	M	Copper	7440508	UG/L	19	19	16.1	16.1	1.6		91.4		CMW-SD-2019
Surface Water Allendale	M	Iron	7439896	UG/L	19	19	8400	8400	229		113000		APB-SD-2029
Surface Water Allendale	M	Lead	7439921	UG/L	7	19	23.6	62.3	3.4	J	223		CMW-SD-2019
Surface Water Allendale	M	Magnesium	7439954	UG/L	19	19	2260	2260	1190		5920		CMW-SD-2025
Surface Water Allendale	M	Manganese	7439965	UG/L	19	19	362	362	14.1		2600		APB-SD-2029
Surface Water Allendale	M	Nickel	7440020	UG/L	14	19	5.4	7.1	1.6	J	34.3	J	APB-SD-2029
Surface Water Allendale	M	Potassium	7440097	UG/L	19	19	2740	2740	1490	J	5370	J	CMW-SD-2019
Surface Water Allendale	M	Selenium	7782492	UG/L	4	19	2.7	6.9	3.1	J	10.8		APB-SD-2029
Surface Water Allendale	M	Silver	7440224	UG/L	6	19	0.63	1.4	1	J	1.8	J	CMW-SD-2025
Surface Water Allendale	M	Sodium	7440235	UG/L	18	18	23800	23800	15600		39700		CMW-SD-2019
Surface Water Allendale	M	Thallium	7440280	UG/L	6	19	4.5	9.7	2.2	J	14.5		CMW-SD-2024
Surface Water Allendale	M	Vanadium	7440622	UG/L	6	19	2.9	7.9	0.5		22		CMW-SD-2019
Surface Water Allendale	M	Zinc	7440666	UG/L	14	19	72.2	95.6	15.2	J	500		APB-SD-2029
Surface Water Allendale	OS	Phenol	108952	UG/L	1	19	5	2	2	J	2	J	CMW-SD-2019
Surface Water Allendale	PESTP	Aldrin	309002	UG/L	3	19	0.025	0.024	0.003	J	0.059		APC-SD-2035
Surface Water Allendale	PESTP	Aroclor, Total	AROCLORTOT	UG/L	1	19	1.2	4.6	4.6		4.6		CMW-SD-2019
Surface Water Allendale	PESTP	Aroclor-1254	11097691	UG/L	1	19	0.72	4.6	4.6		4.6		CMW-SD-2019
Surface Water Allendale	PESTP	delta-BHC	319868	UG/L	3	19	0.022	0.0045	0.0017	J	0.0096	J	WRC-SD-2013
Surface Water Allendale	PESTP	Endosulfan Sulfate	1031078	UG/L	2	19	0.071	0.25	0.0026	J	0.49		CMW-SD-2019
Surface Water Allendale	PESTP	Endrin	72208	UG/L	1	19	0.058	0.21	0.21		0.21		CMW-SD-2019
Surface Water Allendale	PESTP	Endrin Aldehyde	7421934	UG/L	3	19	0.043	0.0027	0.002	J	0.0032	J	APC-SD-2035
Surface Water Allendale	PESTP	gamma-Chlordane	5103742	UG/L	1	19	0.03	0.12	0.12		0.12		CMW-SD-2019
Surface Water Allendale	WET	Conductivity	CONDUCTIVIT	MS/CM	1	1	206	206	206		206		Allendale Dam
Surface Water Allendale	WET	pH	pH	SU	1	1	6.8	6.8	6.8		6.8		Allendale Dam
Surface Water Allendale	WET	Temperature	TEMPERATURE	C	1	1	11	11	11		11		Allendale Dam

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Suface Water Filtered Allendale	APB-SD-2029	APB-SW-2029-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	APB-SD-2034	APB-SW-2034-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	APC-SD-2035	APC-SW-2035-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	APC-SD-2036	APC-SW-2036-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2016	CMW-SW-2016-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2019	CMW-SW-2019-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2020	CMW-SW-2020-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2021	CMW-SW-2021-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2022	CMW-SW-2022-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2023	CMW-SW-2023-01F-MAX	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2024	CMW-SW-2024-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	CMW-SD-2025	CMW-SW-2025-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2009	WRC-SW-2009-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2010	WRC-SW-2010-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2011	WRC-SW-2011-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2012	WRC-SW-2012-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2013	WRC-SW-2013-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2014	WRC-SW-2014-01F	NA	Surface Water	NONE	0	0
Suface Water Filtered Allendale	WRC-SD-2015	WRC-SW-2015-01F	NA	Surface Water	NONE	0	0

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
SW Filtered Allendale	M	Aluminum	7429905	UG/L	9	19	47.6	80.2	38.8	J	143		CMW-SD-2023
SW Filtered Allendale	M	Arsenic	7440382	UG/L	9	19	4.6	8.4	5.9		11.3		CMW-SD-2024
SW Filtered Allendale	M	Barium	7440393	UG/L	15	19	173	210	183		254		CMW-SD-2024
SW Filtered Allendale	M	Calcium	7440702	UG/L	19	19	14000	14000	5380		37100		CMW-SD-2023
SW Filtered Allendale	M	Chromium	7440473	UG/L	1	19	0.47	1.6	1.6		1.6		WRC-SD-2015
SW Filtered Allendale	M	Cobalt	7440484	UG/L	1	19	0.43	1	1	J	1	J	WRC-SD-2015
SW Filtered Allendale	M	Copper	7440508	UG/L	18	19	4.5	4.8	1.7		16		CMW-SD-2019
SW Filtered Allendale	M	Iron	7439896	UG/L	19	19	791	791	154		7950		CMW-SD-2019
SW Filtered Allendale	M	Magnesium	7439954	UG/L	19	19	2040	2040	482		6240		CMW-SD-2023
SW Filtered Allendale	M	Manganese	7439965	UG/L	19	19	262	262	9.6		1570		APB-SD-2029
SW Filtered Allendale	M	Nickel	7440020	UG/L	12	19	2.8	4	1.3	J	8.2		CMW-SD-2019
SW Filtered Allendale	M	Potassium	7440097	UG/L	19	19	2660	2660	613	J	4900		CMW-SD-2023
SW Filtered Allendale	M	Selenium	7782492	UG/L	2	19	2	4.6	3.9	J	5.3		APB-SD-2029
SW Filtered Allendale	M	Silver	7440224	UG/L	5	19	0.63	1.6	1.4	J	1.8		CMW-SD-2023
SW Filtered Allendale	M	Sodium	7440235	UG/L	18	19	26800	28100	21000		47500		CMW-SD-2019
SW Filtered Allendale	M	Thallium	7440280	UG/L	3	19	3.1	8.3	7	J	10.6	J	CMW-SD-2025
SW Filtered Allendale	M	Vanadium	7440622	UG/L	2	19	0.66	0.8	0.8	J	0.8	J	APC-SD-2036, WRC-SD-2015
SW Filtered Allendale	M	Zinc	7440666	UG/L	18	19	76.7	80.7	50.6		121		CMW-SD-2024

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Surface Water Lymansville	LPX-SD-2045	LPX-SW-2045-01-MAX	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2046	LPX-SW-2046-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2047	LPX-SW-2047-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2048	LPX-SW-2048-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2049	LPX-SW-2049-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2050	LPX-SW-2050-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2051	LPX-SW-2051-01A	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2051	LPX-SW-2051-01-MAX	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2052	LPX-SW-2052-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	LPX-SD-2053	LPX-SW-2053-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	Lymansville Dam	DAM003-SW	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2039	WRL-SW-2039-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2040	WRL-SW-2040-01-MAX	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2041	WRL-SW-2041-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2042	WRL-SW-2042-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2043	WRL-SW-2043-01	NA	Surface Water	NONE	0	0
Surface Water Lymansville	WRL-SD-2044	WRL-SW-2044-01	NA	Surface Water	NONE	0	0

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
Surface Water Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDD	35822469	PG/L	8	15	25.2	43.4	3	EMPC	149		WRL-SD-2042
Surface Water Lymansville	DIOXI	1,2,3,4,6,7,8-HpCDF	67562394	PG/L	5	15	10.3	25.9	10.2	J	58.3		WRL-SD-2042
Surface Water Lymansville	DIOXI	1,2,3,4,7,8,9-HpCDF	55673897	PG/L	1	14	3.3	6.1	6.1	EMPC	6.1	EMPC	LPX-SD-2048
Surface Water Lymansville	DIOXI	1,2,3,4,7,8-HxCDD	39227286	PG/L	1	15	2.4	1.6	1.6	J	1.6	J	LPX-SD-2048
Surface Water Lymansville	DIOXI	1,2,3,4,7,8-HxCDF	70648269	PG/L	1	15	1.8	2.4	2.4	EMPC	2.4	EMPC	WRL-SD-2041
Surface Water Lymansville	DIOXI	1,2,3,6,7,8-HxCDD	57653857	PG/L	1	15	2.5	6.1	6.1	J	6.1	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	1,2,3,6,7,8-HxCDF	57117449	PG/L	1	15	1.6	1.9	1.9	EMPC	1.9	EMPC	LPX-SD-2048
Surface Water Lymansville	DIOXI	1,2,3,7,8,9-HxCDD	19408743	PG/L	4	15	2.9	3.6	1.8	EMPC	6.1	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	1,2,4,5,7,8-hexachloro(9H)xanthene	HCX	PG/L	3	3	40.6	40.6	18.76	J	80.93	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	2,3,4,6,7,8-HxCDF	60851345	PG/L	1	15	1.9	5.9	5.9	J	5.9	J	LPX-SD-2048
Surface Water Lymansville	DIOXI	2,3,7,8-TCDD	1746016	PG/L	8	15	84.9	156	2.9	EMPC	853		WRL-SD-2042
Surface Water Lymansville	DIOXI	2,3,7,8-TCDF	51207319	PG/L	1	14	2.2	7.7	7.7	J	7.7	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	OCDD	3268879	PG/L	9	15	172	279	18.6	, EMPC	1110		WRL-SD-2042
Surface Water Lymansville	DIOXI	OCDF	39001020	PG/L	6	15	14.1	24.4	2.4	, EMPC	83.3	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	PCDD/Fs	GTI500081	PG/L	12	15	339	422	22.7		2610		WRL-SD-2042
Surface Water Lymansville	DIOXI	Total HpCDD	37871004	PG/L	10	15	47.8	69.7	5.3	EMPC	281	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total HpCDF	38998753	PG/L	6	15	16.4	35.6	1.7	EMPC	124	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total HxCDD	34465468	PG/L	4	15	7	19.1	3.1	J	36.8	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total HxCDF	55684941	PG/L	4	15	6.7	18.7	1.3		51.9	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total PeCDD	36088229	PG/L	1	15	3.2	18.6	18.6		18.6		LPX-SD-2045
Surface Water Lymansville	DIOXI	Total PeCDF	30402154	PG/L	3	15	2.8	7	1.3	EMPC	14.6	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total TCDD	41903575	PG/L	8	15	86.1	158	2.9	EMPC	871	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Total TCDF	55722275	PG/L	3	15	4.8	15.4	1.2	EMPC	40.4	J	WRL-SD-2042
Surface Water Lymansville	DIOXI	Toxicity Equivalency	TEQ	PG/L	15	15	90	90	4.7		861		WRL-SD-2042
Surface Water Lymansville	M	Aluminum	7429905	UG/L	8	15	144	249	58.6	J	917		WRL-SD-2042
Surface Water Lymansville	M	Arsenic	7440382	UG/L	2	15	3	9	8.9	J	9.2	J	WRL-SD-2041
Surface Water Lymansville	M	Barium	7440393	UG/L	15	15	21.1	21.1	15.6		37		WRL-SD-2044
Surface Water Lymansville	M	Beryllium	7440417	UG/L	1	15	0.39	0.2	0.2		0.2		WRL-SD-2042
Surface Water Lymansville	M	Calcium	7440702	UG/L	15	15	9530	9530	7750		17000		WRL-SD-2044
Surface Water Lymansville	M	Chromium	7440473	UG/L	5	15	1.4	3.5	1	J	6.3		WRL-SD-2042
Surface Water Lymansville	M	Cobalt	7440484	UG/L	1	15	0.47	1	1	J	1	J	WRL-SD-2042
Surface Water Lymansville	M	Copper	7440508	UG/L	15	15	8.1	8.1	1.3		29.4		WRL-SD-2042
Surface Water Lymansville	M	Iron	7439896	UG/L	15	15	740	740	219		3710		WRL-SD-2044
Surface Water Lymansville	M	Lead	7439921	UG/L	3	15	3.6	14.1	10.2		21.8		WRL-SD-2042
Surface Water Lymansville	M	Magnesium	7439954	UG/L	15	15	1490	1490	1280		2400		WRL-SD-2044
Surface Water Lymansville	M	Manganese	7439965	UG/L	15	15	206	206	59		1490		WRL-SD-2044
Surface Water Lymansville	M	Nickel	7440020	UG/L	8	15	2.2	3.5	1.6	J	5.4		LPX-SD-2051
Surface Water Lymansville	M	Potassium	7440097	UG/L	15	15	2140	2140	1710	J	2760		WRL-SD-2042
Surface Water Lymansville	M	Silver	7440224	UG/L	3	15	0.59	1.5	1.4	J	1.6	, J	WRL-SD-2039, WRL-SD-2040
Surface Water Lymansville	M	Sodium	7440235	UG/L	15	15	22800	22800	20200		31800		WRL-SD-2044
Surface Water Lymansville	M	Thallium	7440280	UG/L	1	15	2.8	7.7	7.7	J	7.7	J	LPX-SD-2047
Surface Water Lymansville	M	Vanadium	7440622	UG/L	1	15	1	2.7	2.7		2.7		WRL-SD-2042
Surface Water Lymansville	M	Zinc	7440666	UG/L	14	15	28	29.6	13.2	J	75.7		WRL-SD-2043
Surface Water Lymansville	OS	bis(2-Ethylhexyl)phthalate	117817	UG/L	1	15	15	160	160	*	160	*	WRL-SD-2043
Surface Water Lymansville	PESTP	4,4'-DDE	72559	UG/L	1	15	0.047	0.0043	0.0043	J	0.0043	J	WRL-SD-2042
Surface Water Lymansville	PESTP	4,4'-DDT	50293	UG/L	1	15	0.047	0.01	0.01	J	0.01	J	LPX-SD-2050
Surface Water Lymansville	PESTP	Aldrin	309002	UG/L	3	15	0.026	0.031	0.0088	J	0.069		LPX-SD-2049
Surface Water Lymansville	PESTP	alpha-Chlordane	5103719	UG/L	1	15	0.025	0.019	0.019	J	0.019	J	WRL-SD-2042
Surface Water Lymansville	PESTP	Endosulfan Sulfate	1031078	UG/L	1	15	0.047	0.0032	0.0032	J	0.0032	J	WRL-SD-2042
Surface Water Lymansville	PESTP	Endrin Aldehyde	7421934	UG/L	2	8	0.038	0.0032	0.0013	J	0.005	J	WRL-SD-2042
Surface Water Lymansville	PESTP	gamma-Chlordane	5103742	UG/L	1	15	0.025	0.021	0.021	J	0.021	J	WRL-SD-2042
Surface Water Lymansville	WET	Conductivity	CONDUCTIVIT	MS/CM	1	1	242	242	242		242		Lymansville Dam
Surface Water Lymansville	WET	pH	pH	SU	1	1	6.8	6.8	6.8		6.8		Lymansville Dam
Surface Water Lymansville	WET	Temperature	TEMPERATURE	C	1	1	11	11	11		11		Lymansville Dam

receptor	BORING	NSAMPLE	SUBMATRIX	MATRIX_GENERAL	DEPCODE	TOP	BOTTOM
Surface Water filtered Lymansville	LPX-SD-2045	LPX-SW-2045-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2046	LPX-SW-2046-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2047	LPX-SW-2047-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2048	LPX-SW-2048-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2049	LPX-SW-2049-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2050	LPX-SW-2050-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2051	LPX-SW-2051-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2052	LPX-SW-2052-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	LPX-SD-2053	LPX-SW-2053-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2039	WRL-SW-2039-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2040	WRL-SW-2040-01F-MAX	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2041	WRL-SW-2041-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2042	WRL-SW-2042-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2043	WRL-SW-2043-01F	NA	Surface Water	NONE	0	0
Surface Water filtered Lymansville	WRL-SD-2044	WRL-SW-2044-01F	NA	Surface Water	NONE	0	0

Receptor	Fraction	Parameter	CasNo	Units	Detects	Count	Average	AverageOfDetects	MinOfDetects	MinQual	MaxOfDetects	MaxQual	MaxLocation
SW Filtered Lymansville	M	Aluminum	7429905	UG/L	6	15	33.7	62.2	41	J	100		LPX-SD-2050
SW Filtered Lymansville	M	Arsenic	7440382	UG/L	2	15	3.1	9.6	8.6		10.5		WRL-SD-2041
SW Filtered Lymansville	M	Barium	7440393	UG/L	7	15	110	214	184		286		WRL-SD-2040
SW Filtered Lymansville	M	Calcium	7440702	UG/L	15	15	9150	9150	7660		17300		WRL-SD-2044
SW Filtered Lymansville	M	Copper	7440508	UG/L	15	15	5.3	5.3	1.4		10		LPX-SD-2050
SW Filtered Lymansville	M	Iron	7439896	UG/L	15	15	411	411	126		2960		WRL-SD-2044
SW Filtered Lymansville	M	Lead	7439921	UG/L	1	15	1.2	4.7	4.7		4.7		WRL-SD-2043
SW Filtered Lymansville	M	Magnesium	7439954	UG/L	15	15	1450	1450	1240		2420		WRL-SD-2044
SW Filtered Lymansville	M	Manganese	7439965	UG/L	15	15	190	190	46.4		1550		WRL-SD-2044
SW Filtered Lymansville	M	Nickel	7440020	UG/L	5	15	1.6	3.1	1.5	J	5.1		WRL-SD-2040
SW Filtered Lymansville	M	Potassium	7440097	UG/L	15	15	2120	2120	1800		2760		WRL-SD-2044
SW Filtered Lymansville	M	Silver	7440224	UG/L	3	15	0.56	1.3	1.1	J	1.6		WRL-SD-2040
SW Filtered Lymansville	M	Sodium	7440235	UG/L	15	15	24400	24400	20800		31900		WRL-SD-2044
SW Filtered Lymansville	M	Thallium	7440280	UG/L	4	15	3.7	7.9	7.3	J	9		LPX-SD-2046
SW Filtered Lymansville	M	Zinc	7440666	UG/L	14	15	53.5	56.8	20.9		105		WRL-SD-2040

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CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

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APPENDIX B

Streamlined Human Health Risk Evaluation

This Report has been prepared as a Streamlined Human Health Risk Evaluation for residential soils, flood plain sediments, and bank sediments for the Centredale Manor Restoration Project Site EE/CA. Section 1 provides an overview of the site. Section 2 contains a discussion of the selection of contaminants of potential concern (COPCs) and exposure point concentrations (EPCs). Section 3 contains information on the potential receptors considered and the routes by which they might be exposed. Section 4 contains a discussion of toxicity factors used and the potential adverse effects of site contaminants. Section 5 contains the numerical results of the risk characterization. Finally, Section 6 presents uncertainties.

1.0 Overview of the Exposure Areas

The Centredale Manor Restoration Project Site (the Site) is currently known to encompass numerous residential-use land within the Woonasquatucket River flood zone, and recreational areas including Allendale Pond, Lymansville Pond, and the stretch of the Woonasquatucket River connecting the two ponds. A detailed description of the Site is provided in Section 1.2 of the EE/CA report. A characterization of the contamination detected within the river sediment and flood plain areas at the Site is discussed in Section 1.4 of that report. Table B-1.1 presents the four recreational areas and 28 residential exposure points included in this human health risk evaluation and the receptors and exposure pathways considered. The plat and lot numbers associated with each residential exposure point are identified in the rationale column.

2.0 Data Evaluation

Data evaluation is a study area-specific task that uses a variety of information to determine which of the detected chemicals at a study area are most likely to present a risk to potential receptors. The end result of this qualitative selection process is a list of COPCs and representative exposure point concentrations for each exposure scenario.

2.1 Selection of Contaminants of Potential Concern

Tables B-2.1 through B-2.3 present a summary of the COPC selection process for quantitative risk evaluation for Area residential soils, flood plain sediments, and bank sediments, respectively. COPCs were identified by comparison of site data to screening criteria based on EPA Region IX PRGs for residential soil exposures. Region IX PRGs for carcinogens were adjusted to correspond to cancer risk levels of 1.0E-05. Region IX PRGs for non-carcinogens are based on a hazard index of 1.0; these values were not adjusted. Dioxin TEQ values were screened against 40 ppt for soils, corresponding to 1.0E-05 cancer risk levels, and 60 ppt for sediments based on a national background study of dioxin concentrations in sediments (Winter, 2000). All validated CLP data collected during recent and historical investigations were used to identify COPCs.

The following chemicals were identified as COPCs based on a comparison of maximum site concentrations to risk-based COPC screening levels for residential land use:

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors (1242 and 1254)
- Metals (antimony, arsenic, chromium, lead, and manganese)
- Dioxins

Aluminum, copper, and iron were not identified as COPCs because EPA Region I does not advocate quantitative risk assessment of the health effects of aluminum, copper, or iron because of the lack of adequate toxicity criteria. Total Aroclors were accepted as COPCs because two Aroclors were detected at maximum concentrations exceeding COPC screening levels.

In general the same contaminants were selected in each media, however, the list of COPCs selected for residential soils was the most inclusive.

2.2 Exposure Point Concentrations

Current EPA risk assessment guidance (EPA, 1992 and 1994b) was used to identify appropriate exposure point concentrations. When a sufficient number of samples was available, 95 percent UCLs of the arithmetic mean were used as exposure point concentrations in estimating chemical intakes.

The methodology used for estimating the 95 percent UCL depends on the distribution of the sample set. For this risk evaluation, the distribution was determined using the Shapiro-Wilk W-Test (Gilbert, 1987). When the results of the test were inconclusive and the distribution was regarded as undefined, the distribution was assumed to be log normal and the 95 percent UCL for log-normally distributed data sets was selected as the exposure point concentration.

For normally distributed data, the calculation of the UCL is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\Sigma(X_i - \bar{X})^2}{(n-1)}\right]^{1/2}$$

where:

S	=	standard deviation
X_i	=	individual sample value
n	=	number of samples
$\bar{x}$	=	mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \bar{X} + t\left(\frac{S}{n^{1/2}}\right)$$

where:

UCL	=	95 percent Upper confidence limit of the mean
$\bar{X}$	=	Arithmetic average
t	=	One-sided t distribution factor ($t_{0.95}$)
s	=	standard deviation
n	=	number of samples

For log-normally distributed data sets, the UCL is calculated using the following equation:

$$UCL = \exp\left(\bar{X} + 0.5s^2 + \frac{Hs}{(n-1)^{1/2}}\right)$$

where:

UCL	=	95 percent UCL of the mean
exp	=	Constant (base of the natural log, e)
$\bar{X}$	=	Mean of the transformed data
s	=	Standard deviation of the transformed data
H	=	H-statistic (from Gilbert, 1987; $H_{0.95}$)
n	=	Number of samples

This equation uses individual sample results that have been transformed by taking the natural logarithm of the results.

In data sets with 10 samples or less and data sets in which the calculated 95 percent UCL exceeded the maximum detected concentration, the maximum detected concentration was used as the exposure point concentration. Listings of sample locations included in the evaluation of each receptor group are included in Table B-2.4. Exposure point concentrations used in the risk assessment are presented in Table B-2.5 and appear to the left in risk summary tables, Tables B-3.1 through B-3.32 and B-4.1 through B-4.32.

3.0 Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure in the Study Area and identifies the exposure input parameters used to estimate exposure intakes and risks. A summary of the potentially significant exposures identified for quantitative evaluation for the Study Area is provided in Table B-1.1. Tables B-3.1 through B-3.32 and Tables B-4.1 through B-4.32 present exposure factor equations that incorporate exposure parameters into a single factor for use in determining chemical intake. The various assumptions used as input parameters to determine chemical intakes for each potential receptor and exposure route are shown on the tables and discussed below.

The exposure assessment is based on the assumptions that, in general, chemical compositions for environmental media are identical under current and future site conditions. Under current/future conditions, potential human receptors (the recreational user and residents) are assumed to be exposed to surface soil and/or sediment (0 to 2 feet bgs) including flood plain sediments covered by no more than 1 foot of water.

3.1 Potential Receptors

This evaluation quantifies risks to recreational users of four identified recreational areas and to residents at 28 residential locations as identified in Table B-1.1.

Possible exposures of residents to site-related contaminants would be through play and yard work at their homes and nearby homes. These receptors are assumed to be exposed to soils in a limited area (soils within their own property or that of their adjacent neighbor).

Possible exposures of recreational users to site-related contaminants would be through recreational activities, such as walking, or exploring the edges of the ponds and river. These receptors are expected to contact flood plain sediments and bank sediments along the edges of the ponds and river. It is not anticipated that these receptors will contact sediments found within the river in areas regularly inundated by water (covered by 1 or more feet of water for more than 1 month per year).

3.1.1 Residents

Residents are evaluated for exposure to surficial soils and flood plain sediments in close proximity to their lots (0 to 2 feet bgs) under current/future land use. Residents (ages 0 to 30 years), are assumed to be exposed to site media frequently (150 days/year). For noncancer risks, the 0 to 6-year old child is considered the most sensitive receptor and therefore is the receptor of concern. Residential receptors are assumed to ingest an average of 200 mg/day for 6 years for the child and 100 mg/day for 24 years for the adult. Feet, hands, forearms, and lower legs are expected to be available for dermal contact with soil/sediment. Surface areas, body weights, and soil-to-skin adherence factors are shown in the exposure factor equations on the risk summary tables, Tables B-3.1 through B-3.28 and Tables B-4.1 through B-4.28. Soil-to-skin adherence values were selected based on moist conditions.

3.1.2 Recreational Users

Recreational users are evaluated for exposure to surficial flood plain sediments and bank sediments (0 to 2 feet bgs) in four study areas, under current and future land use. For the recreational area north of Allendale Pond, Allendale Pond recreational area, and Lymansville Pond recreational area the receptor is identified as an adolescent aged 9 through 18 years. For the Lymansville Reach area, which lies adjacent to the Allendale Mill Complex, the Lee Romano Baseball Field, and the Boys and Girls Club, the receptor is identified as a child aged 0 to 18 years. For noncancer risks in this area, the 0 to 6-year old child is considered the most sensitive receptor and therefore is the receptor of concern. Recreational users are assumed to be exposed to site media 52 days/year, corresponding to 2 days/week for 6 months of the year May to October. These receptors are assumed to ingest an average of 200 mg/day for children aged 0 to 6 years and 100 mg/day for older children and adolescents. Recreational users are assumed to ingest 50 percent of their daily soil from contaminated soils at the site. Feet, hands, forearms, and lower legs are expected to be available for dermal contact with sediment. Surface areas, body weights, and soil-to-skin adherence factors are shown in the exposure factor equations on the risk summary tables, Tables B-3.29 through B-3.32 and Tables B-4.29 through B-4.32. Soil-to-skin adherence values were selected based on moist conditions.

3.2 Exposure Pathways

The primary routes of exposure for potential human receptors are incidental ingestion of and dermal contact with soil and sediment.

3.3 Chemical Intake

Estimates of chemical intake are calculated by multiplying exposure point concentrations by the exposure factor for the route of exposure. Chemical intakes are not presented separately, but are incorporated in the cancer risk and hazard index equations presented in Tables B-3.1 through B-3.32 and Tables B-4.1 through B-4.32.

4.0 Toxicity Assessment

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The toxicity values presented in this section are integrated with the exposure assessment (Section 3) to characterize the potential for the occurrence of adverse health effects (Section 5).

Brief summaries of the toxicity profiles for the major COPCs are presented in Section 4.3

4.1 Carcinogenic Effects

The Cancer Slope Factor (CSF) is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$The primary sources of information for Cancer Slope Factors are the EPA Washington (EPA, 1997, 1999, and 2000a). EPA's database (IRIS - the Integrated Risk Information System) (EPA, 2000a) was consulted as the primary source for CSF values, as well as for RfDs. If values are not available in IRIS, the annual Health Effects Assessment Summary Tables (HEAST) (EPA, 1997) were consulted, as well as the current Region 9 EPA Preliminary Remediation Goals (PRGs) Table (EPA, 1999). Oral CSFs available from these EPA sources represent administered toxicity values.

These administered CSFs for COPCs at the study area are presented in Tables B-3.1 through B-3.32.

Absorbed CSFs are derived from the corresponding administered values. In the derivation of an absorbed CSF, the administered CSF is divided by the gastrointestinal absorption efficiency. Absorbed CSFs are used to evaluate dermal exposures and oral exposures when a reliable oral soil absorption factor is known. Absorbed CSFs and the absorption efficiencies used in their determination are also included in Tables B-3.1 through B-3.32.

Risk estimates for dioxins were evaluated through use of dioxin TEQs. The TEFs presented in Table B-5.1 were used to convert concentrations of individual dioxin and furan congeners to TEQs of 2,3,7,8-TCDD. Concentrations of individual dioxins and furans were multiplied by their TEFs to yield 2,3,7,8-TCDD equivalent concentrations. These values were then totaled to yield total dioxin TEQs for each sample. These concentrations could then be used in conjunction with the toxicity value for 2,3,7,8-TCDD in determining cancer risk.

In computing the dioxin TEQs for each sample, non-detected values were treated as one-half of the detection limit for those specific dioxin congeners that were positively detected in one or more samples within a soil data group. One-half of the detection limit for non-detected dioxin results were included along with positive results in the TEQ summation for each sample.

Risk estimates for PAHs were evaluated through use of a benzo(a)pyrene equivalent. Benzo(a)pyrene equivalents were determined by using the relative potency factors presented in Table B-5.2. Concentrations of detected carcinogenic PAHs were multiplied by their relative potency factors to yield benzo(a)pyrene equivalent concentrations of each detected PAH in a sample. These were then totaled to yield a benzo(a)pyrene equivalent concentration for each sample. These concentrations could then be used in conjunction with the toxicity value for benzo(a)pyrene in determining cancer risk.

PCB cancer risk characterization is addressed by evaluation of total Aroclor concentrations. For each sample, the Aroclor total was calculated as the sum of any positive Aroclor results. If all results were non-detected, then one-half of the minimum Aroclor detection limit was selected. Non-detected results for Aroclors were not added to positive results.

4.2 Noncarcinogenic Effects

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to a Reference Dose (RfD). The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

The primary source of information for Reference Dose values is the EPA IRIS database, followed by other EPA sources described for carcinogens. Oral RfDs available from EPA sources represent administered toxicity values. Administered Reference Doses for the COPCs at the study area are presented in Tables B-4.1 through B-4.32.

An absorbed RfD is developed by multiplying an administered RfD by the gastrointestinal tract absorption factor. The resulting absorbed RfD is used to evaluate dermal exposures and oral exposures when a reliable oral soil absorption factor is known. Absorbed RfDs and the absorption efficiencies used in their determination are included in Tables B-4.1 through B-4.32.

PCB non-cancer risk characterization is addressed by evaluation of Aroclor 1254 concentrations. Among the aroclors detected in the study area, only Aroclor 1254 has an oral RfD available.

4.3 Toxicity Summaries for Major Chemicals of Concern

This section contains brief summaries of the toxicological profiles for the major COPCs.

4.3.1 Dioxins

The term "dioxin" refers to a group of 30 chemical compounds that share chemical structure and similar biological mechanisms of action (EPA, 2000b). These compounds are members of three closely related families of chemicals: the chlorinated dibenzo-p-dioxins (CDDs),

chlorinated dibenzofurans (CDFs), and certain polychlorinated biphenyls (PCBs). The most studied and one of the most toxic dioxins is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Dioxins are produced through combustion, chlorine bleaching of pulp and paper, certain types of chemical manufacturing and processing, and other industrial processes. PCBs were widely used as coolants and lubricants in electrical equipment before their manufacture in the United States was ended in 1977.

Dioxins are potent animal toxicants with a potential to produce a broad spectrum of adverse effects in humans. Dioxins can alter the fundamental growth and development of cells in ways that have the potential to lead to many kinds of impacts, including adverse effects upon reproduction and development; suppression of the immune system; chloracne (a severe acne-like condition that sometimes persists for many years); and cancer. EPA characterizes TCDD as a "human carcinogen" based on evidence of animal and human studies and characterizes other dioxins as "likely human carcinogens".

Dioxins enter the ecological food web by being deposited from the atmosphere, either directly from air-emissions or indirectly by processes that return dioxins already in the environment to the atmosphere. Dioxins are highly persistent in the environment and can accumulate in the tissues of animals.

4.3.2 Polychlorinated Biphenyls (PCBs)

PCBs are a group of synthetic organic chemicals that contain 209 individual compounds (known as congeners). Mixtures of PCBs, or Aroclors, were manufactured for use in industry until 1977. EPA considers PCBs to be a probable human carcinogen based on evidence of the ability of PCBs to cause cancer in animal studies. Data on humans exposed to PCBs suggest an association between PCB exposure and human cancer, but lack of data on exposure dose, length of exposure, types of PCBs and other chemicals people were exposed to precludes identification of a cause and effect relationship based only on human studies. Studies in animals have also demonstrated immunological, reproductive, and neurological effects from PCB exposure. Studies in mice, monkeys, guinea pigs, and rabbits have shown PCBs to be immunosuppressive.

4.3.3 Lead

Unborn children and young children are particularly sensitive to the adverse effects of exposure to lead. Exposure to a fetus through its' mother may cause premature births, lower birth weight, and decreased mental ability of the infant. Lead exposure is dangerous for young children because they absorb lead at a greater rate than adults, retain more of the lead they ingest, and are more sensitive to its effects. Effects include decreased intelligence and decreased growth. EPA has classified lead as a B2 carcinogen based on the results of animal studies.

4.3.4 Arsenic

Inorganic arsenic is a human poison. Organic arsenic is less harmful. High levels of inorganic arsenic in food or water can be fatal. Arsenic damages many tissues including nerves, stomach and intestines, and skin. Breathing high levels can give you a sore throat and irritated lungs. Lower levels of exposure to inorganic arsenic may cause nausea, vomiting, diarrhea, decreased production of red and white blood cells, abnormal heart rhythm, blood vessel damage, and a "pins and needles" sensation in hands and feet.

Long term exposure to inorganic arsenic may lead to a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Direct skin contact may cause redness and swelling.

The Department of Health and Human Services (DHHS) has determined that arsenic is a known carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver, and lung.

3.5 Polyaromatic Hydrocarbons (PAHs)

PAHs are a large class of ubiquitous natural and anthropogenic chemicals, all with similar chemical structures (ATSDR 1990). The compounds in this class are highly lipophilic and therefore are readily absorbed across GI and respiratory epithelia and become distributed

widely in the tissues of treated animals, primarily to tissues high in fat. Although epidemiology studies suggested that complex mixtures that contain PAHs (coal tar, soots, coke oven emissions, cigarette smoke) are carcinogenic to humans (EPA 1994), the carcinogenicity cannot be attributed to PAHs alone because of the presence of other potentially carcinogenic substances in these mixtures (ATSDR 1990).

Benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are classified in Group B2 (probable human carcinogens). Benzo(a)pyrene is the most extensively studied member of the class, inducing tumors in multiple tissues of virtually all laboratory species tested by all routes of exposure. Assignment of other individual PAHs to EPA cancer weight-of-evidence groups was based largely on the results of animal studies with large doses of purified compound (EPA 1994b). The EPA (2000) provides a slope factor for oral exposure to benzo(a)pyrene based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates are available for the other PAHs in Group B2. A Relative Potency Factor (RPF) scheme for the Group B2 PAHs is based on the induction of lung epidermoid carcinomas in rats in the lung-implantation experiments (Clement International 1990). This scheme is used to convert concentrations of carcinogenic PAHs to benzo(a)pyrene equivalents or to adjust the benzo(a)pyrene slope factor to yield slope factors for each of the other Group B2 PAHs.

Oral noncancer toxicity data are available for acenaphthene, anthracene, fluoranthene, fluorene, and naphthalene. Adverse effects resulting from human exposures to these noncarcinogenic PAHs include hemolytic anemia with associated jaundice and occasionally renal disease. Animal studies, using high doses of naphthalene, resulted in reduced the growth rates.

4.3.6 Chromium

Animal studies show that Cr(VI) is generally more toxic than Cr(III), but neither oxidation state is very toxic by the oral route. The respiratory and dermal toxicity of chromium are well-documented. Compounds of both Cr(VI) and Cr(III) have induced developmental effects in experimental animals that include neural tube defects, malformations, and fetal deaths.

The inhalation of chromium compounds has been associated with the development of cancer in workers in the chromate industry. The relative risk for developing lung cancer has been calculated to be as much as 30 times that of controls. There is also evidence for an increased risk of developing nasal, pharyngeal, and gastrointestinal carcinomas. Based on sufficient evidence for humans and animals, Cr (VI) has been placed in the EPA weight-of-evidence classification A, human carcinogen.

4.3.7 Manganese

Manganese is an essential trace element in humans that can elicit a variety of serious toxic responses upon prolonged exposure to elevated concentrations either orally or by inhalation. The central nervous system is the primary target. Initial symptoms are headache, insomnia, disorientation, anxiety, lethargy, and memory loss. These symptoms progress with continued exposure and eventually include motor disturbances, tremors, and difficulty in walking, symptoms similar to those seen with Parkinsonism. These motor difficulties are often irreversible.

Effects on reproduction (decreased fertility, impotence) have been observed in humans with inhalation exposure and in animals with oral exposure at the same or similar doses that initiate the central nervous system effects. An increased incidence of coughs, colds, dyspnea during exercise, bronchitis, and altered lung ventilatory parameters have also been seen in humans and animals with inhalation exposure.

5.0 Risk Characterization

A summary of the quantitative risk assessment for the Study Area, is provided in this section. Total carcinogenic risks for each exposure route, as well as the cumulative risk, are presented in Tables B-3.1 through B-3.32. Total noncarcinogenic hazard indices for each exposure route, as well as the cumulative risk, are presented in Tables B-4.1 through B-4.32. Table B-6 presents the total cancer risks and health hazards for all scenarios.

- The hazard indices (HI) for residents exposed to soil range from 0.159 to 5.27. Eight locations exceeded a target organ-specific hazard index of 1 for the immune system

resulting from exposures to Aroclor 1254 and one location exceeded a target organ-specific hazard index of 1 for the skin resulting from exposure to arsenic.

- The hazard indices for the recreational users range from 0.009 to 0.4.
- The cancer risk estimates for residents exposed to soil range from 3E-05 to 5.3E-03.
- The cancer risk estimates for recreational users range from 4.6E-06 to 2.3E-04.

Total hazard indicies and cancer risks for recreational users who reside at a contaminated residential property in the area would be higher than the estimated risks to non-resident recreational users.

Since lead cannot be evaluated using hazard index and/or cancer risk methodology, a qualitative comparison of site data to EPA's Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (EPA, 1994a) was performed. The EPA's Integrated Exposure Uptake and Biokinetic (IEUBK) model, which estimates the risk to a child resident is the basis for this soil screening level. Locations with lead concentrations exceeding 400 ppm are identified in Table B-6. Fifteen residential locations and 3 recreational areas had samples with lead concentrations exceeding 400 ppm.

6.0 Uncertainties

Uncertainties associated with the various aspects of this risk evaluation include the following:

- The use of COPC selection criteria based on 1.0E-05 cancer risk levels eliminates some contaminants from the evaluation that may contribute to total risk estimates.

- The limited number of samples at each residential exposure point results in the use of maximum detected concentrations for the risk evaluation.

- Selection of high-end exposure parameters may overestimate actual exposures.

- The absence of a quantitative evaluation of lead risks adds to the uncertainty of conclusions regarding lead exposures.

- Toxicity values based on animal studies introduce a degree of uncertainty to the risk characterization process.

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TABLE B-1.1
SELECTION OF EXPOSURE PATHWAYS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Flood Plain Sediments and Bank Sediments	Recreational Area North of Allendale Pond	Recreational User	Adolescent	Ingestion	Adolescents are expected to visit the flood plain area north of Allendale Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
					Dermal	Adolescents are expected to visit the flood plain area north of Allendale Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
		Allendale Pond Recreational Area	Recreational User	Adolescent	Ingestion	Adolescents are expected to visit the flood plain areas along the shoreline of Allendale Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
					Dermal	Adolescents are expected to visit the flood plain areas along the shoreline of Allendale Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
		Lymansville Reach Recreational Area	Recreational User	Child	Ingestion	Children are expected to visit the banks of the river in the area of the Lymansville Reach for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
					Dermal	Children are expected to visit the banks of the river in the area of the Lymansville Reach for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
		Lymansville Pond Recreational Area	Recreational User	Adolescent	Ingestion	Adolescents are expected to visit the flood plain areas along the shoreline of Lymansville Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
					Dermal	Adolescents are expected to visit the flood plain areas along the shoreline of Lymansville Pond for recreational purposes and therefore be exposed to sediments in areas covered by less than one foot of water through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 1	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-268 and 14-271 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-268 and 14-271 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 2	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-272 and 14-302 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-272 and 14-302 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.

TABLE B-1.1
SELECTION OF EXPOSURE PATHWAYS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
	Residential Soils/Flood Plain Sediments	Exposure Point 3	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-303, 14-333, and 14-334 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-303, 14-333, and 14-334 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 4	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-365 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-365 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 5	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-366 and 14-398 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-366 and 14-398 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 6	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-399 and 14-418 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-399 and 14-418 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 7	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-419, 14-420, and 14-421 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-419, 14-420, and 14-421 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 8	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-422, 14-424, and 14-425 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-422, 14-424, and 14-425 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 9	Resident	Adult/Child	Ingestion	Residential exposure at lot 14-430 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lot 14-430 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.

TABLE B-1.1
SELECTION OF EXPOSURE PATHWAYS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
	Residential Soils	Exposure Point 10	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-448 and 14-449 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-448 and 14-449 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 11	Resident	Adult/Child	Ingestion	Residential exposure at lots 14-210, 12-239, and 12-240 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 14-210, 12-239, and 12-240 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 12	Resident	Adult/Child	Ingestion	Residential exposure at lots 12-550 and 12-551 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 12-550 and 12-551 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 13	Resident	Adult/Child	Ingestion	Residential exposure at lots 12-552 and 12-553 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 12-552 and 12-553 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 14	Resident	Adult/Child	Ingestion	Residential exposure at lots 12-554 and 12-555 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 12-554 and 12-555 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 15	Resident	Adult/Child	Ingestion	Residential exposure at lot 12-556 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lot 12-556 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 16	Resident	Adult/Child	Ingestion	Residential exposure at lots 12-323, 12-324, 11-11, and 11-12 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 12-323, 12-324, 11-11, and 11-12 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.

TABLE B-1.1
SELECTION OF EXPOSURE PATHWAYS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
	Residential Soils	Exposure Point 17	Resident	Adult/Child	Ingestion	Residential exposure at lot 11-419 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lot 11-419 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 18	Resident	Adult/Child	Ingestion	Residential exposure at lots 11-420 and 11-422 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 11-420 and 11-422 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 19	Resident	Adult/Child	Ingestion	Residential exposure at lots 11-423, 11-424, 11-425, and 11-426 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 11-423, 11-424, 11-425, and 11-426 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 20	Resident	Adult/Child	Ingestion	Residential exposure at lots 11-427, 11-428, and 11-429 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 11-427, 11-428, and 11-429 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 21	Resident	Adult/Child	Ingestion	Residential exposure at lots 11-432 and 11-433 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 11-432 and 11-433 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 22	Resident	Adult/Child	Ingestion	Residential exposure at lots 11-486 and 11-328 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 11-486 and 11-328 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 23	Resident	Adult/Child	Ingestion	Residential exposure at lot 11-396 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lot 11-396 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.

TABLE B-1.1
SELECTION OF EXPOSURE PATHWAYS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
	Residential Soils	Exposure Point 24	Resident	Adult/Child	Ingestion	Residential exposure at lot 11-577 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lot 11-577 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Flood Plain Sediments	Exposure Point 25	Resident	Adult/Child	Ingestion	Residential exposure at lots 10-4 and 10-5 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 10-4 and 10-5 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 26	Resident	Adult/Child	Ingestion	Residential exposure at lots 10-42, 10-604, and 10-44 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 10-42, 10-604, and 10-44 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils/Bank Sediments	Exposure Point 27	Resident	Adult/Child	Ingestion	Residential exposure at lots 10-53 and 10-68 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 10-53 and 10-68 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
	Residential Soils	Exposure Point 28	Resident	Adult/Child	Ingestion	Residential exposure at lots 10-74, 10-75, and 10-76 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.
					Dermal	Residential exposure at lots 10-74, 10-75, and 10-76 is evaluated. Adults and children ages 0-30 years may be exposed to contaminated soil on-site through inadvertent contact.

TABLE B-2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Soils
Exposure Medium:	Residential soils
Exposure Point:	Homes

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
92-52-4	1,1'-Biphenyl	120	J	120	J	ug/kg	RES-10-042-01	1/57	360 - 110000	120	0				NO	NTX
91-57-6	2-Methylnaphthalene	44	J	1100		ug/kg	RES-10-075-01	2/57	360 - 110000	1100	0				NO	NTX
83-32-9	Acenaphthene	80	J	14000	J	ug/kg	RES-11-424-01	7/57	360 - 9700	14000	0	4000000 nc			NO	BSL
208-96-8	Acenaphthylene	160	J	3100		ug/kg	RES-10-075-01	6/58	360 - 110000	3100	0				NO	NTX
120-12-7	Anthracene	17	J	40000	J	ug/kg	RES-11-424-01	32/59	360 - 8400	40000	0	20000000 nc			NO	BSL
100-52-7	Benzaldehyde	52	J	800	J	ug/kg	RES-11-396-01	11/58	360 - 110000	800	0				NO	NTX
56-55-3	Benzo(a)anthracene	30	J	140000		ug/kg	RES-11-424-01	51/61	370 - 3900	140000	0	6000 ca			YES	ASL
50-32-8	Benzo(a)pyrene	62	J	110000	J	ug/kg	RES-11-424-01	50/61	360 - 3900	110000	0	600 ca			YES	ASL
205-99-2	Benzo(b)fluoranthene	38	J	120000		ug/kg	RES-11-424-01	53/61	370 - 3300	120000	0	6000 ca			YES	ASL
191-24-2	Benzo(g,h,i)perylene	71	J	58000	J	ug/kg	RES-11-424-01	39/61	360 - 4800	58000	0				NO	NTX
207-08-9	Benzo(k)fluoranthene	42	J	100000	J	ug/kg	RES-11-424-01	53/61	370 - 3300	100000	0	60000 ca			YES	ASL
117-81-7	bis(2-Ethylhexyl)phthalate	49	JEB	10000		ug/kg	RES-14-303-01	29/61	370 - 110000	10000	0	300000 ca*			NO	BSL
85-68-7	Butylbenzylphthalate	140	J	620	J	ug/kg	RES-11-012-01	4/58	360 - 110000	620	0	10000000 nc			NO	BSL
86-74-8	Carbazole	77	J	26000	J	ug/kg	RES-11-424-01	13/58	360 - 8800	26000	0	200000 ca			NO	BSL
218-01-9	Chrysene	42	J	150000		ug/kg	RES-11-424-01	54/61	370 - 3900	150000	0	600000 ca			NO	BSL
84-74-2	Di-n-Butylphthalate	37	J	610	EB	ug/kg	RES-14-398-01	6/58	400 - 110000	610	0	6000000 nc			NO	BSL
117-84-0	Di-n-octylphthalate	800	J	800	J	ug/kg	RES-14-303-01	1/58	360 - 110000	800	0	1000000 nc			NO	BSL
53-70-3	Dibenzo(a,h)anthracene	77	J	26000	J	ug/kg	RES-11-424-01	16/60	360 - 8800	26000	0	600 ca			YES	ASL
132-64-9	Dibenzofuran	77	J	5200		ug/kg	RES-10-075-01	5/57	360 - 110000	5200	0	300000 nc			NO	BSL
206-44-0	Fluoranthene	51	J	300000	J	ug/kg	RES-11-424-01	56/61	410 - 3900	300000	0	2000000 nc			NO	BSL
86-73-7	Fluorene	59	J	16000	J	ug/kg	RES-11-424-01	11/57	360 - 8800	16000	0	3000000 nc			NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	56	J	56000	J	ug/kg	RES-11-424-01	39/61	360 - 5000	56000	0	6000 ca			YES	ASL
91-20-3	Naphthalene	65	J	2300		ug/kg	RES-10-075-01	3/57	360 - 110000	2300	0	60000 nc			NO	BSL
87-86-5	Pentachlorophenol	18000	J	18000	J	ug/kg	RES-14-333-01	1/58	900 - 280000	18000	0	30000 ca			NO	BSL
85-01-8	Phenanthrene	72	J	180000	J	ug/kg	RES-11-424-01	46/60	360 - 8400	180000	0				NO	NTX
129-00-0	Pyrene	55	J	280000	J	ug/kg	RES-11-424-01	56/61	410 - 3900	280000	0	2000000 nc			NO	BSL

TABLE B-2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Soils
Exposure Medium:	Residential soils
Exposure Point:	Homes

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
72-54-8	4,4'-DDD	4.4		38		ug/kg	RES-11-328-01	13/57	3.5 - 97	38	0	20000 ca			NO	BSL
72-55-9	4,4'-DDE	3.6	J	1100		ug/kg	RES-14-303-01	33/58	3.5 - 9.6	1100	0	20000 ca			NO	BSL
50-29-3	4,4'-DDT	2.9	J	1300		ug/kg	RES-12-556-01	29/58	3.7 - 97	1300	0	20000 ca*			NO	BSL
309-00-2	Aldrin	3.4	P	3.4	P	ug/kg	RES-11-012-01	1/57	1.8 - 50	3.4	0	300 ca*			NO	BSL
5103-71-9	alpha-Chlordane	1.6	J	62		ug/kg	RES-14-398-01	34/60	1.8 - 50	62	0	20000 ca*			NO	BSL
AROCLORTOT	Aroclor, Total	30		48000		ug/kg	RES-14-303-01	37/60	72 - 410	48000	0	2000 ca**			YES	ASL
53469-21-9	Aroclor-1242	140		11000		ug/kg	RES-14-303-01	3/58	35 - 200	11000	0	2000 ca			YES	ASL
11097-69-1	Aroclor-1254	30	J	37000	*	ug/kg	RES-14-303-01	37/60	35 - 200	37000	0	2000 ca**			YES	ASL
11096-82-5	Aroclor-1260	30	J	140		ug/kg	RES-10-044-01	3/57	35 - 970	140	0	2000 ca			NO	BSL
60-57-1	Dieldrin	6.3		81		ug/kg	RES-12-240-01	4/57	3.5 - 97	81	0	300 ca			NO	BSL
33213-65-9	Endosulfan II	12		3400	*	ug/kg	RES-14-303-01	14/59	3.5 - 20	3400	0	300000 nc			NO	BSL
1031-07-8	Endosulfan Sulfate	6.4		18		ug/kg	RES-11-424-01	3/57	3.5 - 97	18	0				NO	NTX
53494-70-5	Endrin Ketone	15		62		ug/kg	RES-10-075-01	7/58	3.5 - 97	62	0				NO	NTX
5103-74-2	gamma-Chlordane	2.4		260		ug/kg	RES-14-303-01	33/60	1.8 - 10	260	0	20000 ca*			NO	BSL
76-44-8	Heptachlor	2.1		4.4		ug/kg	RES-12-551-01	2/57	1.8 - 50	4.4	0	1000 ca			NO	BSL
1024-57-3	Heptachlor Epoxide	3		26		ug/kg	RES-11-012-01	5/57	1.8 - 50	26	0	500 ca*			NO	BSL
72-43-5	Methoxychlor	26		35	J	ug/kg	RES-12-551-01	2/57	18 - 500	35	0	300000 nc			NO	BSL

TABLE B-2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
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CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Soils
Exposure Medium:	Residential soils
Exposure Point:	Homes

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
35822-46-9	1,2,3,4,6,7,8-HpCDD	2.09	EMPC	5300		ng/kg	RES-14-449-03	169/179	3.2 - 15	5300	0				NO	NTX
67562-39-4	1,2,3,4,6,7,8-HpCDF	1.2	EMPC	2920	$	ng/kg	RES-11-433-01	163/179	1.3 - 8.4	2920	0				NO	NTX
55673-89-7	1,2,3,4,7,8,9-HpCDF	0.24		694		ng/kg	RES-11-433-01	127/179	0.2 - 4.4	694	0				NO	NTX
39227-28-6	1,2,3,4,7,8-HxCDD	0.201		167		ng/kg	RES-11-433-01	134/179	0.176 - 3.8	167	0				NO	NTX
70648-26-9	1,2,3,4,7,8-HxCDF	0.199	EMPC	1720	EB$	ng/kg	RES-11-433-01	134/179	0.4 - 4.8	1720	0				NO	NTX
57653-85-7	1,2,3,6,7,8-HxCDD	0.347	EMPC	284		ng/kg	RES-11-433-01	126/179	0.3 - 6.74	284	0				NO	NTX
57117-44-9	1,2,3,6,7,8-HxCDF	0.22	EMPC	797		ng/kg	RES-11-433-01	147/178	0.2 - 2.8	797	0				NO	NTX
19408-74-3	1,2,3,7,8,9-HxCDD	0.247	EMPC	580		ng/kg	RES-11-433-01	128/179	0.3 - 4.2	580	0				NO	NTX
72918-21-9	1,2,3,7,8,9-HxCDF	0.177		51.8		ng/kg	RES-11-433-01	77/176	0.06 - 3.9	51.8	0				NO	NTX
40321-76-4	1,2,3,7,8-PeCDD	0.0826	EMPC	187		ng/kg	CMS-470	108/179	0.1 - 4.2	187	0				NO	NTX
57117-41-6	1,2,3,7,8-PeCDF	0.12	EMPC	239		ng/kg	RES-11-433-01	136/179	0.1 - 3.4	239	0				NO	NTX
HCX	1,2,4,5,7,8-hexachloro(9H)xanthene	0.59	J	5150		ng/kg	RES-14-449-03	62/62	0 - 0	5150	0				NO	NTX
60851-34-5	2,3,4,6,7,8-HxCDF	0.167	EMPC	1260		ng/kg	RES-11-433-01	160/179	0.2 - 2.1	1260	0				NO	NTX
57117-31-4	2,3,4,7,8-PeCDF	0.064	EMPC	745		ng/kg	RES-11-433-01	138/179	0.2 - 5.7	745	0				NO	NTX
1746-01-6	2,3,7,8-TCDD	0.0948	EMPC	57310		ng/kg	RES-14-449-03	180/203	0.3 - 493	57310	0				NO	NTX
51207-31-9	2,3,7,8-TCDF	0.146	EMPC	811	$	ng/kg	RES-11-433-01	142/179	0.2 - 6.6	811	0				NO	NTX
3268-87-9	OCDD	19.1		29200	J&	ng/kg	RES-14-303-01	177/179	19.7 - 22.7	29200	0				NO	NTX
39001-02-0	OCDF	1.3	EMPC	2240	J	ng/kg	RES-11-433-01	177/179	4.4 - 9.8	2240	0				NO	NTX
GTI500081	PCDD/Fs	212		68300		ng/kg	CMS-487	48/48	0 - 0	68300	0				NO	NTX
37871-00-4	Total HpCDD	6.8		9750		ng/kg	RES-14-449-03	158/174	9.3 - 57	9750	0				NO	NTX
38998-75-3	Total HpCDF	1.8	EMPC	4540	J$	ng/kg	RES-11-433-01	159/174	2.3 - 16.6	4540	0				NO	NTX
34465-46-8	Total HxCDD	2		3360	J$	ng/kg	RES-11-433-01	141/173	1 - 70.8	3360	0				NO	NTX
55684-94-1	Total HxCDF	1.7	EMPC	4950	J$	ng/kg	RES-11-433-01	158/174	1.7 - 28.4	4950	0				NO	NTX
36088-22-9	Total PeCDD	0.83	EMPC	2620	J	ng/kg	RES-11-433-01	152/174	0.3 - 37.4	2620	0				NO	NTX
30402-15-4	Total PeCDF	0.99	EMPC	7370	J	ng/kg	RES-11-433-01	164/172	4.9 - 24.6	7370	0				NO	NTX
41903-57-5	Total TCDD	0.78	EMPC	59560		ng/kg	RES-14-449-03	162/174	0.3 - 10.2	59560	0				NO	NTX
55722-27-5	Total TCDF	0.7	EMPC	6810		ng/kg	RES-14-449-03	162/170	0.49 - 11.5	6810	0				NO	NTX
TEQ	Toxicity Equivalency	0.675953		57720.11		ng/kg	RES-14-449-03	203/203	0 - 0	57720.1103	0	40 ca			YES	ASL

TABLE B-2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Soils
Exposure Medium:	Residential soils
Exposure Point:	Homes

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
7429-90-5	Aluminum	2160		213000		mg/kg	RES-10-076-01	61/61	0 - 0	213000	0	80000 nc			NO	NTX
7440-36-0	Antimony	1.6	J	38.2	J	mg/kg	RES-10-042-01	21/61	0.48 - 6.6	38.2	0	30 nc			YES	ASL
7440-38-2	Arsenic	1.7	J	55.6		mg/kg	RES-10-042-01	60/61	1.9 - 1.9	55.6	0	3 ca*			YES	ASL
7440-39-3	Barium	17.7		874		mg/kg	RES-10-075-01	61/61	0 - 0	874	0	5000 nc			NO	BSL
7440-41-7	Beryllium	0.36		2.9	J	mg/kg	RES-14-448-01	24/59	0.21 - 1.5	2.9	0	200 nc			NO	BSL
7440-43-9	Cadmium	0.32	J	7.9		mg/kg	RES-14-303-01	26/59	0.07 - 0.59	7.9	0	40 nc			NO	BSL
7440-70-2	Calcium	714		48700		mg/kg	RES-11-429-01	58/61	642 - 1440	48700	0				NO	NTX
7440-47-3	Chromium	4.6		536	J	mg/kg	RES-14-449-01	61/61	0 - 0	536	0	300 ca*			YES	ASL
7440-48-4	Cobalt	1.9		21.7		mg/kg	RES-10-042-01	60/61	0.25 - 0.25	21.7	0	5000 nc			NO	BSL
7440-50-8	Copper	8.2		25500		mg/kg	RES-11-433-01	60/61	7.3 - 7.3	25500	0	3000 nc			NO	NTX
7439-89-6	Iron	5350		89700		mg/kg	RES-10-076-01	61/61	0 - 0	89700	0	20000 nc			NO	NTX
7439-92-1	Lead	10.4		2460		mg/kg	RES-11-012-01	61/61	0 - 0	2460	0	400 nc			YES	ASL
7439-95-4	Magnesium	886	J	10100		mg/kg	RES-14-271-01	61/61	0 - 0	10100	0				NO	NTX
7439-96-5	Manganese	66.5		2880		mg/kg	RES-10-076-01	61/61	0 - 0	2880	0	2000 nc			YES	ASL
7439-97-6	Mercury	0.05	J	3		mg/kg	RES-10-044-01	24/58	0.11 - 0.36	3	0	nc			NO	NTX
7440-02-0	Nickel	3.2		71.6		mg/kg	RES-12-240-01	61/61	0 - 0	71.6	0	2000 nc			NO	BSL
7440-09-7	Potassium	313		4380		mg/kg	RES-14-271-01	61/61	0 - 0	4380	0				NO	NTX
7782-49-2	Selenium	0.58	J	4.7		mg/kg	RES-12-240-01	16/58	0.41 - 3.6	4.7	0	400 nc			NO	BSL
7440-22-4	Silver	0.26	J	6.4	J	mg/kg	RES-14-449-01	26/61	0.22 - 0.95	6.4	0	400 nc			NO	BSL
7440-23-5	Sodium	94.6		2010		mg/kg	RES-10-042-01	41/61	35.2 - 362	2010	0				NO	NTX
7440-28-0	Thallium	2.4	J	6.8	J	mg/kg	RES-14-333-01	2/58	0.48 - 5	6.8	0	5 nc			YES	ASL
7440-62-2	Vanadium	5.9		79.3		mg/kg	RES-12-551-01	61/61	0 - 0	79.3	0	500 nc			NO	BSL
7440-66-6	Zinc	17.9		1730		mg/kg	RES-10-075-01	61/61	0 - 0	1730	0	20000 nc			NO	BSL

(1) Minimum/maximum detected concentration.
(2) N/A

(3) Screening values are based on Region IX Residential Soil PRGs. Cancer values are adjusted to 1.0E-05 cancer risk
(4) Rationale Codes Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic

TABLE B-2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Flood Plain Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
120-82-1	1,2,4-Trichlorobenzene	1.8	J	1.8	J	ug/kg	CMS-456	1/1	0 - 0	1.8	0	600000 nc			NO	BSL
108-90-7	Chlorobenzene	3.1	J	3.1	J	ug/kg	CMS-456	1/1	0 - 0	3.1	0	200000 nc			NO	BSL
108-88-3	Toluene	2.2	J	2.2	J	ug/kg	CMS-456	1/1	0 - 0	2.2	0	500000 sat			NO	BSL
GTI500034	Total Volatile Organics	7.1		7.1		ug/kg	CMS-456	1/1	0 - 0	7.1	0				NO	NTX
95-95-4	2,4,5-Trichlorophenol	170	J	170	J	ug/kg	CMS-456	1/21	980 - 12000	170	0	6000000 nc			NO	BSL
91-57-6	2-Methylnaphthalene	80	J	440	J	ug/kg	SD-37	2/21	390 - 5000	440	0				NO	NTX
88-75-5	2-Nitrophenol	5000		5000		ug/kg	CMW-FP-2026	1/21	390 - 4800	5000	0				NO	NTX
83-32-9	Acenaphthene	150	J	1600		ug/kg	SD-37	3/21	410 - 5000	1600	1800	4000000 nc			NO	BSL
208-96-8	Acenaphthylene	190	J	280	J	ug/kg	CMS-456	2/21	390 - 5000	280	0				NO	NTX
120-12-7	Anthracene	67	J	3100		ug/kg	SD-37	8/21	410 - 5000	3100	2000	20000000 nc			NO	BSL
56-55-3	Benzo(a)anthracene	93	J	8600	*	ug/kg	SD-37	19/21	410 - 4800	8600	1700	6000 ca			YES	ASL
50-32-8	Benzo(a)pyrene	110	J	6200	*	ug/kg	SD-37	19/21	410 - 4800	6200	1600	600 ca			YES	ASL
205-99-2	Benzo(b)fluoranthene	170	J	8400	*	ug/kg	SD-37	20/21	410 - 410	8400	1700	6000 ca			YES	ASL
191-24-2	Benzo(g,h,i)perylene	64	J	2600		ug/kg	SD-37	14/21	410 - 5000	2600	1000				NO	NTX
207-08-9	Benzo(k)fluoranthene	66	J	2400		ug/kg	CMW-SD-2021, SD-37	19/21	410 - 490	2400	1800	60000 ca			NO	BSL
117-81-7	bis(2-Ethylhexyl)phthalate	43	J	3300	J	ug/kg	SD-35	11/21	480 - 5000	3300	0	300000 ca*			NO	BSL
85-68-7	Butylbenzylphthalate	240		660	J	ug/kg	CMW-SD-2021	4/21	390 - 5000	660	1900	10000000 nc			NO	BSL
86-74-8	Carbazole	80	J	2000	J	ug/kg	SD-37	6/21	410 - 5000	2000	1900	200000 ca			NO	BSL
218-01-9	Chrysene	120	J	7900	*	ug/kg	SD-37	20/21	410 - 410	7900	2100	600000 ca			NO	BSL
84-74-2	Di-n-Butylphthalate	120		130	J	ug/kg	CMS-456	2/21	390 - 4800	130	1800	6000000 nc			NO	BSL
117-84-0	Di-n-octylphthalate	140	J	140	J	ug/kg	SD-14	1/21	410 - 4800	140	0	1000000 nc			NO	BSL
53-70-3	Dibenzo(a,h)anthracene	46	J	880		ug/kg	SD-37	9/21	410 - 5000	880	2100	600 ca			YES	ASL
132-64-9	Dibenzofuran	66	J	1300		ug/kg	SD-37	3/21	410 - 5000	1300	0	300000 nc			NO	BSL
206-44-0	Fluoranthene	49	J	17000	*	ug/kg	SD-37	21/21	0 - 0	17000	3400	2000000 nc			NO	BSL
86-73-7	Fluorene	190	J	2000		ug/kg	SD-37	4/21	410 - 5000	2000	1900	3000000 nc			NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	74	J	2700		ug/kg	SD-37	19/21	410 - 4800	2700	1100	6000 ca			NO	BSL
91-20-3	Naphthalene	930		930		ug/kg	SD-37	1/21	390 - 5000	930	0	60000 nc			NO	BSL
85-01-8	Phenanthrene	140	J	17000	*	ug/kg	SD-37	19/21	410 - 4800	17000	2000				NO	NTX
129-00-0	Pyrene	190	J	17000	*	ug/kg	SD-37	20/21	410 - 410	17000	3200	2000000 nc			NO	BSL
GTI500035	Total Semi-Volatile Organics	28000		28000		ug/kg	CMS-456	1/1	0 - 0	28000	0				NO	NTX

TABLE B-2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Flood Plain Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
72-54-8	4,4'-DDD	0.89	J	5.6	J	ug/kg	APB-FP-2032, CMW-FP-2027	13/35	3.7 - 11	5.6	0	20000 ca			NO	BSL
72-55-9	4,4'-DDE	0.31	J	23	J	ug/kg	SD-30	24/40	3.8 - 5.2	23	0	20000 ca			NO	BSL
50-29-3	4,4'-DDT	1.6	J	11	J	ug/kg	SD-37	5/36	3.7 - 27	11	3.5	20000 ca*			NO	BSL
309-00-2	Aldrin	0.58	J	1.9	J	ug/kg	SD-34	2/35	1.9 - 5.5	1.9	0	300 ca*			NO	BSL
5103-71-9	alpha-Chlordane	0.21	J	25	J	ug/kg	SD-14	23/35	2.1 - 4.8	25	3.1	20000 ca*			NO	BSL
AROCLORTOT	Aroclor, Total	23		7800		ug/kg	SD-33	25/42	49 - 200	7800	210	2000 ca**			YES	ASL
12672-29-6	Aroclor-1248	330		720		ug/kg	CMS-456	3/37	37 - 110	720	0	2000 ca			NO	BSL
11097-69-1	Aroclor-1254	23	J	7800	*J	ug/kg	SD-33	25/41	39 - 97	7800	180	2000 ca**			YES	ASL
319-85-7	beta-BHC	1.4	J	32		ug/kg	CMW-SD-2021	3/30	1.9 - 6.6	32	0	3000 ca			NO	BSL
319-86-8	delta-BHC	0.12	J	2.4	J	ug/kg	SD-20	2/37	1.9 - 5.5	2.4	0				NO	NTX
60-57-1	Dieldrin	1.4	J, EB	47		ug/kg	APB-FP-2032	9/36	2.2 - 11	47	0	300 ca			NO	BSL
959-98-8	Endosulfan I	0.25	J	0.25	J	ug/kg	SD-39	1/36	1.9 - 47	0.25	0	300000 nc			NO	BSL
33213-65-9	Endosulfan II	10		170	*	ug/kg	CMW-SD-2022	3/36	3.7 - 11	170	0	300000 nc			NO	BSL
1031-07-8	Endosulfan sulfate	1.7	J	23		ug/kg	SD-30	10/32	3.8 - 39	23	0				NO	NTX
72-20-8	Endrin	1.4	J	28		ug/kg	APB-FP-2032	6/36	3.7 - 27	28	0	20000 nc			NO	BSL
7421-93-4	Endrin Aldehyde	0.77	J	5.2	J	ug/kg	SD-20	4/35	3.7 - 10	5.2	0				NO	NTX
53494-70-5	Endrin Ketone	1.9	J	20	J	ug/kg	SD-37	3/34	3.7 - 27	20	0				NO	NTX
5103-74-2	gamma-Chlordane	1.4	J	22		ug/kg	CMW-SD-2021	22/30	2.1 - 4.8	22	4	20000 ca*			NO	BSL
76-44-8	Heptachlor	0.43	J	0.62	J	ug/kg	SD-12	2/36	1.9 - 5.5	0.62	0	1000 ca			NO	BSL
1024-57-3	Heptachlor Epoxide	2.2	J	3.8	J	ug/kg	CMW-FP-2027	2/32	1.9 - 20	3.8	0	500 ca*			NO	BSL
72-43-5	Methoxychlor	2.3	J	16	J	ug/kg	SD-22	14/40	19 - 240	16	0	300000 nc			NO	BSL
75-99-0	Dalapon	66		66		ug/kg	CMS-456	1/1	0 - 0	66	0				NO	NTX

TABLE B-2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Flood Plain Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
35822-46-9	1,2,3,4,6,7,8-HpCDD	175.58	J	2140	$	ng/kg	CMW-SD-2021	16/37	0.92 - 238.32	2140	664				NO	NTX
67562-39-4	1,2,3,4,6,7,8-HpCDF	4.6	EMPC	644.3	J	ng/kg	SD-20	29/34	0.57 - 8.13	644.3	247				NO	NTX
55673-89-7	1,2,3,4,7,8,9-HpCDF	1.02	J	47.6	EMPC	ng/kg	SD-33	20/36	0.53 - 8.21	47.6	12.9				NO	NTX
39227-28-6	1,2,3,4,7,8-HxCDD	0.5	EMPC	35.64	EMPC	ng/kg	SD-23	25/37	0.28 - 16.36	35.64	11.1				NO	NTX
70648-26-9	1,2,3,4,7,8-HxCDF	0.6	EMPC	148.93	J	ng/kg	SD-33	26/26	0 - 0	148.93	33.7				NO	NTX
57653-85-7	1,2,3,6,7,8-HxCDD	1.97	EMPC	104		ng/kg	CMW-SD-2021	32/32	0 - 0	104	37.6				NO	NTX
57117-44-9	1,2,3,6,7,8-HxCDF	0.33	EMPC	60.38	J	ng/kg	SD-33	29/29	0 - 0	60.38	22.7				NO	NTX
19408-74-3	1,2,3,7,8,9-HxCDD	0.48	EMPC	549.73	EMPC	ng/kg	SD-38	32/37	0.47 - 16.36	549.73	31.9				NO	NTX
72918-21-9	1,2,3,7,8,9-HxCDF	4.45		46.3	J	ng/kg	APB-FP-2033	7/8	0.7 - 0.7	46.3	1.1				NO	NTX
40321-76-4	1,2,3,7,8-PeCDD	0.41	J	22.8		ng/kg	CMW-FP-2026	19/35	0.56 - 9.39	22.8	5.7				NO	NTX
57117-41-6	1,2,3,7,8-PeCDF	0.22	EMPC	151.03	J	ng/kg	SD-30	27/27	0 - 0	151.03	6.1				NO	NTX
HCX	1,2,4,5,7,8-hexachloro(9H)xanthene	17.46	J	364758	J	ng/kg	SD-23	16/35	281.32 - 5036	364758	9.6				NO	NTX
60851-34-5	2,3,4,6,7,8-HxCDF	0.66	EMPC	37.5		ng/kg	CMW-SD-2021	24/29	0.6 - 3	37.5	27.3				NO	NTX
57117-31-4	2,3,4,7,8-PeCDF	0.6	EMPC	52.4	J	ng/kg	SD-33	29/37	0.37 - 18.64	52.4	12.3				NO	NTX
1746-01-6	2,3,7,8-TCDD	0.988		21800		ng/kg	CMS-192	92/105	0.7 - 46	21800	30.1				NO	NTX
51207-31-9	2,3,7,8-TCDF	0.7	EMPC	587.64	J	ng/kg	SD-30	31/37	0.48 - 3.15	587.64	29.7				NO	NTX
3268-87-9	OCDD	2560	EB	13200	J	ng/kg	CMS-472	14/37	25.06 - 1575.88	13200	5010				NO	NTX
39001-02-0	OCDF	163	EB	1158.08	J	ng/kg	SD-22	9/33	6.02 - 581.98	1158.08	330				NO	NTX
GTI500081	PCDD/Fs	21500		21500		ng/kg	CMS-472	1/1	0 - 0	21500	0				NO	NTX
37871-00-4	Total HpCDD	768	J	3640	J	ng/kg	CMS-472	7/7	0 - 0	3640	1330				NO	NTX
38998-75-3	Total HpCDF	244		913	J	ng/kg	CMW-SD-2021	7/7	0 - 0	913	583				NO	NTX
34465-46-8	Total HxCDD	158		644	J	ng/kg	CMW-SD-2021	7/7	0 - 0	644	294				NO	NTX
55684-94-1	Total HxCDF	129		850		ng/kg	CMW-FP-2026	7/7	0 - 0	850	443				NO	NTX
36088-22-9	Total PeCDD	20.2		170		ng/kg	CMW-FP-2026	7/7	0 - 0	170	37.4				NO	NTX
30402-15-4	Total PeCDF	51.6		697	J	ng/kg	APB-FP-2033	7/7	0 - 0	697	257				NO	NTX
41903-57-5	Total TCDD	5		16890		ng/kg	CMW-FP-2026	7/7	0 - 0	16890	58.5				NO	NTX
55722-27-5	Total TCDF	23.4		912	J	ng/kg	APB-FP-2033	7/7	0 - 0	912	270				NO	NTX
TEQ	Toxicity Equivalency	0.890753		21800		ng/kg	CMS-192	106/106	0 - 0	21800	71.5	40 ca			YES	ASL

TABLE B-2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe	Current/Future
Medium:	Sediments
Exposure Medium:	Flood Plain Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	(4) Rationale for Contaminant Deletion or Selection
7429-90-5	Aluminum	3210		15400		mg/kg	APB-FP-2033	11/11	0 - 0	15400	12100	80000 nc			NO	NTX
7440-36-0	Antimony	1.1	J	6.3	J	mg/kg	APB-FP-2028	7/11	0.72 - 1.1	6.3	2.3	30 nc			NO	BSL
7440-38-2	Arsenic	1.8		10.9		mg/kg	CMW-FP-2026	11/11	0 - 0	10.9	7.7	3 ca*			YES	ASL
7440-39-3	Barium	34.4	J	244		mg/kg	APB-FP-2031	11/11	0 - 0	244	182	5000 nc			NO	BSL
7440-41-7	Beryllium	0.41	J	3.3		mg/kg	APB-FP-2031	9/11	0.44 - 0.53	3.3	2.7	200 nc			NO	BSL
7440-43-9	Cadmium	0.51		4.9		mg/kg	APB-FP-2033	7/10	0.08 - 0.1	4.9	0.46	40 nc			NO	BSL
7440-70-2	Calcium	666	J	4530	J	mg/kg	CMW-SD-2021	11/11	0 - 0	4530	2080				NO	NTX
7440-47-3	Chromium	16.4		329		mg/kg	APB-FP-2028	11/11	0 - 0	329	143	300 ca*			YES	ASL
7440-48-4	Cobalt	2.4	J	10.1		mg/kg	APB-FP-2033	11/11	0 - 0	10.1	9.1	5000 nc			NO	BSL
7440-50-8	Copper	21.7		231		mg/kg	APB-FP-2028	11/11	0 - 0	231	187	3000 nc			NO	NTX
7439-89-6	Iron	4960		28800		mg/kg	CMW-SD-2021	11/11	0 - 0	28800	22400	20000 nc			NO	NTX
7439-92-1	Lead	138		1090		mg/kg	APB-FP-2033	11/11	0 - 0	1090	278	400 nc			YES	ASL
7439-95-4	Magnesium	701	J	4820	J	mg/kg	APB-FP-2033	11/11	0 - 0	4820	1930				NO	NTX
7439-96-5	Manganese	52.1		1700	J	mg/kg	CMS-456	11/11	0 - 0	1700	1360	2000 nc			NO	BSL
7439-97-6	Mercury	0.16		1.4		mg/kg	APB-FP-2028	11/11	0 - 0	1.4	0.28	nc			NO	NTX
7439-98-7	Molybdenum	1.9	J	1.9	J	mg/kg	CMS-456	1/1	0 - 0	1.9	0				NO	NTX
7440-02-0	Nickel	3.7		66.4		mg/kg	APB-FP-2031	11/11	0 - 0	66.4	99	2000 nc			NO	BSL
7440-09-7	Potassium	369	J	1340	J	mg/kg	APB-FP-2033	11/11	0 - 0	1340	1220				NO	NTX
7440-22-4	Silver	2.6		8.4		mg/kg	CMW-FP-2026	9/11	1.5 - 2	8.4	7.7	400 nc			NO	BSL
7440-23-5	Sodium	34.4	J	342	J	mg/kg	APB-FP-2033	6/11	71.8 - 175	342	123				NO	NTX
7440-28-0	Thallium	0.6	J	0.6	J	mg/kg	APB-FP-2030	1/11	0.35 - 299	0.6	0	5 nc			NO	BSL
7440-62-2	Vanadium	10.3		93.8		mg/kg	CMW-FP-2026	11/11	0 - 0	93.8	65.7	500 nc			NO	BSL
7440-66-6	Zinc	154		587	J	mg/kg	CMW-SD-2021	11/11	0 - 0	587	255	20000 nc			NO	BSL
AVS	Acid Volatile Sulfide	1.03		314.55588		umol/g	CMW-SD-2021	6/9	0.0575 - 0.11962	314.55588	0.12				NO	NTX
7440-43-9	Cadmium	0.004	J	0.04149	J	umol/g	APB-FP-2028	6/8	0.00112 - 0.00273	0.04149	0.009				NO	NTX
7440-50-8	Copper	0.4069		4		umol/g	APB-FP-2028	9/9	0 - 0	4	3				NO	NTX
7439-92-1	Lead	0.65408		3.23622		umol/g	APB-FP-2033	9/9	0 - 0	3.23622	1.2				NO	NTX
7439-97-6	Mercury	0.00005		0.00043		umol/g	APB-FP-2030	3/9	0.00004 - 0.00009	0.00043	0.00024				NO	NTX
7440-02-0	Nickel	0.14879		6.85786	J	umol/g	CMW-SD-2021	9/9	0 - 0	6.85786	1.8				NO	NTX
SEMOVERAVS	SEM/AVS	0.06548		81.12411		umol/g	APB-FP-2030	9/9	0 - 0	81.12411	69				NO	NTX
SEM	Simultaneously Extracted Metal	3.73775		20.59823		umol/g	CMW-SD-2021	9/9	0 - 0	20.59823	8.9				NO	NTX
7440-66-6	Zinc	1.3934		9.71184		umol/g	CMW-SD-2021	9/9	0 - 0	9.71184	3.3				NO	NTX
7440-44-0	Total Organic Carbon	1010		202000		mg/kg	SD-23	39/39	0 - 0	202000	73000				NO	NTX

TABLE B-2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Flood Plain Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	(4) Rationale for Contaminant Deletion or Selection

(1) Minimum/maximum detected concentration.
(2) N/A

(3) Screening values are based on Region IX Residential Soil PRGs. Cancer values are adjusted to 1.0E-05 cancer risk levels. Dioxin value is based on a national background study of dioxins in sediments per Duane Winters conversation with A. Burke.
(4) Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST)
Frequent Detection (FD)
Toxicity Information Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Infrequent Detection (IFD)
Background Levels (BKG)
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions: N/A = Not Applicable
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

TABLE B-2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Bank Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (1) Contaminant Deletion or Selection
95-63-6	1,2,4-Trimethylbenzene	1.7	J	1.7	J	ug/kg	CMS-703	1/2	8.7 - 8.7	1.7	0	6000 sat			NO	BSL
91-20-3	Naphthalene	66	J	66	J	ug/kg	CMS-703	1/2	8.7 - 8.7	66	0	60000 nc			NO	BSL
127-18-4	Tetrachloroethene	2.7	J	28		ug/kg	CMS-703	2/2	0 - 0	28	0	60000 ca*			NO	BSL
GTI500034	Total Volatile Organics	2.7		96		ug/kg	CMS-703	2/2	0 - 0	96	0				NO	NTX
83-32-9	Acenaphthene	530	J	530	J	ug/kg	APB-BK-2003	1/18	360 - 3900	530	820	4000000 nc			NO	BSL
120-12-7	Anthracene	210	J	1400	J	ug/kg	APB-BK-2003	3/18	360 - 3900	1400	630	20000000 nc			NO	BSL
56-55-3	Benzo(a)anthracene	59	J	3800		ug/kg	APB-BK-2003	14/18	360 - 3900	3800	1900	6000 ca			NO	BSL
50-32-8	Benzo(a)pyrene	45	J	3400	J	ug/kg	APB-BK-2003	14/18	360 - 3900	3400	1500	600 ca			YES	ASL
205-99-2	Benzo(b)fluoranthene	76	J	3600	J	ug/kg	APB-BK-2003	14/18	360 - 3900	3600	1500	6000 ca			NO	BSL
191-24-2	Benzo(g,h,i)perylene	43	J	2100	J	ug/kg	APB-BK-2003	9/18	360 - 3900	2100	840				NO	NTX
207-08-9	Benzo(k)fluoranthene	45	J	2400	J	ug/kg	APB-BK-2003	14/18	360 - 3900	2400	1200	60000 ca			NO	BSL
117-81-7	bis(2-Ethylhexyl)phthalate	47	J	460	J	ug/kg	WRL-BK-2004	10/18	840 - 3900	460	1000	300000 ca*			NO	BSL
86-74-8	Carbazole	150		790	J	ug/kg	APB-BK-2003	2/18	360 - 3900	790	490	200000 ca			NO	BSL
218-01-9	Chrysene	48	J	4100		ug/kg	APB-BK-2003	16/18	1800 - 3900	4100	2000	600000 ca			NO	BSL
84-74-2	Di-n-Butylphthalate	47	J	130	J	ug/kg	LPX-BK-2006	2/18	360 - 3900	130	1100	6000000 nc			NO	BSL
53-70-3	Dibenzo(a,h)anthracene	54		960	J	ug/kg	APB-BK-2003	5/18	360 - 3900	960	840	600 ca			YES	ASL
206-44-0	Fluoranthene	39	J	9500		ug/kg	APB-BK-2003	17/18	1800 - 1800	9500	3900	2000000 nc			NO	BSL
86-73-7	Fluorene	560	J	560	J	ug/kg	APB-BK-2003	1/18	360 - 3900	560	430	3000000 nc			NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	60	J	2200	J	ug/kg	APB-BK-2003	12/18	360 - 3900	2200	1100	6000 ca			NO	BSL
91-20-3	Naphthalene	110		110		ug/kg	LPX-BK-2007	1/18	360 - 3900	110	0	60000 nc			NO	BSL
85-01-8	Phenanthrene	69	J	7000		ug/kg	APB-BK-2003	15/18	360 - 3900	7000	2900				NO	NTX
129-00-0	Pyrene	110	J	8100		ug/kg	APB-BK-2003	15/18	360 - 3900	8100	3200	2000000 nc			NO	BSL

TABLE B-2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Bank Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (1) Contaminant Deletion or Selection
72-55-9	4,4'-DDE	4.9		4.9		ug/kg	WRL-BK-2005	1/16	3.1 - 5.6	4.9	0	20000 ca			NO	BSL
50-29-3	4,4'-DDT	5.1	P	7.8		ug/kg	LPX-BK-2007	4/16	3.1 - 5.6	7.8	11	20000 ca*			NO	BSL
AROCLORTOT	Aroclor, Total	13		300		ug/kg	CMS-703	9/21	51 - 93	300	190	2000 ca**			NO	BSL
11097-69-1	Aroclor-1254	13	JP	300		ug/kg	CMS-703	8/20	36 - 57	300	180	2000 ca**			NO	BSL
11096-82-5	Aroclor-1260	24		24		ug/kg	CMS-701	1/20	31 - 130	24	0	2000 ca			NO	BSL
60-57-1	Dieldrin	4.4	P	17	P	ug/kg	WRL-BK-2004	5/16	3.6 - 4.6	17	0	300 ca			NO	BSL
33213-65-9	Endosulfan II	4		4		ug/kg	APB-BK-2003	1/16	3.1 - 5.6	4	0	300000 nc			NO	BSL
72-20-8	Endrin	5.6	P	5.6	P	ug/kg	WRL-BK-2005	1/16	3.1 - 5.6	5.6	0	20000 nc			NO	BSL
35822-46-9	1,2,3,4,6,7,8-HpCDD	14.3		418		ng/kg	LPX-BK-2006	15/18	2.2 - 4	418	263				NO	NTX
67562-39-4	1,2,3,4,6,7,8-HpCDF	7.2		192		ng/kg	LPX-BK-2006	15/18	1 - 3.8	192	106				NO	NTX
55673-89-7	1,2,3,4,7,8,9-HpCDF	0.29	J	9.8	EMPC	ng/kg	LPX-BK-2006	11/18	0.2 - 6.5	9.8	11.8				NO	NTX
39227-28-6	1,2,3,4,7,8-HxCDD	0.38	J	9.8		ng/kg	LPX-BK-2006	13/18	0.2 - 3.2	9.8	3.4				NO	NTX
70648-26-9	1,2,3,4,7,8-HxCDF	4.2	J	49.8		ng/kg	LPX-BK-2006	13/18	0.76 - 1.9	49.8	26.5				NO	NTX
57653-85-7	1,2,3,6,7,8-HxCDD	1.3	J	24.4		ng/kg	LPX-BK-2007	12/18	0.47 - 2.6	24.4	14.9				NO	NTX
57117-44-9	1,2,3,6,7,8-HxCDF	2.2	J	21.4		ng/kg	LPX-BK-2006	12/18	0.28 - 1.5	21.4	10.9				NO	NTX
19408-74-3	1,2,3,7,8,9-HxCDD	0.64	J	28.1		ng/kg	LPX-BK-2006	15/17	1.2 - 1.9	28.1	13.4				NO	NTX
72918-21-9	1,2,3,7,8,9-HxCDF	0.18	J	0.67	EMPC	ng/kg	WRL-BK-2004	6/18	0.1 - 3.2	0.67	0				NO	NTX
40321-76-4	1,2,3,7,8-PeCDD	0.55	J	12.4		ng/kg	LPX-BK-2007	14/18	0.1 - 1.8	12.4	2.7				NO	NTX
57117-41-6	1,2,3,7,8-PeCDF	2.3	J	20	EMPC	ng/kg	LPX-BK-2006	13/18	0.47 - 1.5	20	9.6				NO	NTX
HCX	1,2,4,5,7,8-hexachloro(9H)xanthene	1.46	J	1198.35	J	ng/kg	WRL-BK-2004	10/10	0 - 0	1198.35	2.8				NO	NTX
60851-34-5	2,3,4,6,7,8-HxCDF	0.2	EMPC	28.7		ng/kg	LPX-BK-2006	15/18	0.45 - 1.8	28.7	25.5				NO	NTX
57117-31-4	2,3,4,7,8-PeCDF	1.7	EMPC	20.6		ng/kg	LPX-BK-2006	13/18	0.61 - 1.8	20.6	17				NO	NTX
1746-01-6	2,3,7,8-TCDD	0.59	J	116000		ng/kg	CMS-060	64/65	40 - 40	116000	13.2				NO	NTX
51207-31-9	2,3,7,8-TCDF	5.9		38.4		ng/kg	LPX-BK-2007	13/18	1.2 - 3.1	38.4	12.6				NO	NTX
3268-87-9	OCDD	18.8		2780	J	ng/kg	WRL-BK-2004	17/18	9.1 - 9.1	2780	1230				NO	NTX
39001-02-0	OCDF	11.8	EBJ	175		ng/kg	LPX-BK-2006	13/18	1.1 - 9.1	175	203				NO	NTX
37871-00-4	Total HpCDD	30		827	J	ng/kg	LPX-BK-2006	15/18	4.6 - 8.4	827	471				NO	NTX
38998-75-3	Total HpCDF	14	EMPC	364	J	ng/kg	LPX-BK-2006	17/18	3.6 - 3.6	364	347				NO	NTX
34465-46-8	Total HxCDD	5	EMPC	253	J	ng/kg	LPX-BK-2006	13/18	7.3 - 23.9	253	120				NO	NTX
55684-94-1	Total HxCDF	2.1	EMPC	422	J	ng/kg	LPX-BK-2006	18/18	0 - 0	422	201				NO	NTX
36088-22-9	Total PeCDD	3.4	EMPC	68.8	J	ng/kg	LPX-BK-2006	15/17	11.1 - 25.3	68.8	43.1				NO	NTX
30402-15-4	Total PeCDF	2.9	EMPC	328	J	ng/kg	LPX-BK-2006	17/18	15.5 - 15.5	328	157				NO	NTX
41903-57-5	Total TCDD	3.4	EMPC	3020	J&	ng/kg	WRL-BK-2004	17/18	4.2 - 4.2	3020	25				NO	NTX
55722-27-5	Total TCDF	5.1	EMPC	405	J	ng/kg	LPX-BK-2007	17/18	13.3 - 13.3	405	87.3				NO	NTX
TEQ	Toxicity Equivalency	1.05626		116000		ng/kg	CMS-060	65/65	0 - 0	116000	34.5	40 ca			YES	ASL

TABLE B-2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Scenario Timeframe:	Current/Future
Medium:	Sediments
Exposure Medium:	Bank Sediments
Exposure Point:	Recreational Areas

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (1) Contaminant Deletion or Selection
7429-90-5	Aluminum	1690		10900		mg/kg	LPX-BK-2006	18/18	0 - 0	10900	3340	80000 nc			NO	NTX
7440-36-0	Antimony	1.3	J	1.8	J	mg/kg	LPX-BK-2006	4/18	0.6 - 1	1.8	0	30 nc			NO	BSL
7440-38-2	Arsenic	0.89		10.5		mg/kg	APB-BK-2003	18/18	0 - 0	10.5	2.7	3 ca*			YES	ASL
7440-39-3	Barium	10		262		mg/kg	APB-BK-2003	18/18	0 - 0	262	95.5	5000 nc			NO	BSL
7440-41-7	Beryllium	0.19	J	0.96		mg/kg	WRL-BK-2004	17/18	0.11 - 0.11	0.96	0.67	200 nc			NO	BSL
7440-43-9	Cadmium	0.21	J	5.1		mg/kg	LPX-BK-2006	3/17	0.06 - 0.11	5.1	0.3	40 nc			NO	BSL
7440-70-2	Calcium	158		2920	J	mg/kg	WRL-BK-2004	18/18	0 - 0	2920	736				NO	NTX
7440-47-3	Chromium	2.8	J	104		mg/kg	WRL-BK-2004	18/18	0 - 0	104	119	300 ca*			NO	BSL
7440-50-8	Copper	8.4		67.6		mg/kg	WRL-BK-2004	17/18	5.6 - 5.6	67.6	53.7	3000 nc			NO	NTX
7439-89-6	Iron	4890		14600		mg/kg	APB-BK-2003	18/18	0 - 0	14600	7650	20000 nc			NO	NTX
7439-92-1	Lead	17.8		373		mg/kg	APB-BK-2003	18/18	0 - 0	373	117	400 nc			NO	BSL
7439-95-4	Magnesium	358		1520	J	mg/kg	LPX-BK-2007	18/18	0 - 0	1520	710				NO	NTX
7439-96-5	Manganese	44.1	J	885		mg/kg	WRL-BK-2004	18/18	0 - 0	885	448	2000 nc			NO	BSL
7439-97-6	Mercury	0.03	J	0.48	J	mg/kg	WRL-BK-2004	17/17	0 - 0	0.48	0.073	nc			NO	NTX
7440-09-7	Potassium	224		756	J	mg/kg	APB-BK-2003	18/18	0 - 0	756	380				NO	NTX
7782-49-2	Selenium	0.97	J	0.97	J	mg/kg	WRL-BK-2004	1/17	0.92 - 1.6	0.97	1.2	400 nc			NO	BSL
7440-23-5	Sodium	17.4	J	28.5		mg/kg	APB-BK-2003	2/18	16.6 - 286	28.5	34.6				NO	NTX
7440-28-0	Thallium	0.59	J	0.59	J	mg/kg	WRL-BK-2005	1/17	0.42 - 0.73	0.59	0.34	5 nc			NO	BSL
7440-62-2	Vanadium	8.5		56.1		mg/kg	WRL-BK-2004	18/18	0 - 0	56.1	50.6	500 nc			NO	BSL
7440-66-6	Zinc	32.9		144	J	mg/kg	APB-BK-2003	17/18	30.8 - 30.8	144	94.8	20000 nc			NO	BSL

(1) Minimum/maximum detected concentration.

(2) N/A

(3) Screening values are based on Region IX Residential Soil PRGs. Cancer values are adjusted to 1.0E-05 cancer risk levels. Dioxin value is based on a national background study of dioxins in sediments per Duane Winters conversation with A. Burke.

(4) Rationale Codes Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic

TABLE B-2.4
EXPOSURE SCENARIO SAMPLE LIST
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
reca	APB-BK-2003	APB-BK-2003X-01-MAX	BK	0.0-0.5	Field Dup. APB-BK-2003X-01
reca	APB-BK-2003	APB-BK-2003Y-01	BK	0.0-0.5	None
reca	APB-BK-2003	APB-BK-2003Z-01	BK	0.0-0.5	None
reca	APB-FP-2028	APB-FP-2028-0.502-01	FP	0.5-2.0	None
reca	APB-FP-2028	APB-FP-2028-000.5-01	FP	0.0-0.5	None
reca	APB-FP-2028	APB-FP-2028-023.5-01	FP	2.0-3.5	None
reca	APB-FP-2030	APB-SD-2030-01	FP	0.0-0.5	None
reca	APB-FP-2031	APB-FP-2031-01	FP	0.0-0.5	None
reca	APB-FP-2032	APB-FP-2032-01	FP	0.0-0.5	None
reca	APB-FP-2033	APB-FP-2033-0.502-01	FP	0.5-2.0	None
reca	APB-FP-2033	APB-FP-2033-000.5-01	FP	0.0-0.5	None
reca	CMS-023	3428-CMS-023	FP	0.0-0.3	None
reca	CMS-023	CMS-023-A	FP	0.0-1.0	None
reca	CMS-023	CMS-023-B-MAX	FP	1.0-2.0	Field Dup. CMS-023-B
reca	CMS-023	CMS-023-C	FP	2.0-3.0	None
reca	CMS-024	3428-CMS-024	FP	0.0-0.3	None
reca	CMS-024	CMS-024-A	FP	0.0-1.0	None
reca	CMS-024	CMS-024-B	FP	1.0-2.0	None
reca	CMS-025	3428-CMS-025	FP	0.0-0.3	None
reca	CMS-025	CMS-025-A	FP	0.0-1.0	None
reca	CMS-025	CMS-025-B	FP	1.0-2.0	None
reca	CMS-201	3428-CMS-201	FP	0.0-0.3	None
reca	CMS-202	3428-CMS-202	FP	0.0-0.3	None
reca	CMS-202	CMS-202-A	FP	0.0-1.0	None
reca	CMS-203	3428-CMS-203	FP	0.0-0.3	None
reca	CMS-203	CMS-203-A	FP	0.0-1.0	None
reca	CMS-204	3428-CMS-204-MAX	FP	0.0-0.3	Field Dup. 3428-CMS-204
reca	CMS-204	CMS-204-A	FP	0.0-1.0	None
reca	CMS-205	3428-CMS-205	FP	0.0-0.3	None
reca	CMS-205	CMS-205-A	FP	0.0-1.0	None
reca	CMS-205	CMS-205-B	FP	1.0-2.0	None
reca	CMS-205	CMS-205-C	FP	2.0-3.0	None
reca	CMS-206	3428-CMS-206	FP	0.0-0.3	None
reca	CMS-206	CMS-206-A	FP	0.0-1.0	None
reca	CMS-206	CMS-206-B	FP	1.0-2.0	None
reca	CMS-206	CMS-206-C	FP	2.0-3.0	None
reca	CMS-206	CMS-206-D	FP	3.0-4.0	None
reca	CMS-600	CMS-600-A	SD	0.0-0.5	None
reca	CMS-601	CMS-601-A	SD	0.0-0.5	None
reca	CMS-616	CMS-616-A	SD	0.0-0.5	None
reca	SD-20	SD-20	FP	0.0-0.3	None
reca	SD-21	SD-21	FP	0.5-2.0	None
reca	SD-22	SD-22	FP	0.0-0.3	None
reca	SD-23	SD-23	FP	0.0-0.3	None
reca	SD-24	SD-24	FP	0.0-0.3	None
recbgc	LPX-SD-2046	LPX-SD-2046-0.502-01	SD	0.5-2.0	None
recbgc	LPX-SD-2046	LPX-SD-2046-000.5-01	SD	0.0-0.5	None
recbgc	LPX-SD-2046	LPX-SD-2046-0204-01	SD	2.0-4.0	None
recbgc	SD-18	SD-18	FP	0.0-0.3	None
recbgc	SD-19	SD-19	FP	0.0-0.3	None
recbgc	WRL-BK-2004	WRL-BK-2004X-01	BK	0.0-0.5	None
recbgc	WRL-BK-2004	WRL-BK-2004Y-01	BK	0.0-0.5	None
recbgc	WRL-BK-2004	WRL-BK-2004Z-01	BK	0.0-0.5	None
recbgc	WRL-BK-2005	WRL-BK-2005X-01	BK	0.0-0.5	None
recbgc	WRL-BK-2005	WRL-BK-2005Y-01	BK	0.0-0.5	None
recbgc	WRL-BK-2005	WRL-BK-2005Z-01	BK	0.0-0.5	None
recbgc	WRL-SD-2041	WRL-SD-2041-01	SD	0.0-0.5	None

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Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
recbgc	WRL-SD-2042	WRL-SD-2042-01	SD	0.0-0.5	None
recL	LPX-BK-2006	LPX-BK-2006X-01	BK	0.0-0.5	None
recL	LPX-BK-2006	LPX-BK-2006Y-01	BK	0.0-0.5	None
recL	LPX-BK-2006	LPX-BK-2006Z-01	BK	0.0-0.5	None
recL	LPX-BK-2007	LPX-BK-2007X-01	BK	0.0-0.5	None
recL	LPX-BK-2007	LPX-BK-2007Y-01-MAX	BK	0.0-0.5	Field Dup. LPX-BK-2007Y-01
recL	LPX-BK-2007	LPX-BK-2007Z-01	BK	0.0-0.5	None
recL	LPX-BK-2008	LPX-BK-2008X-01	BK	0.0-0.5	None
recL	LPX-BK-2008	LPX-BK-2008Y-01	BK	0.0-0.5	None
recL	LPX-BK-2008	LPX-BK-2008Z-01	BK	0.0-0.5	None
recL	SD-10	SD-10	FP	0.0-0.5	None
recL	SD-11	SD-11	FP	0.0-1.0	None
recL	SD-12	SD-12	FP	0.0-1.0	None
recL	SD-13	SD-13	FP	0.0-1.0	None
recL	SD-14	SD-14	FP	0.0-0.5	None
recL	SD-15	SD-15	FP	0.0-0.5	None
recL	SD-16	SD-16	FP	0.0-0.5	None
recL	SD-17	SD-17	FP	0.0-0.5	None
recna	CMS-017	3428-CMS-017	BK	0.0-0.3	None
recna	CMS-018	3428-CMS-018	BK	0.0-0.3	None
recna	CMS-019	3428-CMS-019	BK	0.0-0.3	None
recna	CMS-019	CMS-019-A	BK	0.0-1.0	None
recna	CMS-019	CMS-019-B-MAX	BK	1.0-2.0	Field Dup. CMS-019-B
recna	CMS-019	CMS-019-C	BK	2.0-3.0	None
recna	CMS-019	CMS-019-D	BK	3.0-4.0	None
recna	CMS-019	CMS-019-F	BK	5.0-6.0	None
recna	CMS-019	CMS-019-G	BK	6.0-7.0	None
recna	CMS-020	3428-CMS-020	BK	0.0-0.3	None
recna	CMS-021	3428-CMS-021-MAX	BK	0.0-0.3	Field Dup. 3428-CMS-021
recna	CMS-021	CMS-021-A	BK	0.0-1.0	None
recna	CMS-021	CMS-021-B	BK	1.0-2.0	None
recna	CMS-021	CMS-021-C	BK	2.0-3.0	None
recna	CMS-021	CMS-021-D	BK	3.0-4.0	None
recna	CMS-021	CMS-021-E	BK	4.0-5.0	None
recna	CMS-021	CMS-021-F	BK	5.0-6.0	None
recna	CMS-022	3428-CMS-022	BK	0.0-0.3	None
recna	CMS-022	CMS-022-A	BK	0.0-1.0	None
recna	CMS-022	CMS-022-B	BK	1.0-2.0	None
recna	CMS-022	CMS-022-C	BK	2.0-3.0	None
recna	CMS-022	CMS-022-D	BK	3.0-4.0	None
recna	CMS-176	3428-CMS-176	SITE	0.0-0.3	None
recna	CMS-178	3428-CMS-178-MAX	FP	0.0-0.3	Field Dup. 3428-CMS-178
recna	CMS-179	3428-CMS-179	FP	0.0-0.3	None
recna	CMS-180	3428-CMS-180	FP	0.0-0.3	None
recna	CMS-181	3428-CMS-181	FP	0.0-0.3	None
recna	CMS-182	3428-CMS-182-MAX	FP	0.0-0.3	Field Dup. 3428-CMS-182
recna	CMS-182	CMS-182-A	FP	0.0-1.0	None
recna	CMS-183	3428-CMS-183	FP	0.0-0.3	None
recna	CMS-186	3428-CMS-186	FP	0.0-0.3	None
recna	CMS-186	CMS-186-A	FP	0.0-1.0	None
recna	CMS-186	CMS-186-B	FP	1.0-2.0	None
recna	CMS-187	3428-CMS-187	FP	0.0-0.3	None
recna	CMS-187	CMS-187-A	FP	0.0-1.0	None
recna	CMS-187	CMS-187-B	FP	1.0-2.0	None
recna	CMS-188	3428-CMS-188	FP	0.0-0.3	None
recna	CMS-188	CMS-188-A	FP	0.0-1.0	None
recna	CMS-190	3428-CMS-190	BK	0.0-0.3	None

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Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
recna	CMS-191	3428-CMS-191-MAX	FP	0.0-0.3	Field Dup. 3428-CMS-191
recna	CMS-191	CMS-191-A-MAX	FP	0.0-1.0	Field Dup. CMS-191-A
recna	CMS-192	3428-CMS-192	FP	0.0-0.3	None
recna	CMS-192	CMS-192-A	FP	0.0-1.0	None
recna	CMS-193	3428-CMS-193	FP	0.0-0.3	None
recna	CMS-193	CMS-193-A-MAX	FP	0.0-1.0	Field Dup. CMS-193-A
recna	CMS-194	3428-CMS-194	BK	0.0-0.3	None
recna	CMS-195	3428-CMS-195	FP	0.0-0.3	None
recna	CMS-195	CMS-195-A	FP	0.0-1.0	None
recna	CMS-195	CMS-195-B	FP	1.0-2.0	None
recna	CMS-196	3428-CMS-196	FP	0.0-0.3	None
recna	CMS-196	CMS-196-A	FP	0.0-1.0	None
recna	CMS-197	3428-CMS-197	FP	0.0-0.3	None
recna	CMS-199	3428-CMS-199	BK	0.0-0.3	None
recna	CMS-200	3428-CMS-200	FP	0.0-0.3	None
recna	CMS-200	CMS-200-A	FP	0.0-1.0	None
recna	CMS-446	CMS-446-A	SITE	0.0-1.0	None
recna	CMS-447	CMS-447-A	SITE	0.0-1.0	None
recna	CMS-472	CMS-472-A	FP	0.0-1.0	None
recna	CMS-497	CMS-497-A	RES	0.0-1.0	None
recna	CMS-498	CMS-498-A	RES	0.0-1.0	None
recna	CMS-499	CMS-499-A	RES	0.0-1.0	None
recna	CMW-FP-2027	CMW-FP-2027-01	FP	0.0-0.5	None
recna	RES-14-365-01	RES-SS-14-365-01	RES	0.0-1.0	None
recna	RES-14-365-02	RES-SS-14-365-02	RES	0.0-1.0	None
recna	RES-14-365-03	RES-SS-14-365-03	RES	0.0-1.0	None
recna	RES-14-366-01	RES-SS-14-366-01	RES	0.0-1.0	None
recna	RES-14-366-02	RES-SS-14-366-02	RES	0.0-1.0	None
recna	RES-14-366-03	RES-SS-14-366-03	RES	0.0-1.0	None
recna	RES-14-399-01	RES-SS-14-399-01	RES	0.0-1.0	None
recna	RES-14-399-02	RES-SS-14-399-02	RES	0.0-1.0	None
recna	SD-25	SD-25	FP	0.0-0.3	None
res1	CMS-085	3428-CMS-085	FP	0.0-0.3	None
res1	CMS-091	3428-CMS-091	FP	0.0-0.3	None
res1	CMS-099	3428-CMS-099	FP	0.0-0.3	None
res1	CMS-100	3428-CMS-100	FP	0.0-0.3	None
res1	CMS-108	3428-CMS-108	FP	0.0-0.3	None
res1	CMS-220	3428-CMS-220	RES	0.0-0.3	None
res1	CMS-223	3428-CMS-223	RES	0.0-0.3	None
res1	CMS-456	CMS-456-A	FP	0.0-1.0	None
res1	CMS-456	CMS-456-B	FP	1.0-2.0	None
res1	CMS-506	CMS-506-A	RES	0.0-1.0	None
res1	CMS-507	CMS-507-A	RES	0.0-1.0	None
res1	CMS-508	CMS-508-A	RES	0.0-1.0	None
res1	RES-14-271-01	RES-SS-14-271-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-14-271-01
res1	RES-14-271-01A	RES-SS-14-271-01A	RES	0.0-1.0	None
res10	CMS-466	CMS-466-A	RES	0.0-1.0	None
res10	CMS-467	CMS-467-A	RES	0.0-1.0	None
res10	CMS-601	CMS-601-A	SD	0.0-0.5	None
res10	RES-14-448-01	RES-SS-14-448-01	RES	0.0-1.0	None
res10	RES-14-449-01	RES-SS-14-449-01	RES	0.0-1.0	None
res10	RES-14-449-02	RES-SS-14-449-02	RES	0.0-1.0	None
res10	RES-14-449-03	RES-SS-14-449-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-14-449-03
res11	APB-FP-2033	APB-FP-2033-0.502-01	FP	0.5-2.0	None
res11	APB-FP-2033	APB-FP-2033-000.5-01	FP	0.0-0.5	None
res11	CMS-478	CMS-478-A	RES	0.0-1.0	None
res11	CMS-479	CMS-479-A	RES	0.0-1.0	None

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Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
res11	CMS-480	CMS-480-A	RES	0.0-1.0	None
res11	CMS-484	CMS-484-A	RES	0.0-1.0	None
res11	CMS-484	CMS-484-B-MAX	RES	1.0-2.0	Field Dup. CMS-484-B
res11	CMS-484	CMS-484-C-MAX	RES	2.0-3.0	Field Dup. CMS-484-C
res11	CMS-485	CMS-485-A	RES	0.0-1.0	None
res11	CMS-486	CMS-486-A	RES	0.0-1.0	None
res11	CMS-487	CMS-487-A	RES	0.0-1.0	None
res11	CMS-487	CMS-487-B	RES	1.0-2.0	None
res11	CMS-487	CMS-487-C	RES	2.0-3.0	None
res11	RES-12-239-01	RES-SS-12-239-01	RES	0.0-1.0	None
res11	RES-12-240-01	RES-SS-12-240-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-12-240-01
res11	RES-12-240-02	RES-SS-12-240-02	RES	0.0-1.0	None
res11	RES-14-210-01	RES-SS-14-210-01	RES	0.0-1.0	None
res11	RES-14-210-02	RES-SS-14-210-02	RES	0.0-1.0	None
res11	RES-14-210-03	RES-SS-14-210-03	RES	0.0-1.0	None
res12	CMS-216e	3428-CMS-216	RES	0.0-0.3	None
res12	CMS-469	CMS-469-A	RES	0.0-1.0	None
res12	CMS-470	CMS-470-A	RES	0.0-1.0	None
res12	CMS-470	CMS-470-B	RES	1.0-2.0	None
res12	CMS-471	CMS-471-A	RES	0.0-1.0	None
res12	CMS-471	CMS-471-B	RES	1.0-2.0	None
res12	CMS-471	CMS-471-C	RES	2.0-3.0	None
res12	CMS-494	CMS-494-A	RES	0.0-1.0	None
res12	CMS-495	CMS-495-A	RES	0.0-1.0	None
res12	CMS-496	CMS-496-A	RES	0.0-1.0	None
res12	RES-12-550-01	RES-SS-12-550-01	RES	0.0-1.0	None
res12	RES-12-551-01	RES-SS-12-551-01	RES	0.0-1.0	None
res13	CMS-488	CMS-488-A	RES	0.0-1.0	None
res13	CMS-489	CMS-489-A	RES	0.0-1.0	None
res13	CMS-490	CMS-490-A	RES	0.0-1.0	None
res13	CMS-490	CMS-490-B-MAX	RES	1.0-2.0	Field Dup. CMS-490-B
res13	CMS-491	CMS-491-A	RES	0.0-1.0	None
res13	CMS-492	CMS-492-A	RES	0.0-1.0	None
res13	CMS-493	CMS-493-A	RES	0.0-1.0	None
res13	CMS-493	CMS-493-B	RES	1.0-2.0	None
res13	CMS-493	CMS-493-C	RES	2.0-3.0	None
res13	RES-12-552-01	RES-SS-12-552-01	RES	0.0-1.0	None
res13	RES-12-553-01	RES-SS-12-553-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-12-553-01
res13	SD-24	SD-24	FP	0.0-0.3	None
res14	CMS-473	CMS-473-A	RES	0.0-1.0	None
res14	CMS-474	CMS-474-A	RES	0.0-1.0	None
res14	CMS-474	CMS-474-B	RES	1.0-2.0	None
res14	CMS-474	CMS-474-C	RES	2.0-3.0	None
res14	CMS-475	CMS-475-A	RES	0.0-1.0	None
res14	CMS-476	CMS-476-A	RES	0.0-1.0	None
res14	CMS-477	CMS-477-A	RES	0.0-1.0	None
res14	CMS-477	CMS-477-B-MAX	RES	1.0-2.0	Field Dup. CMS-477-B
res14	CMS-477	CMS-477-C-MAX	RES	2.0-3.0	Field Dup. CMS-477-C
res14	RES-12-554-01	RES-SS-12-554-01	RES	0.0-1.0	None
res14	RES-12-555-01	RES-SS-12-555-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-12-555-01
res15	CMS-468	CMS-468-A	RES	0.0-1.0	None
res15	RES-12-556-01	RES-SS-12-556-01	RES	0.0-1.0	None
res15	RES-12-556-02	RES-SS-12-556-02	RES	0.0-1.0	None
res16	RES-11-011-01	RES-SS-11-011-01	RES	0.0-1.0	None
res16	RES-11-011-02	RES-SS-11-011-02	RES	0.0-1.0	None
res16	RES-11-011-03	RES-SS-11-011-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-011-03
res16	RES-11-012-01	RES-SS-11-012-01	RES	0.0-1.0	None

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Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
res16	RES-11-012-02	RES-SS-11-012-02	RES	0.0-1.0	None
res16	RES-11-012-03	RES-SS-11-012-03	RES	0.0-1.0	None
res17	RES-11-419-01	RES-SS-11-419-01	RES	0.0-1.0	None
res17	RES-11-419-02	RES-SS-11-419-02	RES	0.0-1.0	None
res17	RES-11-419-03	RES-SS-11-419-03	RES	0.0-1.0	None
res18	RES-11-420-01	RES-SS-11-420-01	RES	0.0-1.0	None
res18	RES-11-420-02	RES-SS-11-420-02	RES	0.0-1.0	None
res18	RES-11-420-03	RES-SS-11-420-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-420-03
res18	RES-11-420-04	RES-SS-11-420-04	RES	0.0-1.0	None
res18	RES-11-422-01	RES-SS-11-422-01	RES	0.0-1.0	None
res18	RES-11-422-02	RES-SS-11-422-02	RES	0.0-1.0	None
res18	RES-11-422-03	RES-SS-11-422-03	RES	0.0-1.0	None
res18	SD-16	SD-16	FP	0.0-0.5	None
res18	SD-17	SD-17	FP	0.0-0.5	None
res19	RES-11-423-01	RES-SS-11-423-01	RES	0.0-1.0	None
res19	RES-11-423-02	RES-SS-11-423-02	RES	0.0-1.0	None
res19	RES-11-423-03	RES-SS-11-423-03	RES	0.0-1.0	None
res19	RES-11-424-01	RES-SS-11-424-01	RES	0.0-1.0	None
res19	RES-11-424-02	RES-SS-11-424-02	RES	0.0-1.0	None
res19	RES-11-424-03	RES-SS-11-424-03	RES	0.0-1.0	None
res19	RES-11-425-01	RES-SS-11-425-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-425-01
res19	RES-11-425-02	RES-SS-11-425-02	RES	0.0-1.0	None
res19	RES-11-425-03	RES-SS-11-425-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-425-03
res19	RES-11-426-01	RES-SS-11-426-01	RES	0.0-1.0	None
res19	RES-11-426-02	RES-SS-11-426-02	RES	0.0-1.0	None
res19	RES-11-426-03	RES-SS-11-426-03	RES	0.0-1.0	None
res19	SD-14	SD-14	FP	0.0-0.5	None
res19	SD-15	SD-15	FP	0.0-0.5	None
res2	CMS-108	3428-CMS-108	FP	0.0-0.3	None
res2	CMS-115	3428-CMS-115	FP	0.0-0.3	None
res2	CMS-116	3428-CMS-116	FP	0.0-0.3	None
res2	CMS-123	3428-CMS-123	FP	0.0-0.3	None
res2	CMS-123	CMS-123-A	FP	0.0-1.0	None
res2	CMS-130	3428-CMS-130	FP	0.0-0.3	None
res2	CMS-222	3428-CMS-222	RES	0.0-0.3	None
res2	CMS-223	3428-CMS-223	RES	0.0-0.3	None
res2	CMS-500	CMS-500-A-MAX	RES	0.0-1.0	Field Dup. CMS-500-A
res2	CMS-501	CMS-501-A	RES	0.0-1.0	None
res2	CMS-502	CMS-502-A	RES	0.0-1.0	None
res2	CMS-503	CMS-503-A	RES	0.0-1.0	None
res2	CMS-504	CMS-504-A-MAX	RES	0.0-1.0	Field Dup. CMS-504-A
res2	CMS-505	CMS-505-A	RES	0.0-1.0	None
res2	RES-14-272-01	RES-SS-14-272-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-14-272-01
res2	RES-14-302-01	RES-SS-14-302-01	RES	0.0-1.0	None
res20	RES-11-427-01	RES-SS-11-427-01	RES	0.0-1.0	None
res20	RES-11-427-02	RES-SS-11-427-02	RES	0.0-1.0	None
res20	RES-11-427-03	RES-SS-11-427-03	RES	0.0-1.0	None
res20	RES-11-428-01	RES-SS-11-428-01	RES	0.0-1.0	None
res20	RES-11-428-02	RES-SS-11-428-02	RES	0.0-1.0	None
res20	RES-11-428-03	RES-SS-11-428-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-428-03
res20	RES-11-428-G	RES-SS-11-428-G	RES	0.0-1.0	None
res20	RES-11-429-01	RES-SS-11-429-01	RES	0.0-1.0	None
res20	RES-11-429-02	RES-SS-11-429-02	RES	0.0-1.0	None
res20	SD-13	SD-13	FP	0.0-1.0	None
res21	RES-11-432-01	RES-SS-11-432-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-432-01
res21	RES-11-432-02	RES-SS-11-432-02	RES	0.0-1.0	None
res21	RES-11-432-03	RES-SS-11-432-03	RES	0.0-1.0	None

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EXPOSURE SCENARIO SAMPLE LIST
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
res21	RES-11-433-01	RES-SS-11-433-01	RES	0.0-1.0	None
res21	RES-11-433-02	RES-SS-11-433-02	RES	0.0-1.0	None
res21	RES-11-433-03	RES-SS-11-433-03	RES	0.0-1.0	None
res22	RES-11-328-01	RES-SS-11-328-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-328-01
res22	RES-11-328-02	RES-SS-11-328-02	RES	0.0-1.0	None
res22	RES-11-328-03	RES-SS-11-328-03	RES	0.0-1.0	None
res22	RES-11-486-01	RES-SS-11-486-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-486-01
res22	RES-11-486-02	RES-SS-11-486-02	RES	0.0-1.0	None
res22	RES-11-486-03	RES-SS-11-486-03	RES	0.0-1.0	None
res23	RES-11-396-01	RES-SS-11-396-01	RES	0.0-1.0	None
res23	RES-11-396-02	RES-SS-11-396-02	RES	0.0-1.0	None
res23	RES-11-396-03	RES-SS-11-396-03	RES	0.0-1.0	None
res24	RES-11-577-01	RES-SS-11-577-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-11-577-01
res24	RES-11-577-02	RES-SS-11-577-02	RES	0.0-1.0	None
res24	RES-11-577-03	RES-SS-11-577-03	RES	0.0-1.0	None
res25	RES-10-004-01	RES-SS-10-004-01	RES	0.0-1.0	None
res25	RES-10-004-02	RES-SS-10-004-02	RES	0.0-1.0	None
res25	RES-10-004-03	RES-SS-10-004-03	RES	0.0-1.0	None
res25	RES-10-005-01	RES-SS-10-005-01	RES	0.0-1.0	None
res25	RES-10-005-02	RES-SS-10-005-02	RES	0.0-1.0	None
res25	RES-10-005-03	RES-SS-10-005-03	RES	0.0-1.0	None
res25	SD-11	SD-11	FP	0.0-1.0	None
res26	RES-10-042-01	RES-SS-10-042-01	RES	0.0-1.0	None
res26	RES-10-042-02	RES-SS-10-042-02	RES	0.0-1.0	None
res26	RES-10-042-03	RES-SS-10-042-03	RES	0.0-1.0	None
res26	RES-10-604-01	RES-SS-10-604-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-604-01
res26	RES-10-604-02	RES-SS-10-604-02	RES	0.0-1.0	None
res26	RES-10-604-03	RES-SS-10-604-03	RES	0.0-1.0	None
res27	LPX-BK-2006	LPX-BK-2006X-01	BK	0.0-0.5	None
res27	LPX-BK-2006	LPX-BK-2006Y-01	BK	0.0-0.5	None
res27	LPX-BK-2006	LPX-BK-2006Z-01	BK	0.0-0.5	None
res27	RES-10-044-01	RES-SS-10-044-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-044-01
res27	RES-10-044-02	RES-SS-10-044-02	RES	0.0-1.0	None
res27	RES-10-044-03	RES-SS-10-044-03	RES	0.0-1.0	None
res27	RES-10-053-01	RES-SS-10-053-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-053-01
res27	RES-10-053-02	RES-SS-10-053-02	RES	0.0-1.0	None
res27	RES-10-053-03	RES-SS-10-053-03-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-053-03
res28	RES-10-068-01	RES-SS-10-068-01	RES	0.0-1.0	None
res28	RES-10-068-02	RES-SS-10-068-02	RES	0.0-1.0	None
res28	RES-10-068-03	RES-SS-10-068-03	RES	0.0-1.0	None
res28	RES-10-074-01	RES-SS-10-074-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-074-01
res28	RES-10-074-02	RES-SS-10-074-02	RES	0.0-1.0	None
res28	RES-10-074-03	RES-SS-10-074-03	RES	0.0-1.0	None
res28	RES-10-075-01	RES-SS-10-075-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-10-075-01
res28	RES-10-075-02	RES-SS-10-075-02	RES	0.0-1.0	None
res28	RES-10-075-03	RES-SS-10-075-03	RES	0.0-1.0	None
res28	RES-10-076-01	RES-SS-10-076-01	RES	0.0-1.0	None
res28	RES-10-076-02	RES-SS-10-076-02	RES	0.0-1.0	None
res28	RES-10-076-03	RES-SS-10-076-03	RES	0.0-1.0	None
res3	CMS-144	3428-CMS-144	FP	0.0-0.3	None
res3	CMS-151	3428-CMS-151	FP	0.0-0.3	None
res3	CMS-159	3428-CMS-159	FP	0.0-0.3	None
res3	CMS-159	CMS-159-A	FP	0.0-1.0	None
res3	CMS-174	3428-CMS-174	FP	0.0-0.3	None
res3	CMS-225	3428-CMS-225	RES	0.0-0.3	None
res3	CMS-481	CMS-481-A	RES	0.0-1.0	None
res3	CMS-482	CMS-482-A	RES	0.0-1.0	None

TABLE B-2.4
EXPOSURE SCENARIO SAMPLE LIST
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
res3	CMS-483	CMS-483-A	RES	0.0-1.0	None
res3	CMS-483	CMS-483-B	RES	1.0-2.0	None
res3	CMS-483	CMS-483-C	RES	2.0-3.0	None
res3	RES-14-303-01	RES-SS-14-303-01	RES	0.0-1.0	None
res3	RES-14-303-02	RES-SS-14-303-02	RES	0.0-1.0	None
res3	RES-14-333-01	RES-SS-14-333-01	RES	0.0-1.0	None
res3	RES-14-333-02	RES-SS-14-333-02	RES	0.0-1.0	None
res3	RES-14-333-03	RES-SS-14-333-03	RES	0.0-1.0	None
res3	RES-14-334-01	RES-SS-14-334-01	RES	0.0-1.0	None
res4	CMS-179	3428-CMS-179	FP	0.0-0.3	None
res4	CMS-180	3428-CMS-180	FP	0.0-0.3	None
res4	RES-14-365-01	RES-SS-14-365-01	RES	0.0-1.0	None
res4	RES-14-365-02	RES-SS-14-365-02	RES	0.0-1.0	None
res4	RES-14-365-03	RES-SS-14-365-03	RES	0.0-1.0	None
res5	CMS-184	3428-CMS-184	FP	0.0-0.3	None
res5	CMS-185	3428-CMS-185	FP	0.0-0.3	None
res5	CMS-189	3428-CMS-189	FP	0.0-0.3	None
res5	CMS-221	3428-CMS-221	RES	0.0-0.3	None
res5	CMS-497	CMS-497-A	RES	0.0-1.0	None
res5	CMS-498	CMS-498-A	RES	0.0-1.0	None
res5	CMS-499	CMS-499-A	RES	0.0-1.0	None
res5	RES-14-366-01	RES-SS-14-366-01	RES	0.0-1.0	None
res5	RES-14-366-02	RES-SS-14-366-02	RES	0.0-1.0	None
res5	RES-14-366-03	RES-SS-14-366-03	RES	0.0-1.0	None
res5	RES-14-398-01	RES-SS-14-398-01	RES	0.0-1.0	None
res6	CMS-193	3428-CMS-193	FP	0.0-0.3	None
res6	CMS-193	CMS-193-A-MAX	FP	0.0-1.0	Field Dup. CMS-193-A
res6	CMS-197	3428-CMS-197	FP	0.0-0.3	None
res6	CMS-472	CMS-472-A	FP	0.0-1.0	None
res6	RES-14-399-01	RES-SS-14-399-01	RES	0.0-1.0	None
res6	RES-14-399-02	RES-SS-14-399-02	RES	0.0-1.0	None
res7	CMS-201	3428-CMS-201	FP	0.0-0.3	None
res7	CMS-202	3428-CMS-202	FP	0.0-0.3	None
res7	CMS-202	CMS-202-A	FP	0.0-1.0	None
res7	CMS-205	3428-CMS-205	FP	0.0-0.3	None
res7	CMS-205	CMS-205-A	FP	0.0-1.0	None
res7	CMS-205	CMS-205-B	FP	1.0-2.0	None
res7	CMS-205	CMS-205-C	FP	2.0-3.0	None
res7	CMS-206	3428-CMS-206	FP	0.0-0.3	None
res7	CMS-206	CMS-206-A	FP	0.0-1.0	None
res7	CMS-206	CMS-206-B	FP	1.0-2.0	None
res7	CMS-206	CMS-206-C	FP	2.0-3.0	None
res7	CMS-206	CMS-206-D	FP	3.0-4.0	None
res7	CMS-418	CMS-418-A	SITE	0.0-1.0	None
res7	CMS-418	CMS-418-B	SITE	1.0-2.0	None
res7	CMS-460	CMS-460-A	RES	0.0-1.0	None
res7	CMS-461	CMS-461-A	RES	0.0-1.0	None
res7	RES-14-419-01	RES-SS-14-419-01	RES	0.0-1.0	None
res7	RES-14-420-01	RES-SS-14-420-01	RES	0.0-1.0	None
res7	RES-14-421-01	RES-SS-14-421-01	RES	0.0-1.0	None
res8	CMS-462	CMS-462-A	RES	0.0-1.0	None
res8	CMS-463	CMS-463-A-MAX	RES	0.0-1.0	Field Dup. CMS-463-A
res8	RES-14-422-01	RES-SS-14-422-01	RES	0.0-1.0	None
res8	RES-14-422-02	RES-SS-14-422-02	RES	0.0-1.0	None
res8	RES-14-424-01	RES-SS-14-424-01	RES	0.0-1.0	None
res8	RES-14-424-02	RES-SS-14-424-02	RES	0.0-1.0	None
res8	RES-14-425-01	RES-SS-14-425-01	RES	0.0-1.0	None

TABLE B-2.4
EXPOSURE SCENARIO SAMPLE LIST
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	BORING	NSAMPLE	SUBMATRIX	Interval	QC_TYPE
res8	RES-14-425-02	RES-SS-14-425-02	RES	0.0-1.0	None
res8	RES-14-425-03	RES-SS-14-425-03	RES	0.0-1.0	None
res9	APB-FP-2028	APB-FP-2028-0.502-01	FP	0.5-2.0	None
res9	APB-FP-2028	APB-FP-2028-000.5-01	FP	0.0-0.5	None
res9	APB-FP-2028	APB-FP-2028-023.5-01	FP	2.0-3.5	None
res9	CMS-224	3428-CMS-224	RES	0.0-0.3	None
res9	CMS-464	CMS-464-A-MAX	RES	0.0-1.0	Field Dup. CMS-464-A
res9	CMS-465	CMS-465-A	RES	0.0-1.0	None
res9	CMS-600	CMS-600-A	SD	0.0-0.5	None
res9	RES-14-430-01	RES-SS-14-430-01-MAX	RES	0.0-1.0	Field Dup. RES-SS-14-430-01

TABLE 5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
reca	Total PAH	UG/KG	5300	Max	5300		APB-BK-2003	Undefined	2300	7200	11
reca	Aroclor, Total	UG/KG	2800	95% UCL-T	9200		CMS-616	Lognormal	1800	2800	19
reca	Aroclor-1254	UG/KG	4000	95% UCL-T	9200		CMS-616	Lognormal	1800	4000	19
reca	Toxicity Equivalency	NG/KG	68700	95% UCL-T	75000		CMS-024	Lognormal	11800	68700	41
reca	Antimony	MG/KG	6.3	Max	6.3	J	APB-FP-2028	Lognormal	3	6.9	11
reca	Arsenic	MG/KG	7.2	95% UCL-N	10.5		APB-BK-2003	Normal	7.2	14	11
reca	Chromium	MG/KG	175	95% UCL-N	329		APB-FP-2028	Normal	175	933	11
reca	Manganese	MG/KG	497	95% UCL-T	677		APB-FP-2030	Lognormal	425	497	11
reca	Lead	MG/KG	1090	Max	1090		APB-FP-2033	Lognormal	597	4310	11
recbgc	Total PAH	UG/KG	3900	95% UCL-T	4100		WRL-SD-2042	Undefined	1700	3900	11
recbgc	Aroclor, Total	UG/KG	1300	95% UCL-T	2920		LPX-SD-2046	Lognormal	780	1300	12
recbgc	Aroclor-1254	UG/KG	1700	95% UCL-T	2600	*	LPX-SD-2046	Lognormal	690	1700	12
recbgc	Toxicity Equivalency	NG/KG	8030	Max	8030		SD-18	Lognormal	3480	254000	13
recbgc	Antimony	MG/KG	3.1	95% UCL-T	3.5	J	LPX-SD-2046	Undefined	1.9	3.1	11
recbgc	Arsenic	MG/KG	5.7	95% UCL-T	7.3		LPX-SD-2046	Lognormal	5.1	5.7	11
recbgc	Chromium	MG/KG	187	Max	187		LPX-SD-2046	Lognormal	103	532	11
recbgc	Manganese	MG/KG	518	95% UCL-T	885		WRL-BK-2004	Lognormal	427	518	11
recbgc	Lead	MG/KG	447	Max	447		LPX-SD-2046	Lognormal	233	480	11
recL	Total PAH	UG/KG	1600	Max	1600		LPX-BK-2006	Undefined	940	12000000	14
recL	Aroclor, Total	UG/KG	58	95% UCL-T	98		LPX-BK-2007	Lognormal	57	58	16
recL	Aroclor-1254	UG/KG	42	95% UCL-T	98	P	LPX-BK-2007	Undefined	42	42	16
recL	Toxicity Equivalency	NG/KG	1050	Max	1050		LPX-BK-2007	Lognormal	380	12500	17
recL	Antimony	MG/KG	1.8	Max	1.8	J	LPX-BK-2006	< 11 Samples	NA	NA	9
recL	Arsenic	MG/KG	7	Max	7		LPX-BK-2006	< 11 Samples	NA	NA	9
recL	Chromium	MG/KG	47.2	Max	47.2	J	LPX-BK-2006	< 11 Samples	NA	NA	9
recL	Manganese	MG/KG	167	Max	167		LPX-BK-2007	< 11 Samples	NA	NA	9
recL	Lead	MG/KG	308	Max	308		LPX-BK-2007	< 11 Samples	NA	NA	9
recna	Total PAH	UG/KG	11000	Max	11000		RES-14-366-01	< 11 Samples	NA	NA	5
recna	Aroclor, Total	UG/KG	840	Max	840	J	CMS-192	< 11 Samples	NA	NA	6
recna	Aroclor-1254	UG/KG	840	Max	840	J	CMS-192	< 11 Samples	NA	NA	6
recna	Toxicity Equivalency	NG/KG	25600	95% UCL-T	73000		CMS-022	Undefined	6220	25600	71
recna	Antimony	MG/KG	4.1	Max	4.1	J	CMS-192	< 11 Samples	NA	NA	5
recna	Arsenic	MG/KG	18	Max	18	J	CMS-192	< 11 Samples	NA	NA	5
recna	Chromium	MG/KG	472	Max	472		CMS-192	< 11 Samples	NA	NA	5
recna	Manganese	MG/KG	391	Max	391		RES-14-366-01	< 11 Samples	NA	NA	5
recna	Lead	MG/KG	712	Max	712		CMW-FP-2027	< 11 Samples	NA	NA	5
res1	Total PAH	UG/KG	2600	Max	2600		CMS-456	< 11 Samples	NA	NA	3
res1	Aroclor, Total	UG/KG	7000	Max	7000	J	CMS-456	< 11 Samples	NA	NA	3
res1	Aroclor-1254	UG/KG	4200	Max	4200	J	CMS-456	< 11 Samples	NA	NA	3
res1	Toxicity Equivalency	NG/KG	2100	Max	2100		CMS-456	Lognormal	629	6140	13
res1	Antimony	MG/KG	1.1	Max	1.1	J	CMS-456	< 11 Samples	NA	NA	3
res1	Arsenic	MG/KG	3.1	Max	3.1	J	CMS-456	< 11 Samples	NA	NA	3

Date

TABLE B-2.5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res1	Chromium	MG/KG	180	Max	180		CMS-456	< 11 Samples	NA	NA	3
res1	Manganese	MG/KG	1700	Max	1700	J	CMS-456	< 11 Samples	NA	NA	3
res1	Lead	MG/KG	448	Max	448		CMS-456	< 11 Samples	NA	NA	3
res10	Total PAH	UG/KG	2500	Max	2500		RES-14-449-01	< 11 Samples	NA	NA	2
res10	Aroclor, Total	UG/KG	4600	Max	4600		RES-14-448-01	< 11 Samples	NA	NA	3
res10	Aroclor-1254	UG/KG	4600	Max	4600	*J	RES-14-448-01	< 11 Samples	NA	NA	3
res10	Toxicity Equivalency	NG/KG	57700	Max	57700		RES-14-449-03	< 11 Samples	NA	NA	7
res10	Antimony	MG/KG	12.3	Max	12.3	J	RES-14-449-01	< 11 Samples	NA	NA	2
res10	Arsenic	MG/KG	14.7	Max	14.7	J	RES-14-449-01	< 11 Samples	NA	NA	2
res10	Chromium	MG/KG	536	Max	536	J	RES-14-449-01	< 11 Samples	NA	NA	2
res10	Manganese	MG/KG	325	Max	325	J	RES-14-449-01	< 11 Samples	NA	NA	2
res10	Lead	MG/KG	706	Max	706	J	RES-14-449-01	< 11 Samples	NA	NA	2
res11	Total PAH	UG/KG	5700	Max	5700		RES-12-239-01	< 11 Samples	NA	NA	5
res11	Aroclor, Total	UG/KG	1500	Max	1500		APB-FP-2033	< 11 Samples	NA	NA	5
res11	Aroclor-1254	UG/KG	1500	Max	1500	*	APB-FP-2033	< 11 Samples	NA	NA	5
res11	Toxicity Equivalency	NG/KG	45100	Max	45100		CMS-487	Undefined	10900	18500000	18
res11	Antimony	MG/KG	4.4	Max	4.4		RES-12-240-01	< 11 Samples	NA	NA	5
res11	Arsenic	MG/KG	9.4	Max	9.4		APB-FP-2033	< 11 Samples	NA	NA	5
res11	Chromium	MG/KG	202	Max	202		RES-12-240-01	< 11 Samples	NA	NA	5
res11	Manganese	MG/KG	373	Max	373		APB-FP-2033	< 11 Samples	NA	NA	5
res11	Lead	MG/KG	1090	Max	1090		APB-FP-2033	< 11 Samples	NA	NA	5
res12	Total PAH	UG/KG	1600	Max	1600		RES-12-551-01	< 11 Samples	NA	NA	2
res12	Aroclor, Total	UG/KG	4300	Max	4300		RES-12-551-01	< 11 Samples	NA	NA	2
res12	Aroclor-1254	UG/KG	4300	Max	4300	*	RES-12-551-01	< 11 Samples	NA	NA	2
res12	Toxicity Equivalency	NG/KG	27900	Max	27900		CMS-470	< 11 Samples	NA	NA	10
res12	Antimony	MG/KG	7.1	Max	7.1		RES-12-551-01	< 11 Samples	NA	NA	2
res12	Arsenic	MG/KG	11.6	Max	11.6		RES-12-551-01	< 11 Samples	NA	NA	2
res12	Chromium	MG/KG	381	Max	381	J	RES-12-551-01	< 11 Samples	NA	NA	2
res12	Manganese	MG/KG	260	Max	260		RES-12-550-01	< 11 Samples	NA	NA	2
res12	Lead	MG/KG	379	Max	379		RES-12-551-01	< 11 Samples	NA	NA	2
res13	Total PAH	UG/KG	960	Max	960		RES-12-553-01	< 11 Samples	NA	NA	2
res13	Aroclor, Total	UG/KG	490	Max	490		RES-12-553-01	< 11 Samples	NA	NA	3
res13	Aroclor-1254	UG/KG	490	Max	490		RES-12-553-01	< 11 Samples	NA	NA	3
res13	Toxicity Equivalency	NG/KG	16400	Max	16400		CMS-489	< 11 Samples	NA	NA	10
res13	Arsenic	MG/KG	4	Max	4		RES-12-552-01	< 11 Samples	NA	NA	2
res13	Chromium	MG/KG	168	Max	168	J	RES-12-552-01	< 11 Samples	NA	NA	2
res13	Manganese	MG/KG	174	Max	174		RES-12-552-01	< 11 Samples	NA	NA	2
res13	Lead	MG/KG	356	Max	356		RES-12-553-01	< 11 Samples	NA	NA	2
res14	Total PAH	UG/KG	1100	Max	1100		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Aroclor, Total	UG/KG	4100	Max	4100		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Aroclor-1254	UG/KG	4100	Max	4100		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Toxicity Equivalency	NG/KG	8860	Max	8860		CMS-477	< 11 Samples	NA	NA	10

Date

TABLE 5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res14	Arsenic	MG/KG	13.1	Max	13.1		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Chromium	MG/KG	226	Max	226		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Manganese	MG/KG	337	Max	337		RES-12-555-01	< 11 Samples	NA	NA	2
res14	Lead	MG/KG	664	Max	664		RES-12-555-01	< 11 Samples	NA	NA	2
res15	Total PAH	UG/KG	5000	Max	5000		RES-12-556-01	< 11 Samples	NA	NA	1
res15	Toxicity Equivalency	NG/KG	39.5	Max	39.5		RES-12-556-01	< 11 Samples	NA	NA	3
res15	Antimony	MG/KG	3.1	Max	3.1		RES-12-556-01	< 11 Samples	NA	NA	1
res15	Arsenic	MG/KG	9.3	Max	9.3		RES-12-556-01	< 11 Samples	NA	NA	1
res15	Chromium	MG/KG	18	Max	18		RES-12-556-01	< 11 Samples	NA	NA	1
res15	Manganese	MG/KG	373	Max	373		RES-12-556-01	< 11 Samples	NA	NA	1
res15	Lead	MG/KG	500	Max	500		RES-12-556-01	< 11 Samples	NA	NA	1
res16	Total PAH	UG/KG	2400	Max	2400		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Aroclor, Total	UG/KG	150	Max	150		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Aroclor-1254	UG/KG	150	Max	150		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Toxicity Equivalency	NG/KG	13.7	Max	13.7		RES-11-012-01	< 11 Samples	NA	NA	6
res16	Antimony	MG/KG	2.5	Max	2.5	J	RES-11-012-01	< 11 Samples	NA	NA	2
res16	Arsenic	MG/KG	7.8	Max	7.8		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Chromium	MG/KG	25.7	Max	25.7		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Manganese	MG/KG	425	Max	425		RES-11-012-01	< 11 Samples	NA	NA	2
res16	Lead	MG/KG	2460	Max	2460		RES-11-012-01	< 11 Samples	NA	NA	2
res17	Total PAH	UG/KG	580	Max	580		RES-11-419-01	< 11 Samples	NA	NA	1
res17	Toxicity Equivalency	NG/KG	596	Max	596		RES-11-419-01	< 11 Samples	NA	NA	3
res17	Arsenic	MG/KG	3.5	Max	3.5		RES-11-419-01	< 11 Samples	NA	NA	1
res17	Chromium	MG/KG	29.1	Max	29.1		RES-11-419-01	< 11 Samples	NA	NA	1
res17	Manganese	MG/KG	388	Max	388		RES-11-419-01	< 11 Samples	NA	NA	1
res17	Lead	MG/KG	157	Max	157		RES-11-419-01	< 11 Samples	NA	NA	1
res18	Total PAH	UG/KG	170	Max	170		RES-11-420-01	< 11 Samples	NA	NA	2
res18	Aroclor, Total	UG/KG	58	Max	58		SD-17	< 11 Samples	NA	NA	4
res18	Aroclor-1254	UG/KG	58	Max	58	J	SD-17	< 11 Samples	NA	NA	4
res18	Toxicity Equivalency	NG/KG	620	Max	620		SD-17	< 11 Samples	NA	NA	9
res18	Arsenic	MG/KG	6.7	Max	6.7		RES-11-420-01	< 11 Samples	NA	NA	2
res18	Chromium	MG/KG	20.6	Max	20.6		RES-11-422-01	< 11 Samples	NA	NA	2
res18	Manganese	MG/KG	369	Max	369		RES-11-422-01	< 11 Samples	NA	NA	2
res18	Lead	MG/KG	99.3	Max	99.3		RES-11-420-01	< 11 Samples	NA	NA	2
res19	Total PAH	UG/KG	170000	Max	170000		RES-11-424-01	< 11 Samples	NA	NA	5
res19	Aroclor, Total	UG/KG	51	Max	51		RES-11-425-01	< 11 Samples	NA	NA	6
res19	Aroclor-1254	UG/KG	51	Max	51		RES-11-425-01	< 11 Samples	NA	NA	6
res19	Toxicity Equivalency	NG/KG	1500	Max	1500		RES-11-425-01	Lognormal	311	2070	14
res19	Antimony	MG/KG	7.1	Max	7.1		RES-11-424-01	< 11 Samples	NA	NA	4
res19	Arsenic	MG/KG	2.9	Max	2.9		RES-11-424-01	< 11 Samples	NA	NA	4
res19	Chromium	MG/KG	7.5	Max	7.5		RES-11-424-01	< 11 Samples	NA	NA	4
res19	Manganese	MG/KG	144	Max	144		RES-11-426-01	< 11 Samples	NA	NA	4

Date

TABLE B-2.5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res19	Lead	MG/KG	948	Max	948		RES-11-424-01	< 11 Samples	NA	NA	4
res2	Total PAH	UG/KG	1000	Max	1000		RES-14-272-01	< 11 Samples	NA	NA	2
res2	Aroclor, Total	UG/KG	710	Max	710		RES-14-272-01	< 11 Samples	NA	NA	2
res2	Aroclor-1254	UG/KG	710	Max	710		RES-14-272-01	< 11 Samples	NA	NA	2
res2	Toxicity Equivalency	NG/KG	827	95% UCL-T	2100		CMS-123	Lognormal	524	827	14
res2	Arsenic	MG/KG	3.5	Max	3.5		RES-14-272-01	< 11 Samples	NA	NA	2
res2	Chromium	MG/KG	41.3	Max	41.3		RES-14-272-01	< 11 Samples	NA	NA	2
res2	Manganese	MG/KG	386	Max	386		RES-14-302-01	< 11 Samples	NA	NA	2
res2	Lead	MG/KG	359	Max	359		RES-14-272-01	< 11 Samples	NA	NA	2
res20	Total PAH	UG/KG	530	Max	530		RES-11-428-01	< 11 Samples	NA	NA	4
res20	Aroclor, Total	UG/KG	180	Max	180		RES-11-428-01	< 11 Samples	NA	NA	4
res20	Aroclor-1254	UG/KG	180	Max	180		RES-11-428-01	< 11 Samples	NA	NA	4
res20	Toxicity Equivalency	NG/KG	118	Max	118		SD-13	< 11 Samples	NA	NA	10
res20	Antimony	MG/KG	1.6	Max	1.6	J	RES-11-428-01	< 11 Samples	NA	NA	3
res20	Arsenic	MG/KG	8.7	Max	8.7		RES-11-429-01	< 11 Samples	NA	NA	3
res20	Chromium	MG/KG	10.9	Max	10.9		RES-11-428-01	< 11 Samples	NA	NA	3
res20	Manganese	MG/KG	176	Max	176		RES-11-428-01	< 11 Samples	NA	NA	3
res20	Lead	MG/KG	41.2	Max	41.2		RES-11-428-01	< 11 Samples	NA	NA	3
res21	Total PAH	UG/KG	910	Max	910		RES-11-433-01	< 11 Samples	NA	NA	2
res21	Toxicity Equivalency	NG/KG	1170	Max	1170		RES-11-433-01	< 11 Samples	NA	NA	6
res21	Antimony	MG/KG	17	Max	17		RES-11-433-01	< 11 Samples	NA	NA	2
res21	Arsenic	MG/KG	9.6	Max	9.6		RES-11-433-01	< 11 Samples	NA	NA	2
res21	Chromium	MG/KG	275	Max	275		RES-11-433-01	< 11 Samples	NA	NA	2
res21	Manganese	MG/KG	486	Max	486		RES-11-433-01	< 11 Samples	NA	NA	2
res21	Lead	MG/KG	342	Max	342		RES-11-433-01	< 11 Samples	NA	NA	2
res22	Total PAH	UG/KG	1000	Max	1000		RES-11-486-01	< 11 Samples	NA	NA	2
res22	Aroclor, Total	UG/KG	340	Max	340		RES-11-328-01	< 11 Samples	NA	NA	2
res22	Aroclor-1254	UG/KG	200	Max	200		RES-11-328-01	< 11 Samples	NA	NA	2
res22	Toxicity Equivalency	NG/KG	388	Max	388		RES-11-328-01	< 11 Samples	NA	NA	6
res22	Antimony	MG/KG	5.8	Max	5.8		RES-11-486-01	< 11 Samples	NA	NA	2
res22	Arsenic	MG/KG	6.5	Max	6.5		RES-11-486-01	< 11 Samples	NA	NA	2
res22	Chromium	MG/KG	404	Max	404		RES-11-486-01	< 11 Samples	NA	NA	2
res22	Manganese	MG/KG	314	Max	314		RES-11-486-01	< 11 Samples	NA	NA	2
res22	Lead	MG/KG	436	Max	436		RES-11-486-01	< 11 Samples	NA	NA	2
res23	Total PAH	UG/KG	51	Max	51		RES-11-396-01	< 11 Samples	NA	NA	1
res23	Aroclor, Total	UG/KG	350	Max	350		RES-11-396-01	< 11 Samples	NA	NA	1
res23	Aroclor-1254	UG/KG	350	Max	350		RES-11-396-01	< 11 Samples	NA	NA	1
res23	Toxicity Equivalency	NG/KG	1110	Max	1110		RES-11-396-01	< 11 Samples	NA	NA	3
res23	Antimony	MG/KG	1.8	Max	1.8	J	RES-11-396-01	< 11 Samples	NA	NA	1
res23	Arsenic	MG/KG	5.3	Max	5.3		RES-11-396-01	< 11 Samples	NA	NA	1
res23	Chromium	MG/KG	79.4	Max	79.4		RES-11-396-01	< 11 Samples	NA	NA	1
res23	Manganese	MG/KG	358	Max	358		RES-11-396-01	< 11 Samples	NA	NA	1

Date

TABLE 5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res23	Lead	MG/KG	425	Max	425		RES-11-396-01	< 11 Samples	NA	NA	1
res24	Total PAH	UG/KG	24	Max	24		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Aroclor, Total	UG/KG	86	Max	86		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Aroclor-1254	UG/KG	86	Max	86		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Toxicity Equivalency	NG/KG	418	Max	418		RES-11-577-01	< 11 Samples	NA	NA	3
res24	Arsenic	MG/KG	5.1	Max	5.1		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Chromium	MG/KG	24.3	Max	24.3		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Manganese	MG/KG	96.5	Max	96.5		RES-11-577-01	< 11 Samples	NA	NA	1
res24	Lead	MG/KG	176	Max	176		RES-11-577-01	< 11 Samples	NA	NA	1
res25	Total PAH	UG/KG	140	Max	140		RES-10-004-01, SD-11	< 11 Samples	NA	NA	3
res25	Toxicity Equivalency	NG/KG	271	Max	271		SD-11	< 11 Samples	NA	NA	7
res25	Arsenic	MG/KG	9.1	Max	9.1		RES-10-004-01	< 11 Samples	NA	NA	2
res25	Chromium	MG/KG	18.9	Max	18.9		RES-10-005-01	< 11 Samples	NA	NA	2
res25	Manganese	MG/KG	217	Max	217		RES-10-005-01	< 11 Samples	NA	NA	2
res25	Lead	MG/KG	207	Max	207		RES-10-004-01	< 11 Samples	NA	NA	2
res26	Total PAH	UG/KG	580	Max	580		RES-10-604-01	< 11 Samples	NA	NA	2
res26	Aroclor, Total	UG/KG	73	Max	73		RES-10-604-01	< 11 Samples	NA	NA	2
res26	Aroclor-1254	UG/KG	73	Max	73		RES-10-604-01	< 11 Samples	NA	NA	2
res26	Toxicity Equivalency	NG/KG	365	Max	365		RES-10-042-01	< 11 Samples	NA	NA	6
res26	Antimony	MG/KG	38.2	Max	38.2	J	RES-10-042-01	< 11 Samples	NA	NA	2
res26	Arsenic	MG/KG	55.6	Max	55.6		RES-10-042-01	< 11 Samples	NA	NA	2
res26	Chromium	MG/KG	52.6	Max	52.6		RES-10-042-01	< 11 Samples	NA	NA	2
res26	Manganese	MG/KG	695	Max	695		RES-10-042-01	< 11 Samples	NA	NA	2
res26	Lead	MG/KG	368	Max	368		RES-10-042-01	< 11 Samples	NA	NA	2
res27	Total PAH	UG/KG	1600	Max	1600		LPX-BK-2006	< 11 Samples	NA	NA	5
res27	Aroclor, Total	UG/KG	380	Max	380		RES-10-044-01	< 11 Samples	NA	NA	4
res27	Aroclor-1254	UG/KG	240	Max	240		RES-10-044-01	< 11 Samples	NA	NA	4
res27	Toxicity Equivalency	NG/KG	888	Max	888		LPX-BK-2006	< 11 Samples	NA	NA	9
res27	Antimony	MG/KG	5.2	Max	5.2		RES-10-044-01	< 11 Samples	NA	NA	5
res27	Arsenic	MG/KG	14.8	Max	14.8		RES-10-044-01	< 11 Samples	NA	NA	5
res27	Chromium	MG/KG	52.6	Max	52.6		RES-10-044-01	< 11 Samples	NA	NA	5
res27	Manganese	MG/KG	179	Max	179		RES-10-044-01	< 11 Samples	NA	NA	5
res27	Lead	MG/KG	509	Max	509		RES-10-044-01	< 11 Samples	NA	NA	5
res28	Total PAH	UG/KG	30000	Max	30000		RES-10-075-01	< 11 Samples	NA	NA	4
res28	Toxicity Equivalency	NG/KG	86.4	95% UCL-T	116		RES-10-076-01	Lognormal	48.5	86.4	12
res28	Antimony	MG/KG	3.2	Max	3.2		RES-10-075-01	< 11 Samples	NA	NA	4
res28	Arsenic	MG/KG	32.8	Max	32.8		RES-10-075-01	< 11 Samples	NA	NA	4
res28	Chromium	MG/KG	115	Max	115		RES-10-076-01	< 11 Samples	NA	NA	4
res28	Manganese	MG/KG	2880	Max	2880		RES-10-076-01	< 11 Samples	NA	NA	4
res28	Lead	MG/KG	2160	Max	2160		RES-10-076-01	< 11 Samples	NA	NA	4
res3	Total PAH	UG/KG	14000	Max	14000		RES-14-334-01	< 11 Samples	NA	NA	4
res3	Aroclor, Total	UG/KG	48000	Max	48000		RES-14-303-01	< 11 Samples	NA	NA	4

Date

TABLE B-2.5
EXPOSURE POINT CONCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res3	Aroclor-1254	UG/KG	37000	Max	37000	*	RES-14-303-01	< 11 Samples	NA	NA	4
res3	Toxicity Equivalency	NG/KG	10600	Max	10600		RES-14-303-02	Lognormal	3120	74100	16
res3	Antimony	MG/KG	0.83	Max	0.83	J	CMS-159	< 11 Samples	NA	NA	4
res3	Arsenic	MG/KG	12.1	Max	12.1	J	RES-14-333-01	< 11 Samples	NA	NA	4
res3	Chromium	MG/KG	212	Max	212	J	RES-14-303-01	< 11 Samples	NA	NA	4
res3	Manganese	MG/KG	1250	Max	1250	J	RES-14-333-01	< 11 Samples	NA	NA	4
res3	Lead	MG/KG	946	Max	946		RES-14-303-01	< 11 Samples	NA	NA	4
res4	Total PAH	UG/KG	3200	Max	3200		RES-14-365-01	< 11 Samples	NA	NA	1
res4	Aroclor, Total	UG/KG	80	Max	80		RES-14-365-01	< 11 Samples	NA	NA	1
res4	Aroclor-1254	UG/KG	80	Max	80	J	RES-14-365-01	< 11 Samples	NA	NA	1
res4	Toxicity Equivalency	NG/KG	106	Max	106		RES-14-365-03	< 11 Samples	NA	NA	5
res4	Arsenic	MG/KG	5.8	Max	5.8	J	RES-14-365-01	< 11 Samples	NA	NA	1
res4	Chromium	MG/KG	289	Max	289	J	RES-14-365-01	< 11 Samples	NA	NA	1
res4	Manganese	MG/KG	115	Max	115		RES-14-365-01	< 11 Samples	NA	NA	1
res4	Lead	MG/KG	386	Max	386		RES-14-365-01	< 11 Samples	NA	NA	1
res5	Total PAH	UG/KG	11000	Max	11000		RES-14-366-01	< 11 Samples	NA	NA	2
res5	Aroclor, Total	UG/KG	1500	Max	1500		RES-14-398-01	< 11 Samples	NA	NA	2
res5	Aroclor-1254	UG/KG	1500	Max	1500	*	RES-14-398-01	< 11 Samples	NA	NA	2
res5	Toxicity Equivalency	NG/KG	5450	Max	5450		RES-14-366-02	< 11 Samples	NA	NA	10
res5	Arsenic	MG/KG	7.5	Max	7.5		RES-14-398-01	< 11 Samples	NA	NA	2
res5	Chromium	MG/KG	75.5	Max	75.5	J	RES-14-398-01	< 11 Samples	NA	NA	2
res5	Manganese	MG/KG	391	Max	391		RES-14-366-01	< 11 Samples	NA	NA	2
res5	Lead	MG/KG	890	Max	890		RES-14-398-01	< 11 Samples	NA	NA	2
res6	Total PAH	UG/KG	4900	Max	4900		RES-14-399-01	< 11 Samples	NA	NA	1
res6	Aroclor, Total	UG/KG	520	Max	520		RES-14-399-01	< 11 Samples	NA	NA	1
res6	Aroclor-1254	UG/KG	520	Max	520		RES-14-399-01	< 11 Samples	NA	NA	1
res6	Toxicity Equivalency	NG/KG	9900	Max	9900		CMS-193	< 11 Samples	NA	NA	6
res6	Arsenic	MG/KG	4.4	Max	4.4		RES-14-399-01	< 11 Samples	NA	NA	1
res6	Chromium	MG/KG	50.7	Max	50.7	J	RES-14-399-01	< 11 Samples	NA	NA	1
res6	Manganese	MG/KG	349	Max	349		RES-14-399-01	< 11 Samples	NA	NA	1
res6	Lead	MG/KG	321	Max	321		RES-14-399-01	< 11 Samples	NA	NA	1
res7	Total PAH	UG/KG	1800	Max	1800		CMS-418	< 11 Samples	NA	NA	5
res7	Aroclor, Total	UG/KG	4700	Max	4700		RES-14-419-01	< 11 Samples	NA	NA	5
res7	Aroclor-1254	UG/KG	4700	Max	4700	*	RES-14-419-01	< 11 Samples	NA	NA	5
res7	Toxicity Equivalency	NG/KG	13300	Max	13300		CMS-205	Lognormal	3060	21900	16
res7	Antimony	MG/KG	13.7	Max	13.7	J	RES-14-419-01	< 11 Samples	NA	NA	3
res7	Arsenic	MG/KG	12.5	Max	12.5		RES-14-419-01	< 11 Samples	NA	NA	5
res7	Chromium	MG/KG	308	Max	308		RES-14-419-01	< 11 Samples	NA	NA	5
res7	Manganese	MG/KG	176	Max	176		RES-14-419-01	< 11 Samples	NA	NA	5
res7	Lead	MG/KG	522	Max	522		RES-14-419-01	< 11 Samples	NA	NA	5
res8	Total PAH	UG/KG	990	Max	990		RES-14-422-01	< 11 Samples	NA	NA	3
res8	Aroclor, Total	UG/KG	570	Max	570		RES-14-425-01	< 11 Samples	NA	NA	3

Date

TABL ?.5
EXPOSURE POINT NCENTRATIONS
DRAFT ENGINEERING EVALUATION/COST ANALYIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Receptor	Parameter	Units	EPC	EPCStat	MaxOfDetects	MaxQual	MaxLocation	Distribution	UCL_N	UCL_T	Count
res8	Aroclor-1254	UG/KG	570	Max	570		RES-14-425-01	< 11 Samples	NA	NA	3
res8	Toxicity Equivalency	NG/KG	1950	Max	1950		RES-14-425-01	< 11 Samples	NA	NA	9
res8	Antimony	MG/KG	3.4	Max	3.4	J	RES-14-425-01	< 11 Samples	NA	NA	3
res8	Arsenic	MG/KG	8	Max	8		RES-14-425-01	< 11 Samples	NA	NA	3
res8	Chromium	MG/KG	129	Max	129		RES-14-425-01	< 11 Samples	NA	NA	3
res8	Manganese	MG/KG	641	Max	641		RES-14-425-01	< 11 Samples	NA	NA	3
res8	Lead	MG/KG	223	Max	223		RES-14-422-01	< 11 Samples	NA	NA	3
res9	Total PAH	UG/KG	1100	Max	1100		RES-14-430-01	< 11 Samples	NA	NA	4
res9	Aroclor, Total	UG/KG	1400	Max	1400	J	CMS-600	< 11 Samples	NA	NA	5
res9	Aroclor-1254	UG/KG	1400	Max	1400	J	CMS-600	< 11 Samples	NA	NA	5
res9	Toxicity Equivalency	NG/KG	870	Max	870		CMS-600	< 11 Samples	NA	NA	6
res9	Antimony	MG/KG	6.3	Max	6.3	J	APB-FP-2028	< 11 Samples	NA	NA	4
res9	Arsenic	MG/KG	8.7	Max	8.7		APB-FP-2028	< 11 Samples	NA	NA	4
res9	Chromium	MG/KG	329	Max	329		APB-FP-2028	< 11 Samples	NA	NA	4
res9	Manganese	MG/KG	408	Max	408		APB-FP-2028	< 11 Samples	NA	NA	4
res9	Lead	MG/KG	511	Max	511		APB-FP-2028	< 11 Samples	NA	NA	4

Date

TABLE B-3.1
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 1
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	2.6	Max	CMS-456	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.27E-05	2.19E-05	3.46E-05
Total Aroclors	7	Max	CMS-456	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	9.37E-06	1.74E-05	2.68E-05
Dioxin TEQ	0.002	Max	CMS-456	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.05E-04	8.38E-05	1.89E-04
Antimony	1.1	Max	CMS-456	*			6.69E-07			1.50E-01				
Arsenic	3.1	Max	CMS-456	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	3.11E-06	1.24E-06	4.35E-06
Chromium	180	Max	CMS-456	*			6.69E-07			2.50E-02				
Manganese	1700	Max	CMS-456	*			6.69E-07			4.00E-02				
														2.55E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.2
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 2
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1	Max	RES-14-272-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	4.89E-06	8.42E-06	1.33E-05
Total Aroclors	0.71	Max	RES-14-272-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	9.50E-07	1.76E-06	2.71E-06
Dioxin TEQ	0.00083	95% UCL-T	CMS-123	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.17E-05	3.31E-05	7.48E-05
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	3.5	Max	RES-14-272-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	3.51E-06	1.40E-06	4.91E-06
Chromium	41.3	Max	RES-14-272-01	*			6.69E-07			2.50E-02				
Manganese	386	Max	RES-14-302-01	*			6.69E-07			4.00E-02				
														9.57E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.3
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 3
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	14	Max	RES-14-334-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	6.84E-05	1.18E-04	1.86E-04
Total Aroclors	48	Max	RES-14-303-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.43E-05	1.19E-04	1.83E-04
Dioxin TEQ	0.0106	Max	RES-14-303-02	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	5.32E-04	4.23E-04	9.55E-04
Antimony	0.83	Max	CMS-159	*			6.69E-07			1.50E-01				
Arsenic	12.1	Max	RES-14-333-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.21E-05	4.83E-06	1.70E-05
Chromium	212	Max	RES-14-303-01	*			6.69E-07			2.50E-02				
Manganese	1250	Max	RES-14-333-01	*			6.69E-07			4.00E-02				
														1.34E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.4
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 4
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	3.2	Max	RES-14-365-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.56E-05	2.69E-05	4.26E-05
Total Aroclors	0.08	Max	RES-14-365-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	1.07E-07	1.99E-07	3.06E-07
Dioxin TEQ	0.000106	Max	RES-14-365-03	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	5.32E-06	4.23E-06	9.55E-06
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	5.8	Max	RES-14-365-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	5.82E-06	2.32E-06	8.14E-06
Chromium	289	Max	RES-14-365-01	*			6.69E-07			2.50E-02				
Manganese	115	Max	RES-14-365-01	*			6.69E-07			4.00E-02				
														6.06E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-3.5
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 5
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	11	Max	RES-14-366-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	5.37E-05	9.26E-05	1.46E-04
Total Aroclors	1.5	Max	RES-14-398-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	2.01E-06	3.73E-06	5.73E-06
Dioxin TEQ	0.00545	Max	RES-14-366-02	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	2.74E-04	2.18E-04	4.91E-04
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	7.5	Max	RES-14-398-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	7.53E-06	2.99E-06	1.05E-05
Chromium	75.5	Max	RES-14-398-01	*			6.69E-07			2.50E-02				
Manganese	391	Max	RES-14-366-01	*			6.69E-07			4.00E-02				
														6.54E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.6
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 6
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	4.9	Max	RES-14-399-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.39E-05	4.13E-05	6.52E-05
Total Aroclors	0.52	Max	RES-14-399-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.96E-07	1.29E-06	1.99E-06
Dioxin TEQ	0.0099	Max	CMS-193	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.97E-04	3.95E-04	8.92E-04
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	4.4	Max	RES-14-399-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	4.42E-06	1.76E-06	6.17E-06
Chromium	50.7	Max	RES-14-399-01	*			6.69E-07			2.50E-02				
Manganese	349	Max	RES-14-399-01	*			6.69E-07			4.00E-02				
														9.65E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-3.7
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 7
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.8	Max	CMS-418	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	8.79E-06	1.52E-05	2.39E-05
Total Aroclors	4.7	Max	RES-14-419-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.29E-06	1.17E-05	1.80E-05
Dioxin TEQ	0.0133	Max	CMS-205	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	6.68E-04	5.31E-04	1.20E-03
Antimony	13.7	Max	RES-14-419-01	*			6.69E-07			1.50E-01				
Arsenic	12.5	Max	RES-14-419-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.25E-05	4.99E-06	1.75E-05
Chromium	308	Max	RES-14-419-01	*			6.69E-07			2.50E-02				
Manganese	176	Max	RES-14-419-01	*			6.69E-07			4.00E-02				
														1.26E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.8
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 8
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.99	Max	RES-14-422-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	4.84E-06	8.33E-06	1.32E-05
Total Aroclors	0.57	Max	RES-14-425-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	7.63E-07	1.42E-06	2.18E-06
Dioxin TEQ	0.00195	Max	RES-14-425-01	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	9.79E-05	7.78E-05	1.76E-04
Antimony	3.4	Max	RES-14-425-01	*			6.69E-07			1.50E-01				
Arsenic	8	Max	RES-14-425-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	8.03E-06	3.19E-06	1.12E-05
Chromium	129	Max	RES-14-425-01	*			6.69E-07			2.50E-02				
Manganese	641	Max	RES-14-425-01	*			6.69E-07			4.00E-02				
														2.02E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.9
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 9
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.1	Max	RES-14-430-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	5.37E-06	9.26E-06	1.46E-05
Total Aroclors	1.4	Max	CMS-600	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	1.87E-06	3.48E-06	5.35E-06
Dioxin TEQ	0.00087	Max	CMS-600	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.37E-05	3.47E-05	7.84E-05
Antimony	6.3	Max	APB-FP-2028	*			6.69E-07			1.50E-01				
Arsenic	8.7	Max	APB-FP-2028	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	8.73E-06	3.47E-06	1.22E-05
Chromium	329	Max	APB-FP-2028	*			6.69E-07			2.50E-02				
Manganese	408	Max	APB-FP-2028	*			6.69E-07			4.00E-02				
														1.11E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.10
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 10
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	2.5	Max	RES-14-449-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.22E-05	2.10E-05	3.33E-05
Total Aroclors	4.6	Max	RES-14-448-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.16E-06	1.14E-05	1.76E-05
Dioxin TEQ	0.058	Max	RES-14-449-03	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	2.90E-03	2.30E-03	5.20E-03
Antimony	12.3	Max	RES-14-449-01	*			6.69E-07			1.50E-01				
Arsenic	14.7	Max	RES-14-449-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.48E-05	5.87E-06	2.06E-05
Chromium	536	Max	RES-14-449-01	*			6.69E-07			2.50E-02				
Manganese	325	Max	RES-14-449-01	*			6.69E-07			4.00E-02				
														5.27E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.11
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 11
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	5.7	Max	RES-12-239-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.78E-05	4.80E-05	7.58E-05
Total Aroclors	1.5	Max	APB-FP-2033	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	2.01E-06	3.73E-06	5.73E-06
Dioxin TEQ	0.045	Max	CMS-487	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	2.26E-03	1.80E-03	4.06E-03
Antimony	4.4	Max	RES-12-240-01	*			6.69E-07			1.50E-01				
Arsenic	9.4	Max	APB-FP-2033	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	9.44E-06	3.75E-06	1.32E-05
Chromium	202	Max	RES-12-240-01	*			6.69E-07			2.50E-02				
Manganese	373	Max	APB-FP-2033	*			6.69E-07			4.00E-02				
														4.16E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.12
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 12
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.6	Max	RES-12-551-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	7.82E-06	1.35E-05	2.13E-05
Total Aroclors	4.3	Max	RES-12-551-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	5.76E-06	1.07E-05	1.64E-05
Dioxin TEQ	0.028	Max	CMS-470	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.40E-03	1.11E-03	2.51E-03
Antimony	7.1	Max	RES-12-551-01	*			6.69E-07			1.50E-01				
Arsenic	11.6	Max	RES-12-551-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.16E-05	4.63E-06	1.63E-05
Chromium	381	Max	RES-12-551-01	*			6.69E-07			2.50E-02				
Manganese	260	Max	RES-12-550-01	*			6.69E-07			4.00E-02				
														2.57E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.13
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 13
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.96	Max	RES-12-553-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	4.69E-06	8.08E-06	1.28E-05
Total Aroclors	0.49	Max	RES-12-553-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.56E-07	1.22E-06	1.87E-06
Dioxin TEQ	0.016	Max	CMS-489	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	8.23E-04	6.55E-04	1.48E-03
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	4	Max	RES-12-552-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	4.02E-06	1.60E-06	5.61E-06
Chromium	168	Max	RES-12-552-01	*			6.69E-07			2.50E-02				
Manganese	174	Max	RES-12-552-01	*			6.69E-07			4.00E-02				
														1.50E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-3.14
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 14
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.1	Max	RES-12-555-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	5.37E-06	9.26E-06	1.46E-05
Total Aroclors	4.1	Max	RES-12-555-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	5.49E-06	1.02E-05	1.57E-05
Dioxin TEQ	0.009	Max	CMS-477	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.45E-04	3.54E-04	7.98E-04
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	13.1	Max	RES-12-555-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.32E-05	5.23E-06	1.84E-05
Chromium	226	Max	RES-12-555-01	*			6.69E-07			2.50E-02				
Manganese	337	Max	RES-12-555-01	*			6.69E-07			4.00E-02				
														8.47E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.15
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 15
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	5	Max	RES-12-556-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.44E-05	4.21E-05	6.65E-05
Total Aroclors	nd			*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00			
Dioxin TEQ	0.0000395	Max	RES-12-556-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.98E-06	1.58E-06	3.56E-06
Antimony	3.1	Max	RES-12-556-01	*			6.69E-07			1.50E-01				
Arsenic	9.3	Max	RES-12-556-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	9.34E-06	3.71E-06	1.30E-05
Chromium	18	Max	RES-12-556-01	*			6.69E-07			2.50E-02				
Manganese	373	Max	RES-12-556-01	*			6.69E-07			4.00E-02				
														8.31E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.16
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 16
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	2.4	Max	RES-11-012-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.17E-05	2.02E-05	3.19E-05
Total Aroclors	0.15	Max	RES-11-012-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	2.01E-07	3.73E-07	5.73E-07
Dioxin TEQ	0.0000137	Max	RES-11-012-01	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	6.88E-07	5.47E-07	1.23E-06
Antimony	2.5	Max	RES-11-012-01	*			6.69E-07			1.50E-01				
Arsenic	7.8	Max	RES-11-012-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	7.83E-06	3.11E-06	1.09E-05
Chromium	25.7	Max	RES-11-012-01	*			6.69E-07			2.50E-02				
Manganese	425	Max	RES-11-012-01	*			6.69E-07			4.00E-02				
														4.47E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.17
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 17
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.58	Max	RES-11-419-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.83E-06	4.88E-06	7.72E-06
Total Aroclors	NE			*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00			
Dioxin TEQ	0.000596	Max	RES-11-419-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	2.99E-05	2.38E-05	5.37E-05
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	3.5	Max	RES-11-419-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	3.51E-06	1.40E-06	4.91E-06
Chromium	29.1	Max	RES-11-419-01	*			6.69E-07			2.50E-02				
Manganese	388	Max	RES-11-419-01	*			6.69E-07			4.00E-02				
														6.63E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected
NE Not Evaluated

TABLE B-3.18
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 18
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.17	Max	RES-11-420-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	8.31E-07	1.43E-06	2.26E-06
Total Aroclors	0.058	Max	SD-17	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	7.76E-08	1.44E-07	2.22E-07
Dioxin TEQ	0.00062	Max	SD-17	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	3.11E-05	2.47E-05	5.59E-05
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	6.7	Max	RES-11-420-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	6.73E-06	2.67E-06	9.40E-06
Chromium	20.6	Max	RES-11-422-01	*			6.69E-07			2.50E-02				
Manganese	369	Max	RES-11-422-01	*			6.69E-07			4.00E-02				
														6.78E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.19
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 19
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	170	Max	RES-11-424-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	8.31E-04	1.43E-03	2.26E-03
Total Aroclors	0.051	Max	RES-11-425-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	6.83E-08	1.27E-07	1.95E-07
Dioxin TEQ	0.0015	Max	RES-11-425-01	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	7.53E-05	5.99E-05	1.35E-04
Antimony	7.1	Max	RES-11-424-01	*			6.69E-07			1.50E-01				
Arsenic	2.9	Max	RES-11-424-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	2.91E-06	1.16E-06	4.07E-06
Chromium	7.5	Max	RES-11-424-01	*			6.69E-07			2.50E-02				
Manganese	144	Max	RES-11-426-01	*			6.69E-07			4.00E-02				
														2.40E-03

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.20
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 20
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.53	Max	RES-11-428-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.59E-06	4.46E-06	7.05E-06
Total Aroclors	0.18	Max	RES-11-428-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	2.41E-07	4.47E-07	6.88E-07
Dioxin TEQ	0.000118	Max	SD-13	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	5.92E-06	4.71E-06	1.06E-05
Antimony	1.6	Max	RES-11-428-01	*			6.69E-07			1.50E-01				
Arsenic	8.7	Max	RES-11-429-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	8.73E-06	3.47E-06	1.22E-05
Chromium	10.9	Max	RES-11-428-01	*			6.69E-07			2.50E-02				
Manganese	176	Max	RES-11-428-01	*			6.69E-07			4.00E-02				
														3.06E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.21
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 21
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.91	Max	RES-11-433-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	4.45E-06	7.66E-06	1.21E-05
Total Aroclors	nd			*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00			
Dioxin TEQ	0.00117	Max	RES-11-433-01	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	5.87E-05	4.67E-05	1.05E-04
Antimony	17	Max	RES-11-433-01	*			6.69E-07			1.50E-01				
Arsenic	9.6	Max	RES-11-433-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	9.64E-06	3.83E-06	1.35E-05
Chromium	275	Max	RES-11-433-01	*			6.69E-07			2.50E-02				
Manganese	486	Max	RES-11-433-01	*			6.69E-07			4.00E-02				
														1.31E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.22
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 22
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1	Max	RES-11-486-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	4.89E-06	8.42E-06	1.33E-05
Total Aroclors	0.34	Max	RES-11-328-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	4.55E-07	8.45E-07	1.30E-06
Dioxin TEQ	0.000388	Max	RES-11-328-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.95E-05	1.55E-05	3.50E-05
Antimony	5.8	Max	RES-11-486-02	*			6.69E-07			1.50E-01				
Arsenic	6.5	Max	RES-11-486-02	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	6.53E-06	2.59E-06	9.12E-06
Chromium	404	Max	RES-11-486-02	*			6.69E-07			2.50E-02				
Manganese	314	Max	RES-11-486-02	*			6.69E-07			4.00E-02				
														5.87E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.23
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 23
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.051	Max	RES-11-396-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.49E-07	4.29E-07	6.79E-07
Total Aroclors	0.35	Max	RES-11-396-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	4.68E-07	8.69E-07	1.34E-06
Dioxin TEQ	0.00111	Max	RES-11-396-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	5.57E-05	4.43E-05	1.00E-04
Antimony	1.8	Max	RES-11-396-01	*			6.69E-07			1.50E-01				
Arsenic	5.3	Max	RES-11-396-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	5.32E-06	2.12E-06	7.44E-06
Chromium	79.4	Max	RES-11-396-01	*			6.69E-07			2.50E-02				
Manganese	358	Max	RES-11-396-01	*			6.69E-07			4.00E-02				
														1.09E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.24
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 24
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.024	Max	RES-11-577-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.17E-07	2.02E-07	3.19E-07
Total Aroclors	0.086	Max	RES-11-577-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	1.15E-07	2.14E-07	3.29E-07
Dioxin TEQ	0.000418	Max	RES-11-577-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	2.10E-05	1.67E-05	3.77E-05
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	5.1	Max	RES-11-577-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	5.12E-06	2.04E-06	7.16E-06
Chromium	24.3	Max	RES-11-577-01	*			6.69E-07			2.50E-02				
Manganese	965	Max	RES-11-577-01	*			6.69E-07			4.00E-02				
														4.55E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.25
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 25
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.14	Max	RES-10-004-01,	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	6.84E-07	1.18E-06	1.86E-06
Total Aroclors	nd			*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00			
Dioxin TEQ	0.000271	Max	SD-11	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.36E-05	1.08E-05	2.44E-05
Antimony	nd			*			6.69E-07			1.50E-01				
Arsenic	9.1	Max	RES-10-004-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	9.14E-06	3.63E-06	1.28E-05
Chromium	18.9	Max	RES-10-005-01	*			6.69E-07			2.50E-02				
Manganese	217	Max	RES-10-005-01	*			6.69E-07			4.00E-02				
														3.91E-05

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.26
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 26
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	0.58	Max	RES-10-604-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	2.83E-06	4.88E-06	7.72E-06
Total Aroclors	0.073	Max	RES-10-604-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	9.77E-08	1.81E-07	2.79E-07
Dioxin TEQ	0.000365	Max	RES-10-042-01	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	1.83E-05	1.46E-05	3.29E-05
Antimony	38.2	Max	RES-10-042-01	*			6.69E-07			1.50E-01				
Arsenic	55.6	Max	RES-10-042-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	5.58E-05	2.22E-05	7.80E-05
Chromium	52.6	Max	RES-10-042-01	*			6.69E-07			2.50E-02				
Manganese	695	Max	RES-10-042-01	*			6.69E-07			4.00E-02				
														1.19E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.27
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 27
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.6	Max	LPX-BK-2006	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	7.82E-06	1.35E-05	2.13E-05
Total Aroclors	0.38	Max	RES-10-044-01	*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00	5.09E-07	9.44E-07	1.45E-06
Dioxin TEQ	0.000888	Max	LPX-BK-2006	0.5	6	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.46E-05	3.54E-05	8.00E-05
Antimony	5.2	Max	RES-10-044-01	*			6.69E-07			1.50E-01				
Arsenic	14.8	Max	RES-10-044-01	1	7	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	1.49E-05	5.91E-06	2.08E-05
Chromium	52.6	Max	RES-10-044-01	*			6.69E-07			2.50E-02				
Manganese	179	Max	RES-10-044-01	*			6.69E-07			4.00E-02				
														1.24E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.28
CANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 28
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	30	Max	RES-10-075-01	*		0.13	6.69E-07	1.15E-06	7.30E+00	1.00E+00	7.30E+00	1.47E-04	2.53E-04	3.99E-04
Total Aroclors	nd			*		0.14	6.69E-07	1.24E-06	2.00E+00	1.00E+00	2.00E+00			
Dioxin TEQ	0.0000864	95%UCL-T	RES-10-076-01	0.5	[6]	0.03	3.35E-07	2.66E-07	1.50E+05	1.00E+00	1.50E+05	4.34E-06	3.45E-06	7.79E-06
Antimony	3.2	Max	RES-10-075-01	*			6.69E-07			1.50E-01				
Arsenic	32.8	Max	RES-10-075-01	1	[7]	0.03	6.69E-07	2.66E-07	1.50E+00	1.00E+00	1.50E+00	3.29E-05	1.31E-05	4.60E-05
Chromium	115	Max	RES-10-076-01	*			6.69E-07			2.50E-02				
Manganese	2880	Max	RES-10-076-01	*			6.69E-07			4.00E-02				
														4.53E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((5700 cm^2*0.2 mg/cm^2-ev * 24 y)/70 kg) = 1511 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1511 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-3.29
CANCER RISK SUMMARY
RECREATIONAL EXPOSURE NORTH OF ALLENDALE POND - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	11	Max	RES-14-366-01	*		0.13	2.04E-08	4.92E-08	7.30E+00	1.00E+00	7.30E+00	1.63E-06	3.95E-06	5.59E-06
Total Aroclors	0.84	Max	CMS-192	*		0.14	2.04E-08	5.30E-08	2.00E+00	1.00E+00	2.00E+00	3.42E-08	8.90E-08	1.23E-07
Dioxin TEQ	0.026	95% UCL-T	CMS-022	0.5	[6]	0.03	1.02E-08	1.14E-08	1.50E+05	1.00E+00	1.50E+05	3.91E-05	4.36E-05	8.27E-05
Antimony	4.1	Max	CMS-192	*			2.04E-08			1.50E-01				
Arsenic	18	Max	CMS-192	1	[7]	0.03	2.04E-08	1.14E-08	1.50E+00	1.00E+00	1.50E+00	5.50E-07	3.07E-07	8.56E-07
Chromium	472	Max	CMS-192	*			2.04E-08			2.50E-02				
Manganese	391	Max	RES-14-366-01	*			2.04E-08			4.00E-02				
														8.93E-05

Oral Exposure Factor = Ingestion Rate * Fraction Ingested * Exposure Frequency * Exposure Duration * ABS_{oral} * Conversion Factor / Body Weight * Averaging Time
= (100 mg-y/kg-d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 70 y * 365 d/y)

Dermal Exposure Factor = Exposed Surface Area * Soil Adherence Factor * Exposure Frequency * Exposure Duration * ABS_{dermal} * Conversion Factor / Body Weight * Averaging Time
= (4650 cm2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y *10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 70y * 365 d/y)

CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.30
CANCER RISK SUMMARY
RECREATIONAL EXPOSURE ALLENDALE POND - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	5.3	Max	APB-BK-2003	*		0.13	2.04E-08	4.92E-08	7.30E+00	1.00E+00	7.30E+00	7.87E-07	1.90E-06	2.69E-06
Total Aroclors	2.8	95% UCL-T	CMS-616	*		0.14	2.04E-08	5.30E-08	2.00E+00	1.00E+00	2.00E+00	1.14E-07	2.97E-07	4.11E-07
Dioxin TEQ	0.069	95% UCL-T	CMS-024	0.5	6	0.03	1.02E-08	1.14E-08	1.50E+05	1.00E+00	1.50E+05	1.05E-04	1.17E-04	2.22E-04
Antimony	6.3	Max	APB-FP-2028	*			2.04E-08			1.50E-01				
Arsenic	7.2	95% UCL-N	APB-BK-2003	1	7	0.03	2.04E-08	1.14E-08	1.50E+00	1.00E+00	1.50E+00	2.20E-07	1.23E-07	3.42E-07
Chromium	175	95% UCL-N	APB-FP-2028	*			2.04E-08			2.50E-02				
Manganese	497	95% UCL-T	APB-FP-2030	*			2.04E-08			4.00E-02				
														2.25E-04

Oral Exposure Factor = Ingestion Rate * Fraction Ingested * Exposure Frequency * Exposure Duration * ABS_{oral} * Conversion Factor / Body Weight * Averaging Time
= (100 mg-y/kg-d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 70 y * 365 d/y)

Dermal Exposure Factor = Exposed Surface Area * Soil Adherence Factor * Exposure Frequency * Exposure Duration * ABS_{dermal} * Conversion Factor / Body Weight * Averaging Time
= (4650 cm2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y *10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 70y * 365 d/y)

CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.31
CANCER RISK SUMMARY
RECREATIONAL EXPOSURE LYMANSVILLE REACH AREA - 0-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	3.9	95% UCL-T	WRL-SD-2042	*		0.13	1.07E-07	3.52E-07	7.30E+00	1.00E+00	7.30E+00	3.06E-06	1.00E-05	1.31E-05
Total Aroclors	1.3	95% UCL-T	LPX-SD-2046	*		0.14	1.07E-07	3.79E-07	2.00E+00	1.00E+00	2.00E+00	2.79E-07	9.85E-07	1.26E-06
Dioxin TEQ	0.008	Max	SD-18	0.5	6	0.03	5.37E-08	8.11E-08	1.50E+05	1.00E+00	1.50E+05	6.47E-05	9.77E-05	1.62E-04
Antimony	3.1	95% UCL-T	LPX-SD-2046	*			1.07E-07			1.50E-01				
Arsenic	5.7	95% UCL-T	LPX-SD-2046	1	7	0.03	1.07E-07	8.11E-08	1.50E+00	1.00E+00	1.50E+00	9.19E-07	6.94E-07	1.61E-06
Chromium	187	Max	LPX-SD-2046	*			1.07E-07			2.50E-02				
Manganese	518	95% UCL-T	WRL-BK-2004	*			1.07E-07			4.00E-02				
														1.78E-04

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 12 y)/46.9 kg) = 105.6 mg-y/kg-d
Age-Adjusted Dermal Contact Rate = ((2800 cm^2*1 mg/cm^2-ev * 6 y)/15 kg) + ((4080 cm^2*0.2 mg/cm^2-ev * 12 y)/46.9 kg) = 1329 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate *Fraction Ingested* Exposure Frequency*ABS_{oral}*Conversion Factor/Averaging Time
= (105.6 mg-y/kg-d * 0.5 * 52 d/y * ABS_{oral} * 10-6 kg/mg)/(70y*365 d/y)
Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency*ABS_{dermal}*Conversion Factor/Averaging Time
= (1329 mg-y/kg-ev * 1 ev/d * 52 d/y * ABS_{dermal} * 10-6 kg/mg)/(70y*365 d/y)
CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-3.32
CANCER RISK SUMMARY
RECREATIONAL EXPOSURE LYMANSVILLE POND - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	CSFadm[3] mg/kg-d	GI ABS used in toxicity study[4]	CSFabs[5] mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
Benzo(a)Pyrene equivalents	1.6	Max	LPX-BK-2006	*		0.13	2.04E-08	4.92E-08	7.30E+00	1.00E+00	7.30E+00	2.38E-07	5.75E-07	8.13E-07
Total Aroclors	0.058	95% UCL-T	LPX-BK-2007	*		0.14	2.04E-08	5.30E-08	2.00E+00	1.00E+00	2.00E+00	2.36E-09	6.15E-09	8.51E-09
Dioxin TEQ	0.001	Max	LPX-BK-2007	0.5	[6]	0.03	1.02E-08	1.14E-08	1.50E+05	1.00E+00	1.50E+05	1.60E-06	1.79E-06	3.39E-06
Antimony	1.8	Max	LPX-BK-2006	*			2.04E-08			1.50E-01				
Arsenic	7	Max	LPX-BK-2006	1	[7]	0.03	2.04E-08	1.14E-08	1.50E+00	1.00E+00	1.50E+00	2.14E-07	1.19E-07	3.33E-07
Chromium	47.2	Max	LPX-BK-2006	*			2.04E-08			2.50E-02				
Manganese	167	Max	LPX-BK-2007	*			2.04E-08			4.00E-02				
														4.55E-06

Oral Exposure Factor = Ingestion Rate * Fraction Ingested * Exposure Frequency * Exposure Duration * ABS_{oral} * Conversion Factor / Body Weight * Averaging Time
= (100 mg-y/kg-d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 70 y * 365 d/y)

Dermal Exposure Factor = Exposed Surface Area * Soil Adherence Factor * Exposure Frequency * Exposure Duration * ABS_{dermal} * Conversion Factor / Body Weight * Averaging Time
= (4650 cm2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y *10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 70y * 365 d/y)

CSFabs = CSFadm / GI ABS used in toxicity study
Cancer Risk = EPC*Exposure Factor*CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.1
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 1
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	2.6	Max	CMS-456	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	4.2	Max	CMS-456	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.15E+00	2.26E+00	3.41E+00
Dioxin TEQ	0.002	Max	CMS-456	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	1.1	Max	CMS-456	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	1.51E-02		1.51E-02
Arsenic	3.1	Max	CMS-456	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	5.66E-02	2.38E-02	8.04E-02
Chromium	180	Max	CMS-456	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.29E-01		3.29E-01
Manganese	1700	Max	CMS-456	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	6.65E-02		6.65E-02
														3.90E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.2
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 2
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1	Max	RES-14-272-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.71	Max	RES-14-272-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.95E-01	3.81E-01	5.76E-01
Dioxin TEQ	0.00083	95% UCL-T	CMS-123	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	3.5	Max	RES-14-272-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	6.39E-02	2.68E-02	9.08E-02
Chromium	41.3	Max	RES-14-272-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	7.54E-02		7.54E-02
Manganese	386	Max	RES-14-302-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.51E-02		1.51E-02
														7.57E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.3
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 3
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	14	Max	RES-14-334-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.037	Max	RES-14-303-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.01E-02	1.99E-02	3.00E-02
Dioxin TEQ	0.0106	Max	RES-14-303-02	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	0.83	Max	CMS-159	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	1.14E-02		1.14E-02
Arsenic	12.1	Max	RES-14-333-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.21E-01	9.28E-02	3.14E-01
Chromium	212	Max	RES-14-303-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.87E-01		3.87E-01
Manganese	1250	Max	RES-14-333-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	4.89E-02		4.89E-02
														7.91E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.4
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 4
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	3.2	Max	RES-14-365-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.08	Max	RES-14-365-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	2.19E-02	4.30E-02	6.49E-02
Dioxin TEQ	0.000106	Max	RES-14-365-03	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	5.8	Max	RES-14-365-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.06E-01	4.45E-02	1.50E-01
Chromium	289	Max	RES-14-365-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	5.28E-01		5.28E-01
Manganese	115	Max	RES-14-365-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	4.50E-03		4.50E-03
														7.48E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.5
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 5
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	11	Max	RES-14-366-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	1.5	Max	RES-14-398-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	4.11E-01	8.05E-01	1.22E+00
Dioxin TEQ	0.00545	Max	RES-14-366-02	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	7.5	Max	RES-14-398-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.37E-01	5.75E-02	1.95E-01
Chromium	75.5	Max	RES-14-398-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	1.38E-01		1.38E-01
Manganese	391	Max	RES-14-366-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.53E-02		1.53E-02
														1.56E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.6
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 6
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	4.9	Max	RES-14-399-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.52	Max	RES-14-399-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.42E-01	2.79E-01	4.22E-01
Dioxin TEQ	0.0099	Max	CMS-193	0.5	6	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	4.4	Max	RES-14-399-01	1	7	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	8.04E-02	3.38E-02	1.14E-01
Chromium	50.7	Max	RES-14-399-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	9.26E-02		9.26E-02
Manganese	349	Max	RES-14-399-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.37E-02		1.37E-02
														6.42E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time

= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study

HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.

2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.

3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.

4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.

6 Personal communication with A. Burke.

7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.

* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-4.7
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 7
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.8	Max	CMS-418	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	4.7	Max	RES-14-419-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.29E+00	2.52E+00	3.81E+00
Dioxin TEQ	0.0133	Max	CMS-205	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	13.7	Max	RES-14-419-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	1.88E-01		1.88E-01
Arsenic	12.5	Max	RES-14-419-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.28E-01	9.59E-02	3.24E-01
Chromium	308	Max	RES-14-419-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	5.63E-01		5.63E-01
Manganese	176	Max	RES-14-419-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	6.89E-03		6.89E-03
														4.89E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.8
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 8
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.99	Max	RES-14-422-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.57	Max	RES-14-425-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.56E-01	3.06E-01	4.62E-01
Dioxin TEQ	0.00195	Max	RES-14-425-01	0.5	6	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	3.4	Max	RES-14-425-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	4.66E-02		4.66E-02
Arsenic	8	Max	RES-14-425-01	1	7	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.46E-01	6.14E-02	2.07E-01
Chromium	129	Max	RES-14-425-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	2.36E-01		2.36E-01
Manganese	641	Max	RES-14-425-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	2.51E-02		2.51E-02
														9.77E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time

= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.9
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 9
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.1	Max	RES-14-430-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	1.4	Max	CMS-600	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	3.84E-01	7.52E-01	1.14E+00
Dioxin TEQ	0.00087	Max	CMS-600	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	6.3	Max	APB-FP-2028	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	8.63E-02		8.63E-02
Arsenic	8.7	Max	APB-FP-2028	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.59E-01	6.67E-02	2.26E-01
Chromium	329	Max	APB-FP-2028	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	6.01E-01		6.01E-01
Manganese	408	Max	APB-FP-2028	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.60E-02		1.60E-02
														2.06E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.10
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 10
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	2.5	Max	RES-14-449-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	4.6	Max	RES-14-448-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.26E+00	2.47E+00	3.73E+00
Dioxin TEQ	0.058	Max	RES-14-449-03	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	12.3	Max	RES-14-449-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	1.68E-01		1.68E-01
Arsenic	14.7	Max	RES-14-449-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.68E-01	1.13E-01	3.81E-01
Chromium	536	Max	RES-14-449-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	9.79E-01		9.79E-01
Manganese	325	Max	RES-14-449-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.27E-02		1.27E-02
														5.27E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.11
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 11
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	5.7	Max	RES-12-239-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	1.5	Max	APB-FP-2033	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	4.11E-01	8.05E-01	1.22E+00
Dioxin TEQ	0.045	Max	CMS-487	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	4.4	Max	RES-12-240-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	6.03E-02		6.03E-02
Arsenic	9.4	Max	APB-FP-2033	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.72E-01	7.21E-02	2.44E-01
Chromium	202	Max	RES-12-240-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.69E-01		3.69E-01
Manganese	373	Max	APB-FP-2033	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.46E-02		1.46E-02
														1.90E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.12
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 12
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.6	Max	RES-12-551-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	4.3	Max	RES-12-551-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.18E+00	2.31E+00	3.49E+00
Dioxin TEQ	0.028	Max	CMS-470	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	7.1	Max	RES-12-551-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	9.73E-02		9.73E-02
Arsenic	11.6	Max	RES-12-551-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.12E-01	8.90E-02	3.01E-01
Chromium	381	Max	RES-12-551-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	6.96E-01		6.96E-01
Manganese	260	Max	RES-12-550-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.02E-02		1.02E-02
														4.59E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.13
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 13
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.96	Max	RES-12-553-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.49	Max	RES-12-553-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.34E-01	2.63E-01	3.97E-01
Dioxin TEQ	0.016	Max	CMS-489	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	4	Max	RES-12-552-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	7.31E-02	3.07E-02	1.04E-01
Chromium	168	Max	RES-12-552-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.07E-01		3.07E-01
Manganese	174	Max	RES-12-552-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	6.81E-03		6.81E-03
														8.15E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.14
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 14
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.1	Max	RES-12-555-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	4.1	Max	RES-12-555-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.12E+00	2.20E+00	3.32E+00
Dioxin TEQ	0.009	Max	CMS-477	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	13.1	Max	RES-12-555-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.39E-01	1.00E-01	3.40E-01
Chromium	226	Max	RES-12-555-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	4.13E-01		4.13E-01
Manganese	337	Max	RES-12-555-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.32E-02		1.32E-02
														4.09E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.15
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 15
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	5	Max	RES-12-556-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	nd			*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05			
Dioxin TEQ	4E-05	Max	RES-12-556-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	3.1	Max	RES-12-556-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	4.25E-02		4.25E-02
Arsenic	9.3	Max	RES-12-556-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.70E-01	7.13E-02	2.41E-01
Chromium	18	Max	RES-12-556-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.29E-02		3.29E-02
Manganese	373	Max	RES-12-556-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.46E-02		1.46E-02
														3.31E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.16
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 16
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	2.4	Max	RES-11-012-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.15	Max	RES-11-012-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	4.11E-02	8.05E-02	1.22E-01
Dioxin TEQ	0.0000137	Max	RES-11-012-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	2.5	Max	RES-11-012-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	3.42E-02		3.42E-02
Arsenic	7.8	Max	RES-11-012-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.42E-01	5.98E-02	2.02E-01
Chromium	25.7	Max	RES-11-012-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	4.69E-02		4.69E-02
Manganese	425	Max	RES-11-012-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.66E-02		1.66E-02
														4.22E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.17
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 17
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.58	Max	RES-11-419-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	NE			*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05			
Dioxin TEQ	0.0006	Max	RES-11-419-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	3.5	Max	RES-11-419-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	6.39E-02	2.68E-02	9.08E-02
Chromium	29.1	Max	RES-11-419-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	5.32E-02		5.32E-02
Manganese	388	Max	RES-11-419-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.52E-02		1.52E-02
														1.59E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected
NE Not Evaluated

TABLE B-4.18
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 18
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.17	Max	RES-11-420-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.058	Max	SD-17	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.59E-02	3.11E-02	4.70E-02
Dioxin TEQ	0.00062	Max	SD-17	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	6.7	Max	RES-11-420-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.22E-01	5.14E-02	1.74E-01
Chromium	20.6	Max	RES-11-422-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.76E-02		3.76E-02
Manganese	369	Max	RES-11-422-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.44E-02		1.44E-02
														2.73E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.19
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 19
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	170	Max	RES-11-424-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.051	Max	RES-11-425-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	1.40E-02	2.74E-02	4.14E-02
Dioxin TEQ	0.0015	Max	RES-11-425-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	7.1	Max	RES-11-424-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	9.73E-02		9.73E-02
Arsenic	2.9	Max	RES-11-424-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	5.30E-02	2.22E-02	7.52E-02
Chromium	7.5	Max	RES-11-424-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	1.37E-02		1.37E-02
Manganese	144	Max	RES-11-426-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	5.64E-03		5.64E-03
														2.33E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.20
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 20
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.53	Max	RES-11-428-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.18	Max	RES-11-428-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	4.93E-02	9.67E-02	1.46E-01
Dioxin TEQ	0.00012	Max	SD-13	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	1.6	Max	RES-11-428-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	2.19E-02		2.19E-02
Arsenic	8.7	Max	RES-11-429-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.59E-01	6.67E-02	2.26E-01
Chromium	10.9	Max	RES-11-428-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	1.99E-02		1.99E-02
Manganese	176	Max	RES-11-428-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	6.89E-03		6.89E-03
														4.20E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.21
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 21
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.91	Max	RES-11-433-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	nd			*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05			
Dioxin TEQ	0.00117	Max	RES-11-433-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	17	Max	RES-11-433-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	2.33E-01		2.33E-01
Arsenic	9.6	Max	RES-11-433-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.75E-01	7.36E-02	2.49E-01
Chromium	275	Max	RES-11-433-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	5.02E-01		5.02E-01
Manganese	486	Max	RES-11-433-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.90E-02		1.90E-02
														1.00E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time

= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study

HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.

2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.

3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.

4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.

6 Personal communication with A. Burke.

7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.

* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-4.22
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 22
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1	Max	RES-11-486-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.2	Max	RES-11-328-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	5.48E-02	1.07E-01	1.62E-01
Dioxin TEQ	0.000388	Max	RES-11-328-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	5.8	Max	RES-11-486-02	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	7.95E-02		7.95E-02
Arsenic	6.5	Max	RES-11-486-02	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.19E-01	4.99E-02	1.69E-01
Chromium	404	Max	RES-11-486-02	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	7.38E-01		7.38E-01
Manganese	314	Max	RES-11-486-02	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.23E-02		1.23E-02
														1.16E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.23
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 23
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.051	Max	RES-11-396-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.35	Max	RES-11-396-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	9.59E-02	1.88E-01	2.84E-01
Dioxin TEQ	0.00111	Max	RES-11-396-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	1.8	Max	RES-11-396-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	2.47E-02		2.47E-02
Arsenic	5.3	Max	RES-11-396-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	9.68E-02	4.07E-02	1.37E-01
Chromium	79.4	Max	RES-11-396-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	1.45E-01		1.45E-01
Manganese	358	Max	RES-11-396-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.40E-02		1.40E-02
														6.05E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.24
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 24
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.024	Max	RES-11-577-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.086	Max	RES-11-577-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	2.36E-02	4.62E-02	6.97E-02
Dioxin TEQ	0.000418	Max	RES-11-577-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	5.1	Max	RES-11-577-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	9.32E-02	3.91E-02	1.32E-01
Chromium	24.3	Max	RES-11-577-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	4.44E-02		4.44E-02
Manganese	965	Max	RES-11-577-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	3.78E-02		3.78E-02
														2.84E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time

= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study

HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.

2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.

3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.

4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.

6 Personal communication with A. Burke.

7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.

* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

nd Not Detected

TABLE B-4.25
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 25
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.14	Max	RES-10-004-01, SD-11	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	nd			*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05			
Dioxin TEQ	0.000271	Max	SD-11	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	nd			*			5.48E-06		4.00E-04	1.50E-01	6.00E-05			
Arsenic	9.1	Max	RES-10-004-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.66E-01	6.98E-02	2.36E-01
Chromium	18.9	Max	RES-10-005-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	3.45E-02		3.45E-02
Manganese	217	Max	RES-10-005-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	8.49E-03		8.49E-03
														2.79E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.26
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 26
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	0.58	Max	RES-10-604-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.073	Max	RES-10-604-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	2.00E-02	3.92E-02	5.92E-02
Dioxin TEQ	0.000365	Max	RES-10-042-01	0.5	6	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	38.2	Max	RES-10-042-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	5.23E-01		5.23E-01
Arsenic	55.6	Max	RES-10-042-01	1	7	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	1.02E+00	4.27E-01	1.44E+00
Chromium	52.6	Max	RES-10-042-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	9.61E-02		9.61E-02
Manganese	695	Max	RES-10-042-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	2.72E-02		2.72E-02
														2.15E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.27
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 27
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.6	Max	LPX-BK-2006	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	0.24	Max	RES-10-044-01	*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05	6.58E-02	1.29E-01	1.95E-01
Dioxin TEQ	0.000888	Max	LPX-BK-2006	0.5	6	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	5.2	Max	RES-10-044-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	7.12E-02		7.12E-02
Arsenic	14.8	Max	RES-10-044-01	1	7	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	2.70E-01	1.14E-01	3.84E-01
Chromium	52.6	Max	RES-10-044-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	9.61E-02		9.61E-02
Manganese	179	Max	RES-10-044-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	7.01E-03		7.01E-03
														7.53E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.28
NONCANCER RISK SUMMARY
RESIDENTIAL EXPOSURE POINT 28
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	30	Max	RES-10-075-01	*		0.13	5.48E-06	9.97E-06		1.00E+00				
Aroclor 1254	nd			*		0.14	5.48E-06	1.07E-05	2.00E-05	1.00E+00	2.00E-05			
Dioxin TEQ	0.0000864	95%UCL-T	RES-10-076-01	0.5	[6]	0.03	2.74E-06	2.30E-06		1.00E+00				
Antimony	3.2	Max	RES-10-075-01	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	4.38E-02		4.38E-02
Arsenic	32.8	Max	RES-10-075-01	1	[7]	0.03	5.48E-06	2.30E-06	3.00E-04	1.00E+00	3.00E-04	5.99E-01	2.52E-01	8.51E-01
Chromium	115	Max	RES-10-076-01	*			5.48E-06		3.00E-03	2.50E-02	7.50E-05	2.10E-01		2.10E-01
Manganese	2880	Max	RES-10-076-01	*			5.48E-06		1.40E-01	4.00E-02	5.60E-03	1.13E-01		1.13E-01
														1.22E+00

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y* ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time

= (2800 cm^2*1 mg/cm^2-ev * 1 ev/d * 150 d/y * 6 y* ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y*365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.
nd Not Detected

TABLE B-4.29
NONCANCER RISK SUMMARY
RECREATIONAL EXPOSURE NORTH OF ALLENDALE - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	11	Max	RES-14-366-01	*		0.13	1.42E-07	3.44E-07		1.00E+00				
Aroclor 1254	0.84	Max	CMS-192	*		0.14	1.42E-07	3.71E-07	2.00E-05	1.00E+00	2.00E-05	5.98E-03	1.56E-02	2.16E-02
Dioxin TEQ	0.026	95% UCL-T	CMS-022	0.5	6	0.03	7.12E-08	7.95E-08		1.00E+00				
Antimony	4.1	Max	CMS-192	*			1.42E-07		4.00E-04	1.50E-01	6.00E-05	1.46E-03		1.46E-03
Arsenic	18	Max	CMS-192	1	7	0.03	1.42E-07	7.95E-08	3.00E-04	1.00E+00	3.00E-04	8.55E-03	4.77E-03	1.33E-02
Chromium	472	Max	CMS-192	*			1.42E-07		3.00E-03	2.50E-02	7.50E-05	2.24E-02		2.24E-02
Manganese	391	Max	RES-14-366-01	*			1.42E-07		1.40E-01	4.00E-02	5.60E-03	3.98E-04		3.98E-04
														5.92E-02

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (100 mg/d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (4650 cm^2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y * 10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.30
NONCANCER RISK SUMMARY
RECREATIONAL EXPOSURE ALLENDALE POND - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	5.3	Max	APB-BK-2003	*		0.13	1.42E-07	3.44E-07		1.00E+00				
Aroclor 1254	4	95% UCL-T	CMS-616	*		0.14	1.42E-07	3.71E-07	2.00E-05	1.00E+00	2.00E-05	2.85E-02	7.42E-02	1.03E-01
Dioxin TEQ	0.069	95% UCL-T	CMS-024	0.5	[6]	0.03	7.12E-08	7.95E-08		1.00E+00				
Antimony	6.3	Max	APB-FP-2028	*			1.42E-07		4.00E-04	1.50E-01	6.00E-05	2.24E-03		2.24E-03
Arsenic	7.2	95% UCL-N	APB-BK-2003	1	[7]	0.03	1.42E-07	7.95E-08	3.00E-04	1.00E+00	3.00E-04	3.42E-03	1.91E-03	5.33E-03
Chromium	175	95% UCL-N	APB-FP-2028	*			1.42E-07		3.00E-03	2.50E-02	7.50E-05	8.31E-03		8.31E-03
Manganese	497	95% UCL-T	APB-FP-2030	*			1.42E-07		1.40E-01	4.00E-02	5.60E-03	5.06E-04		5.06E-04
														1.19E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (100 mg/d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (4650 cm^2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y * 10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.31
NONCANCER RISK SUMMARY
RECREATIONAL EXPOSURE LYMANSVILLE REACH AREA - 0-6 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	3.9	95% UCL-T	WRL-SD-2042	*		0.13	9.50E-07	3.46E-06		1.00E+00				
Aroclor 1254	1.3	95% UCL-T	LPX-SD-2046	*		0.14	9.50E-07	3.72E-06	2.00E-05	1.00E+00	2.00E-05	6.17E-02	2.42E-01	3.04E-01
Dioxin TEQ	0.008	Max	SD-18	0.5	[6]	0.03	4.75E-07	7.98E-07		1.00E+00				
Antimony	3.1	95% UCL-T	LPX-SD-2046	*			9.50E-07		4.00E-04	1.50E-01	6.00E-05	7.36E-03		7.36E-03
Arsenic	5.7	95% UCL-T	LPX-SD-2046	1	[7]	0.03	9.50E-07	7.98E-07	3.00E-04	1.00E+00	3.00E-04	1.80E-02	1.52E-02	3.32E-02
Chromium	187	Max	LPX-SD-2046	*			9.50E-07		3.00E-03	2.50E-02	7.50E-05	5.92E-02		5.92E-02
Manganese	518	95% UCL-T	WRL-BK-2004	*			9.50E-07		1.40E-01	4.00E-02	5.60E-03	3.51E-03		3.51E-03
														4.07E-01

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (200 mg/d * 0.5 * 52 d/y * 6 y * ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (2800 cm^2 * 1 mg/cm^2-ev * 1 ev/d * 52 d/y * 6 y * ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-4.32
NONCANCER RISK SUMMARY
RECREATIONAL EXPOSURE LYMANSVILLE POND - 9-18 YEARS OLD
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS[1]	Source	Dermal ABS[1,2]	Oral Exposure Factor d^{-1}	Dermal Exposure Factor d^{-1}	RfDadm[3] mg/kg-d	GI ABS used in toxicity study[4]	RfDabs[5] mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
Benzo(a)Pyrene equivalents	1.6	Max	LPX-BK-2006	*		0.13	1.42E-07	3.44E-07		1.00E+00				
Aroclor 1254	0.042	95% UCL-T	LPX-BK-2007	*		0.14	1.42E-07	3.71E-07	2.00E-05	1.00E+00	2.00E-05	2.99E-04	7.79E-04	1.08E-03
Dioxin TEQ	0.001	Max	LPX-BK-2007	0.5	[6]	0.03	7.12E-08	7.95E-08		1.00E+00				
Antimony	1.8	Max	LPX-BK-2006	*			1.42E-07		4.00E-04	1.50E-01	6.00E-05	6.41E-04		6.41E-04
Arsenic	7	Max	LPX-BK-2006	1	[7]	0.03	1.42E-07	7.95E-08	3.00E-04	1.00E+00	3.00E-04	3.32E-03	1.85E-03	5.18E-03
Chromium	47.2	Max	LPX-BK-2006	*			1.42E-07		3.00E-03	2.50E-02	7.50E-05	2.24E-03		2.24E-03
Manganese	167	Max	LPX-BK-2007	*			1.42E-07		1.40E-01	4.00E-02	5.60E-03	1.70E-04		1.70E-04
														9.31E-03

Oral Exposure Factor = Ingestion Rate *Fraction Ingested* Exposure Frequency*Exposure Duration*ABS_{oral}*Conversion Factor/BW*Averaging Time
= (100 mg/d * 0.5 * 52 d/y * 10 y * ABS_{oral} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

Dermal Exposure Factor = Surface Area*Soil-to-skin Adherence Factor * Exposure Frequency*Exposure Duration*ABS_{dermal}*Conversion Factor/BW*Averaging Time
= (4650 cm^2 * 0.2 mg/cm^2-ev * 1 ev/d * 52 d/y * 10 y * ABS_{dermal} * 10-6 kg/mg)/(50 kg * 10 y * 365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study
HI = EPC*Exposure Factor/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.
2 Table 3.4 US EPA, 1998 Dermal Risk Assessment Guidance.
3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.
4 Table 4.1 US EPA, 1998 Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.
5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.
6 Personal communication with A. Burke.
7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.
* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

TABLE B-5.1
TOXICITY EQUIVALENCY FACTORS FOR DIOXIN CONGENERS
ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE RHODE ISLAND

1	DIOXI	2,3,7,8-TCDD	1746016	1		
2	DIOXI	1,2,3,7,8-PECDD	40321764	1	7/23/99	updated from 0.5 to 1.0 on 7/23/99 per WHO
3	DIOXI	1,2,3,4,7,8-HXCDD	39227286	0.1		
4	DIOXI	1,2,3,6,7,8-HXCDD	57653857	0.1		
5	DIOXI	1,2,3,7,8,9-HXCDD	19408743	0.1		
6	DIOXI	1,2,3,4,6,7,8-HPCDD	35822469	0.01		
7	DIOXI	OCDD	3268879	0.0001	7/23/99	updated from 0.001 to 0.0001 on 7/23/99 per WHO
8	DIOXI	2,3,7,8-TCDF	51207319	0.1		
9	DIOXI	1,2,3,7,8-PECDF	57117416	0.05		
10	DIOXI	2,3,4,7,8-PECDF	57117314	0.5		
11	DIOXI	1,2,3,4,7,8-HXCDF	70648269	0.1		
12	DIOXI	1,2,3,6,7,8-HXCDF	57117449	0.1		
13	DIOXI	1,2,3,7,8,9-HXCDF	72918219	0.1		
14	DIOXI	2,3,4,6,7,8-HXCDF	60851345	0.1		
15	DIOXI	1,2,3,4,6,7,8-HPCDF	67562394	0.01		
16	DIOXI	1,2,3,4,7,8,9-HPCDF	55673897	0.01		
17	DIOXI	OCDF	39001020	0.0001	7/23/99	updated from 0.001 to 0.0001 on 7/23/99 per WHO

TABLE B-5.2
ESTIMATED ORDERS OF POTENTIAL POTENCY FOR CARCINOGENIC PAHs[1]
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Chemical	Weight-of-Evidence	Order of Potential Potency
Benzo(a)anthracene	B2	0.1
Benzo(b)fluoranthene	B2	0.1
Benzo(k)fluoranthene	B2	0.01
Benzo(a)pyrene	B2	1.0
Chrysene	B2	0.001
Dibenzo(a,h)anthracene	B2	1.0
Indeno(1,2,3-cd)pyrene	B2	0.1

1 USEPA Region I, 1994.

TABLE B-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Area	High Lead (1)	Scenario/Receptor	Media CR>1E-04 or HI>1	Total Cancer Risks	Major contributors to cancer risk above 1E-04 (individual cancer risk>1E-06)	Total Noncancer Risks	Total HI by Organ and Major contributors to noncancer RME risk (HI>1.0)
Recreational Area North of Allendale Pond Surface soils, Flood Plain Sediments, Bank Sediments	YES	Current/Future Adolescent Recreational User	NO	8.93E-05	NA	0.0592	NA
Allendale Pond Recreational Area Flood Plain Sediments, Bank Sediments	YES	Current/Future Adolescent Recreational User	YES	2.25E-04	Dioxin TEQ, PAHs	0.119	NA
Lymansville Pond Recreational Area Flood Plain Sediments, Bank Sediments	NO	Current/Future Adolescent Recreational User	NO	4.55E-06	NA	0.00931	NA
Lymansville Reach Recreational Area Flood Plain Sediments, Bank Sediments	YES	Current/Future 0-18 year old Recreational User	YES	1.78E-04	Dioxin TEQ, PAHs, Arsenic, Total aroclors	0.407	NA
Residential Exposure Point 1 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	2.55E-04	Dioxin TEQ, PAHs, Total aroclors, Arsenic	3.9	Immune System -3.41 - Aroclor 1254
Residential Exposure Point 2 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	NO	9.57E-05	NA	0.757	NA
Residential Exposure Point 3 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	1.34E-03	Dioxin TEQ, PAHs, Total aroclors, Arsenic	0.791	NA
Residential Exposure Point 4 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	NO	6.06E-05	NA	0.748	NA
Residential Exposure Point 5 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	6.54E-04	Dioxin TEQ, PAHs, Arsenic, Total aroclors	1.56	Immune System -1.22 - Aroclor 1254
Residential Exposure Point 6 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	YES	9.65E-04	Dioxin TEQ, PAHs, Arsenic, Total aroclors	0.642	NA
Residential Exposure Point 7 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	1.26E-03	Dioxin TEQ, PAHs, Total aroclors, Arsenic	4.89	Immune System -3.81 - Aroclor 1254
Residential Exposure Point 8 Surface soils	NO	Current/Future Lifetime Resident	YES	2.02E-04	Dioxin TEQ, PAHs, Arsenic, Total aroclors	0.977	NA
Residential Exposure Point 9 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	1.11E-04	Dioxin TEQ, PAHs, Arsenic, Total aroclors	2.06	Immune System -1.14 - Aroclor 1254
Residential Exposure Point 10 Surface soils	YES	Current/Future Lifetime Resident	YES	5.27E-03	Dioxin TEQ, PAHs, Arsenic, Total aroclors	5.27	Immune System -3.73 - Aroclor 1254
Residential Exposure Point 11 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	4.16E-03	Dioxin TEQ, PAHs, Arsenic, Total aroclors	1.9	Immune System -1.22 - Aroclor 1254
Residential Exposure Point 12 Surface soils	NO	Current/Future Lifetime Resident	YES	2.57E-03	Dioxin TEQ, PAHs, Total aroclors, Arsenic	4.59	Immune System -3.49 - Aroclor 1254
Residential Exposure Point 13 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	YES	1.50E-03	Dioxin TEQ, PAHs, Arsenic, Total aroclors	0.815	NA

TABLE B-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS
DRAFT ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

Area	High Lead (1)	Scenario/Receptor	Media CR>1E-04 or HI>1	Total Cancer Risks	Major contributors to cancer risk above 1E-04 (individual cancer risk>1E-06)	Total Noncancer Risks	Total HI by Organ and Major contributors to noncancer RME risk (HI>1.0)
Residential Exposure Point 14 Surface soils	YES	Current/Future Lifetime Resident	YES	8.47E-04	Dioxin TEQ, Arsenic, Total aroclors, PAHs	4.09	Immune System -3.32 - Aroclor 1254
Residential Exposure Point 15 Surface soils	YES	Current/Future Lifetime Resident	NO	8.31E-05	NA	0.331	NA
Residential Exposure Point 16 Surface soils	YES	Current/Future Lifetime Resident	NO	4.47E-05	NA	0.422	NA
Residential Exposure Point 17 Surface soils	NO	Current/Future Lifetime Resident	NO	6.63E-05		0.159	NA
Residential Exposure Point 18 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	NO	6.78E-05	NA	0.273	NA
Residential Exposure Point 19 Surface soils, Flood Plain Sediments	YES	Current/Future Lifetime Resident	YES	2.40E-03	PAHs, Dioxin TEQ, Arsenic	0.233	NA
Residential Exposure Point 20 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	NO	3.06E-05	NA	0.42	NA
Residential Exposure Point 21 Surface soils	NO	Current/Future Lifetime Resident	YES	1.31E-04	Dioxin TEQ, Arsenic, PAHs	1	NA
Residential Exposure Point 22 Surface soils	YES	Current/Future Lifetime Resident	NO	5.87E-05	NA	1.16	NA
Residential Exposure Point 23 Surface soils	YES	Current/Future Lifetime Resident	YES	1.09E-04	Dioxin TEQ, Arsenic, Total aroclors	0.605	NA
Residential Exposure Point 24 Surface soils	NO	Current/Future Lifetime Resident	NO	4.55E-05	NA	0.284	NA
Residential Exposure Point 25 Surface soils, Flood Plain Sediments	NO	Current/Future Lifetime Resident	NO	3.91E-05	NA	0.279	NA
Residential Exposure Point 26 Surface soils	NO	Current/Future Lifetime Resident	YES	1.19E-04	Arsenic, Dioxin TEQ, PAHs	2.15	Skin - 1.44 - Arsenic
Residential Exposure Point 27 Surface soils, Bank Sediments	YES	Current/Future Lifetime Resident	YES	1.24E-04	Dioxin TEQ, PAHs, Arsenic	0.753	NA
Residential Exposure Point 28 Surface soils	YES	Current/Future Lifetime Resident	YES	4.53E-04	PAHs, Arsenic, Dioxin TEQ	1.22	NA

Notes:

(1) Maximum Lead > 400mg/kg
NA- Not Applicable

APPENDIX B ADDENDUM TABLE
LIST OF COLOCATED SAMPLES

Sample Collected Fall 1999	Co- Located Sample Collected Summer 1999
RES-14-272-01	CMS-223
RES-14-334-01	CMS-483A
RES-14-365-01	CMS-179
RES-14-366-01	CMS-185
RES-14-366-02	CMS-185
RES-14-398-01	CMS-221
RES-14-399-01	CMS-472A
RES-14-419-01	CMS-461
RES-14-430-01	CMS-464
RES-14-448-01	CMS-467
RES-12-239-01	CMS-485
RES-12-550-01	CMS-471
RES-12-551-01	CMS-494
RES-12-552-01	CMS-490
RES-12-553-01	CMS-493
RES-12-554-01	CMS-471

Note: Samples collected in the fall of 1999 which were believed to be co-located with samples previously collected and analyzed for dioxin were not resampled for those analytes. Therefore, these co-located samples do not appear on the maps depicting dioxin contamination.

APPENDIX C

STREAMLINED ECOLOGICAL RISK ASSESSMENT

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STREAMLINED ECOLOGICAL RISK EVALUATION

1.0 Project Scope

This report presents the Streamlined Ecological Risk Evaluation for the Centredale Manor Restoration Project Site. The evaluation was performed as a Screening-Level Ecological Risk Assessment (SERA), in order to satisfy the needs of the project and to comply with Region I USEPA Guidance. The goal of the evaluation and the SERA is to conduct an initial screening of the analytical data using very conservative screening values and assumptions for two purposes. The first is to determine if "hot spots" of contaminants exist at the site whose concentrations merit removal under a Non-Time Critical Removal Action (NTCRA). The second is to determine which contaminants do not need to be further evaluated as part of a Baseline Ecological Risk Assessment (BERA). A phased approach to the evaluation was used, that relied on environmental chemistry data and field observations from the preliminary assessments. Biological sampling or testing may be conducted if further work is needed.

The SERA provides the first two of eight steps required by the Environmental Protection Agency (USEPA) guidance (USEPA, 1997a and 1998a). Figure C-1 presents the Ecological Risk Assessment Tiered Approach. The first two steps consist of the screening-level assessment. Steps 3 through 7 are conducted if additional evaluations or investigations are necessary based on the results of the first two steps. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with the Region 1 Biological Technical Assistance Group (BTAG).

1.2 Ecological Risk Assessment Approach

The first phase in the ERA process is the screening-level risk assessment. In this phase, conservative exposure estimates are made for grouped or individual ecological receptors, and these exposures are compared to screening-levels and threshold toxicity values. The following general steps were followed for the SERA:

- Problem formulation
- Exposure Assessment
- Ecological Effects Assessment
- Risk Characterization

The process, described in detail below, follows the ERA approach in USEPA guidance (USEPA, 1997a and 1998a), which is the basis for the ERA methodology.

2.0 Problem Formulation

Problem formulation is the first phase of a SERA and discusses the goals, breadth, and focus of the assessment. It includes general descriptions of the site with emphasis on the habitats and ecological receptors present. This phase also involves characterization of site contaminants, contaminant sources, migration routes, and an evaluation of routes of contaminant exposure. Assessment and measurement endpoints that will be evaluated are also selected. Finally, a conceptual model is developed that describes how contaminants associated with the site may come into contact with ecological receptors. The following sections provide more detailed descriptions of the steps involved in problem formulation.

2.1 Site Characterization

The objectives of this step are to initially identify and characterize the habitats and ecological resources on and around the site, and to describe the nature and extent of chemical contamination associated with the site. The site characterization also describes likely contaminant sources, release mechanisms, and migration pathways, and the fate of chemicals resulting from site-related activities, as well as ecological resources that could be adversely affected by these chemicals.

2.1.1 Regional Setting

The site includes an expanded area within and adjacent to the Woonasquatucket River where site contamination potentially has migrated from the site. This is composed of a

1.4-mile section of the Woonasquatucket River between Smith Street (Route 44) and the Lymansville Dam.

The area surrounding the site is comprised of residential, commercial, and light industrial properties. Generally, residential and commercial properties abut the eastern boundary of the site and the Woonasquatucket River (North Providence, Rhode Island) while light industrial and commercial properties abut the western river boundary in Johnston, Rhode Island.

2.1.2 Vegetative Cover types

On March 30 and 31, 2000, Tetra Tech NUS mapped vegetative cover types present within the site. Figure 1, presented in Attachment 1 to this SERE, presents habitat types and land use in and surrounding the site. Land use information for the surrounding area was incorporated into the figure from the Rhode Island RIGIS database.

The habitat types dispersed throughout and adjacent to the site are characteristic of fragmented, disturbed and developed landscapes in the New England region. Parking lots, roadways, lawn areas, and two high rise buildings cover the majority of the Centredale Manor and Brook Village Properties. The Woonasquatucket River flows south along the western boundary of the property and a small, intermittent stream forms the eastern boundary of the property and flows south through a wetland area located south of the property. An abandoned railway line borders and runs parallel to the western bank of the Woonasquatucket River. The area surrounding the property and the remainder of the site consists of dense residential and commercial/light industrial properties with minimal habitat values.

Flora features of the small stream that forms the eastern border of the property include red maple (*Acer rubrum*), red oak (*Qercus rubra*), and Norway maple (*Acer platanoides*) canopy. The stream bank understory has areas comprised of common reed (*Phragmites australis*) and speckled alder (*Alnus rugosa*). Portions of the channel have areas of persistent emergent vegetation represented by water willow (*Decodon verticillatus*) and purple loosestrife (*Lythrum salicaria*). Most of the remaining areas of the channel have a sand and gravel bottom and are not vegetated.

The Woonasquatucket River, which forms the property's western border, has a narrow strip of tree/shrub cover along the river bank which is comprised of red oak, red maple, black cherry (*Prunus serotina*), gray birch (*Betula populifolia*), sweet pepperbush (*Clethra alnifolia*), poison ivy (*Toxicodendron radicans*), and specked alder.

Wetland Flora Features

The wetland areas south of the property to the Allendale Dam are comprised of a palustrine wetland and open water habitat complex situated between residential properties to the east and commercial/light industrial properties along the west side of the river. The Allendale Pond dam had a partial breach in 1991, which apparently lowered the water level in Allendale Pond by an estimated 4 to 7 feet. It appears that as a result of the dam breach, the ponds open water habitat has decreased while the emergent and meadow wetland habitat area has increased.

Flora features in this wetland area have a small forested/scrub-shrub/emergent wetland dominated by red maple and red oak. Scrub/shrub flora consists of speckled alder, red maple, sweet pepperbush, meadowsweet (*Spirea latifolia*), and gray birch. Persistent emergent vegetation includes common reed, tussock sedge (*Carex stricta*), purple loosestrife, cattail (*Typha latifolia*), Canada rush (*Juncus canadensis*) and unidentified wetland grasses. Gray birch, an early successional woody species, is colonizing some of the dryer areas and the historic pond fringes in this area.

A relatively large wetland/upland complex is located south of the Allendale Dam and north of the open water of Lymansville Pond (Figure 1, Attachment 1). The forested area includes mixed upland and wetland areas with indications of past disturbances. It appears that excavations and filling have occurred throughout much of the northern portion of this area. Short trails, a tree stand, and small campfire remains indicate human use of the area. Red maple, red oak, quaking aspen (*Populus tremuloidies*), black cherry, and gray birch are typical overstory species. Most of the forested area has a sparse understory however a dense scrub/shrub thicket is present along the southern and western fringes of the wetland.

The scrub/shrub area of this wetland/upland complex is comprised of speckled alder, *Viburnum spp.*, blueberry (*Vaccinium corymbosum*) and red maple. The river channel in this area becomes impassable by small boat or canoe where it meanders and threads through the dense shrub and emergent vegetation. Water willow and purple loosestrife dominate the persistent emergent vegetation in this area. The vegetation and water also makes it extremely difficult to pass on foot. Because of the difficulty in moving through the dense vegetation and deep water, the vegetation and wetland identification in this portion of the river system must be considered an estimate of wetland size and class. This wetland/upland complex, due primarily to its isolation and difficult access appears to provide relatively good habitat for a variety of small mammals, birds, and reptiles.

Other Areas

Upstream of the site (north of Smith Street), the Woonasquatucket River and associated wetlands were included during this habitat study. A red maple canopy and sparse understory of speckled alder dominate the forested river floodplain north of Smith Street. Small areas of palustrine emergent wetland bordering the river channel were typically comprised of reed canary grass (*Phalaris arundinacea*), water willow, purple loosestrife, and blue vervain (*Verbena hastata*).

A canopy of red maple and red oak with a sparse understory of speckled alder dominates the palustrine forested wetland south of the Lymansville Dam. This area only received a cursory review during the habitat reconnaissance since it was outside the study area.

2.1.3 Wildlife Habitat

As previously described, the Centredale Manor and Brook Village Properties and the area surrounding the immediate river corridor provide minimal habitat for wildlife. However, the remainder of the site including river corridor and the larger wetland/upland areas located in this corridor do provide habitat for a variety of small mammals, birds, reptiles, and amphibians. Table C-1.1 and Attachment 2 provides wildlife information from a survey conducted within the study area by the Rhode Island Department of Environmental Management Division of Fish and Wildlife. In addition, a fish survey

report provided by the Fish and Wildlife Division provides a survey of fish species in the Woonasquatucket River in the vicinity of the study area (unknown reference source and date).

Table C-1.1 provides a list of wildlife observations, including visual sightings, sign, made by TtNUS, USEPA, and RIDEM Fish and Wildlife Service. These observations were recorded during the period of March through the spring of 2000 during periodic site visits. Also included in the lists are sightings reported to USEPA personnel by reputable public person(s).

River Upstream of Centredale Manor Property

At the furthest upstream location (RCC-BK-3001), the stream was approximately 30 feet wide. It was wooded on the west bank and residential on the east bank. The water was approximately 1 to 2 feet deep, and was very sandy with gravel.

Raceway Stream at Centredale

The upstream portion of the Raceway Stream adjacent to the east side of the Centredale Manor parking lot was observed to be approximately 3 to 5 feet wide and approximately 6 to 12 inches deep. The stream had a sandy substrate with algal growth and leaf litter in some areas. No fish were observed in the stream. Residential homes were located within 20 to 50 feet from the east stream bank. The area between the stream and the residential area was wooded with red oaks, maples, and sycamore. Ecological receptors observed during the May 2000 site visit in this area include squirrels, Canada geese, and crows. Runoff from the parking lot drains to the southern end of this stream, which becomes ponded and contains aquatic vegetation.

The stream was 5 to 10 feet wide, and 0.5 to 1 foot deep just upstream of Allendale Pond. The sediment was sandy with gravel and some pockets of silt. No fish were observed in this area. Several living and dead invertebrates (mostly worms) were observed after the sediment was slightly disturbed. Raccoon tracks were observed along the bank and several snails were observed in this area.

Allendale Pond

The water in the ponded area upstream of Allendale Dam was higher in the Spring of 2000 than during previous site visits by TtNUS (August through December 1999). Canada geese, mallard ducks, and a belted kingfisher were observed in this area. Residential areas bordered the east side of the ponded area, while the west side was bordered by industrial property.

The waterway was approximately 75 to 100 feet wide by Allendale dam. The dam was breached in the middle and the water flowed rapidly through the dam. The water was approximately 2 to 3 feet deep in the spring of 2000, but was 0.5 to 1 feet deep in the summer of 1999. Several swans were observed in this area.

River Downstream of Allendale Dam

The main stream located to the west of the Allendale Apartments was approximately 20 to 30 feet wide. The water was flowing too rapidly to estimate the stream depth. The east bank of the stream consisted of rip-rap while the west side had a narrow tree line and steep bank. The stream widened to approximately 50 feet about 500 feet downstream from the site. The water was approximately 1 to 2 feet deep and the bottom was sandy with cobble/gravel.

2.2 Toxicity Profiles

A characterization of site contaminants, contaminant sources, release mechanisms, and migration pathways are presented in Section 1.4 of the EE/CA report. In summary, dioxins, 1,2,4,5,7,8-hexachloro(9H)xanthene, metals, VOCs, SVOCs, pesticides, and/or PCBs were detected in the various media (soil, sediment, and surface water). The following sections present a brief discussion regarding the toxicity, potential food chain and trophic transfer, and fate and transport properties of each class of contaminants.

Tables C-4 through C-15 present summary statistics for detected analytes. These tables are presented for the media sampled: Residential Soils (soils on land used for residential purposes), Bank Soils (soil collected from the banks of river and ponds),

Flood Plain Soils (soils located in areas that are periodically innundated with less than one foot of water, and generally for less than one month of the year), sediment (soils innundated with more than one foot of water generally more than one month per year), and surface water.

Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioconcentration factors (BCFs), biota-to-sediment accumulation factors (BSAFs), organic carbon partition coefficients, and octanol water partition coefficients. These factors are discussed in the following parameter-specific subsections, as necessary. The following paragraphs discuss the significance of each factor. The sections that follow present a discussion of the each chemical class that was detected in each media.

Bioconcentration factors measure the tendency for a chemical to partition from the water column or sediment and concentrate in aquatic organisms. Bioconcentration factors are important for ecological receptors because chemicals with high BCFs could accumulate in lower-order species and subsequently accumulate to toxic levels in species higher up the food chain. The BCF is the concentration of the chemical in the organism at equilibrium divided by the concentration of the chemical in the water.

Biota-sediment accumulation factors (BSAFs) can be used to predict contaminant concentrations in fish tissue from contaminant concentrations in sediment. The BSAFs for the organic compounds can be obtained from The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1: National Sediment Quality Survey (USEPA, 1997b). BSAFs for inorganic chemicals for fish are not available.

The organic carbon partition coefficient (K_{oc}) measures the tendency for a chemical to partition between soil or sediment particles containing organic carbon and water. This coefficient is important in the ecological environment because it determines how strongly an organic chemical will bind to the organic carbon in the sediment.

The octanol/water partition coefficient (K_{ow}) is the ratio of a chemical concentration in octanol divided by the concentration in water. The octanol/water partition coefficient has

been shown to correlate well with bioconcentration factors in aquatic organisms and with adsorption to soil or sediment.

2.2.1 Metals

Many metals are found naturally in the surface water, sediment, and/or soil at various concentrations due primarily to chemical weathering and fallout from volcanoes. Most metals are toxic to aquatic (i.e., fish, and invertebrates) and terrestrial (i.e., plants, invertebrates, and vertebrates) ecological receptors at certain concentrations, with some metals being more toxic at lower concentrations than others. Also, different chemical forms of the metals may be more toxic than other forms. For example, hexavalent chromium is typically more toxic than trivalent chromium, and methylmercury is more toxic than inorganic mercury. In addition, the toxicity of several metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) to aquatic receptors in freshwater systems decreases with increasing water hardness.

Only a portion of the total bulk concentration of metals in soils is bioavailable to ecological receptors. The uptake and accumulation of trace elements by plants are affected by several soil factors such as pH, Eh, clay content, organic matter content, cation exchange capacity, nutrient balance, concentration of other trace elements in soil, soil moisture, and temperature (Tarradellas et al., 1996). The bioavailability of the metals, however, is not known because there are other soil factors that influence uptake.

Many of these same factors also will influence the bioavailability of metals to invertebrates in sediment. One way to estimate the bioavailable portion of certain divalent metals (cadmium, copper, lead, nickel, and zinc) in sediment is to measure the amount of acid volatile sulfides (AVS) and simultaneously extracted metals (SEM) in a sediment sample. If the molar concentration of AVS is higher than the molar concentration of SEM, than all the SEM metals are expected to be unavailable to aquatic invertebrates and, therefore, nontoxic. AVS plays little or no role in determining interstitial water concentrations of metals in aerobic systems or those with low productivity (i.e., where the absence of organic carbon limits sulfate reduction) (Ankley et al., 1996), or when ingestion of sediments is the primary exposure route (Lee at al., 2000).

Of the 29 elements essential for plant growth, seven are micronutrients, including copper, iron, manganese, and zinc (Tarradellas et al., 1996). Also, the following metals may stimulate plant growth but are only essential for some plant species: aluminum, cobalt, nickel, sodium, selenium, and vanadium (Tarradellas et al., 1996). Finally, some elements such as lead, cadmium, and mercury are toxic elements with no known function in plant metabolism (Tarradellas et al., 1996).

ORNL (1998) has calculated soil-to-plant uptake factors for several metals based on a compilation of various studies. Soil to plant uptake factors for some metals that are not listed in ORNL 1998 are listed in ORNL (2000). Cadmium, mercury, selenium, and zinc were the only metals (except for calcium and potassium) with mean uptake factors greater than one (1.02 to 2.25). None of the metals (except for calcium and potassium) have median uptake factors greater than one. Arsenic, cadmium, mercury, nickel, selenium, and zinc were the only metals (except for calcium, magnesium, and potassium) with upper 90th percentile uptake factors greater than one (1.1 to 5) (ORNL, 1998). This indicates that most metals will not biomagnify in plants. Finally, it is reported that for arsenic, copper, nickel, and zinc, the plant-based food chain may be protected because the toxic concentrations of these metals in plants are higher than those for animals, while cadmium and selenium are not toxic to plants at high concentrations and may be accumulated in plants at levels that may be toxic to animals (Cockerham and Shane, 1994). Other metals such as lead, cobalt and mercury can enter the food chain via plant uptake, but to a lesser extent (Cockerham and Shane, 1994).

Cadmium appears to accumulate in most species of earthworms at greater levels than any other metal (Satchell, 1983). This is supported by the high mean soil-to-earthworm uptake factor of 17 for cadmium, compared to mean uptake factors of 5.7 (zinc), 5.2 (mercury), 4.5 (silver), and 3.3 (lead) (Sample et al., 1998). The remaining metals (except potassium, sodium, and some radionuclides) had mean uptake factors of 1.8 or less (Sample et al., 1998). Cadmium, mercury, nickel, silver, and zinc are the only metals with median uptake factors greater than one (Sample et al., 1998). The upper 90th percentile uptake factors were 40.7, 20.6, 15.3, and 12.9 for cadmium, mercury,

silver, and zinc (Sample et al., 1998). The remaining metals had upper 90th percentile uptake factors of 4.7 or less (Sample et al., 1998).

It is important to note that the uptake factors presented in ORNL (1998) and Sample et al., (1998) are presented in dry weight. In order to be used in food chain models they must be multiplied by the percent dry weight of a plant (approximately 30 percent) or invertebrate (approximately 16 percent) to obtain the contaminant concentration in the weight of food. The soil-to-plant uptake factors listed in ORNL 2000 are presented as wet weight.

2.2.2 Semivolatile Organic Compounds

Polyaromatic hydrocarbons (PAHs) and several phthalates make up the majority of the SVOCs that were detected in the surface water, sediment, and surface soil samples. PAHs are a diverse group of compounds consisting of two or more substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of carbonaceous materials. PAHs are ubiquitous in the modern environment and commonly are constituents of coal tar, soot, vehicle exhaust, cigarette smoke, certain petroleum products, road tar, mineral oils, creosote, and many cooked foods. PAHs also are released to the environment through natural sources such as volcano and forest fire emissions. However, most of the emissions result from anthropogenic sources, largely wood burning for homes. Vehicular emissions are another primary source of PAHs. Hazardous waste sites can be a concentrated source on a local scale. Examples of such sites include former manufactured gas sites (i.e., sources of coal tar) and abandoned wood treatment plants (i.e., sources of creosote) [Agency for Toxic Substances and Disease Registry (ATSDR), 1989a].

PAHs are transferred from surface water by volatilization and sorption to settling particles. The compounds are transformed in surface water by photooxidation, chemical oxidation, and microbial metabolism (ATSDR, 1989a). In soil and sediments, microbial metabolism is the major process for degradation of PAHs (ATSDR, 1989a). Although PAHs accumulate in terrestrial and aquatic plants, many organisms are able to metabolize and eliminate these compounds. Vertebrates can readily metabolize PAHs, but lower forms (insects and worms) cannot metabolize PAHs as quickly. Food chain

uptake does not appear to be a major exposure source to PAHs for aquatic animals (ATSDR, 1989a).

Plants and vegetables can absorb PAHs from soil through their roots and translocate them to other plant parts such as developing shoots (Eisler, 1987). In general, however, PAHs are not readily taken up by plants because these compounds are strongly adsorbed onto soil organic particles and root uptake is very inefficient (Donker, et al., 1994). As such, lower molecular weight PAHs (which would be more water soluble) are absorbed by plants more readily than higher molecular weight PAHs. This is indicated by the low (well below 1.0) soil-to-plant uptake factors, which were calculated using the K_{ow} for the contaminants (ORNL, 2000). Finally, many higher plants can catabolize benzo(a)pyrene and possibly other PAHs (Eisler, 1987).

PAHs vary substantially in their toxicity to aquatic organisms. In general, toxicity increases as molecular weight increases, with the exception of some high molecular weight PAHs that have low acute toxicity. Most species of aquatic organisms rapidly accumulate PAHs from low concentrations in the ambient medium. However, uptake of PAHs is highly species specifics, it is higher in algae, mollusks, and other species that are incapable of metabolizing PAHs (Eisler, 1987). The ability of fish to metabolize PAHs may explain why benzo(a)pyrene is frequently not detected or is found at only very low levels in fish from environments heavily contaminated with PAHs (ATSDR, 1989a). The BSAF value for the PAHs as reported in USEPA (1997b) was 0.29.

Phthalates are compounds that are used in production of plastics (ATSDR, 1993). Most phthalates are expected to sorb to soil or sediment particles after their release because of their high Log K_{OC} values (Howard, 1989). Some phthalates may bioconcentrate in aquatic organisms [Spectrum Laboratories, 1999; Howard, 1989; ATSDR, 1993].

2.2.3 Pesticides

The majority of the pesticides that were detected in the media at the site include the organochlorine insecticides such as DDT, chlordane, aldrin, dieldrin, heptachlor, endosulfan, and endrin and their associated breakdown products. In general, these compounds degrade very slowly and tend to be soluble in lipids, which results in

bioaccumulation and possible increases in concentrations through food webs (Newman, 1998).

Pesticides are used to control pestiferous invertebrates and, therefore, they are toxic to many soil and aquatic invertebrates. In addition, many pesticides are toxic to higher trophic level ecological receptors such as mammals and birds. For example, DDT compounds have been linked to eggshell thinning and subsequent decreased survival of several birds of prey (such as eagles and falcons). Other pesticides such as chlordanes, dieldrin, aldrin, endrin, and heptachlor also are very toxic to mammals and birds (Newell et al., 1987).

Organochlorine insecticides such as DDT, chlordane, aldrin, dieldrin, heptachlor, endosulfan, and endrin and their associated breakdown products generally degrade very slowly and tend to be soluble in lipids, which results in bioaccumulation and possible increases in concentrations through food webs (Newman, 1998). Pesticides have high Log K_{OC} values so they are expected to sorb strongly to soil and sediment particles when released to the environment. Consequently, these compounds are not easily displaced from their site of application, whether by runoff or leaching to groundwater. As a result, these compounds typically will not be taken up by plants as indicated by their soil-to-plant uptake factors, which are well below 1.0 (ORNL, 2000).

DDT, DDE and DDD are highly lipid soluble, which, combined with an extremely long half-life, results in bioaccumulation (ATSDR, 1989b). When present in ambient water, DDT and its metabolites are concentrated in freshwater and marine plankton, insects, mollusks, and other invertebrates and fish (ATSDR, 1989b). As these organisms are part of the food chain, a progressive accumulation of residues may result in high levels of residues in organisms at the top of the food chain (ATSDR, 1989b). Moderate to significant bioconcentration in aquatic species has been reported for dieldrin, with bioconcentration factors (BCFs) ranging from 100 to 10,000 (Howard, 1991). Heptachlor also has been reported to bioconcentrate in aquatic species, with bioconcentration factors in fish up to about 20,000 (Howard, 1991). The BSAF values for these pesticides as reported in USEPA (1997b) ranged from 1.67 to 7.7.

Chlordane will bioconcentrate in both marine and freshwater species (ATSDR, 1989c). In living organisms, chlordane concentrations are usually highest in samples collected near areas where chlordane was used to control termites or other pests, in predatory species, and in tissues with high lipid content (Eisler, 1990). Food chain biomagnification is low except in certain marine mammals (Eisler, 1990). The BSAF values for the chlordanes as reported in USEPA (1997b) ranged from 2 to 4.77. Note that the BSAFs for most other pesticides as reported in USEPA (1997) was 1.8.

2.2.4 PCBs

The term polychlorinated biphenyls (PCBs) commonly refers to a variety of mixtures of individual biphenyl isomers, each consisting of two joined benzene rings and up to 10 chlorine atoms. Mixtures of these isomers are known by their commercial designation of Aroclor. This trade name is followed by a four-digit number; the first two numbers indicate the type of isomer mixture and the last two numbers indicate the approximate weight percent of chlorine in the mixture (USEPA, 1985).

PCBs released into water adsorb to sediments and other organic matter. Typically, PCB concentrations are greater in the sediment and suspended material than in the water column. Substantial quantities of PCBs in aquatic sediments can act as an environmental reservoir from which PCBs may be released slowly over a long period of time (ATSDR, 1989d). For PCBs that exist in the dissolved state in water, volatilization becomes the primary fate process. PCBs have the capability to bioaccumulate and biomagnify (USEPA, 1985).

Degradation of PCBs in the environment is dependent upon the degree of chlorination. Generally, the more chlorinated the PCB molecule, the more persistent it will be in the environment. Factors that determine biodegradability include the amount of chlorination, concentration, type of microbial population, available nutrients, and the temperature (ATSDR, 1989d).

PCBs are expected to be highly immobile in the soil due to rapid and strong sorption (ATSDR, 1989d). Some data indicate that plants are capable of taking up PCBs and transferring them into polar metabolites or insoluble molecules (Donker et al., 1994).

However, it is unlikely that uptake and transformation of these compounds occur to any great extent, because a large part (greater than 95 percent) will adsorb to the root surface (Donker et al., 1994). The soil-to-plant uptake factors for PCBs on a wet weight range from 0.00059 to 0.11 (ORNL, 2000). The transfer of vapor-phase PCBs from air to aerial plant parts may be the main source of vegetation contamination (ATSDR, 1989d).

Because PCBs are highly lipophilic, they can bioaccumulate in the lipid portions of animals. Bioconcentration factors in the thousands have been reported for various aquatic species (Eisler, 1986a). The BSAF value for the chlordanes as reported in USEPA (1997b) was 1.85. PCBs also can accumulate in upper trophic level animals such as piscivorous birds and mammals that feed on contaminated prey items (Eisler, 1986a). Finally, Sample et al. (1998) calculated mean, median, and 90th percentile reported soil-to-earthworm bioaccumulation factors (BAF) of 8.9, 6.7 and 15.9, respectively, indicating the PCBs can accumulate in soil invertebrates.

Adverse effects of PCBs on terrestrial wildlife include increased mortality, reproductive effects, and behavioral effects (USEPA, 1985). As a group, birds are more resistant to acutely toxic effects of PCBs than mammals (Eisler, 1986a). Among sensitive avian species, PCBs disrupt the normal pattern of growth, reproduction, metabolism, and behavior (Eisler, 1986a). Of the mammals, the mink is the most sensitive wildlife species tested for which data are available (Eisler, 1986a). Impacts to mink include anorexia, weight loss, lethargy, reproductive effects, and death (Eisler, 1986a).

2.2.5 Volatile Organic Compounds

VOCs are usually very mobile in the environment because they are poorly adsorbed to soil and sediment particles. Also, because they are very volatile, they typically are only detected in surface waters and surface soils at low concentrations.

Most VOCs have very little potential to bioaccumulate in ecological receptors; therefore, biomagnification through the food chain does not appear to be significant. VOCs are not expected to biomagnify in plants and are typically only toxic to ecological receptors only at relatively high concentrations.

2.2.6 Dioxins

Dioxin and dioxin-like compounds consist of the following chemical classes: polychlorinated dibenzo-p-dioxins (PCDDs or CDDs), polychlorinated dibenzofurans (PCDFs of CDFs), polybrominated dibenzodioxins (PBDDs or BDDs), polybrominated dibenzofurans (PBDFs or BDFs), and PCBs (USEPA, 1998d). The CDDs and BDDs each include 75 individual compounds, and the CDFs BDFs each include 135 different compounds (USEPA, 1998b). Of all these compounds, only 7 of the 75 congeners of CDDs or BDDs are thought to have dioxin-like toxicity, as are 10 of the 135 congeners of CDFs, or BDFs (USEPA, 1998b). These are the ones with chlorine/bromine substitutions in, at least, the 2, 3, 7, and 8 positions (USEPA, 1998b). Of the 209 PCB congeners, 13 are thought to have dioxin-like toxicity, which include the PCBs with four or more chlorine atoms with just one or no substitution in the ortho position (USEPA, 1998b).

There are very few toxicity data for dioxins except for 2,3,7,8-TCDD, which has been associated with lethal, carcinogenic, teratogenic, reproductive, mutagenic, histopathologic, and immunotoxic effects (Eisler, 1986b). 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is the most toxic congener within these groups of compounds (Van den Berg et al., 1998). Because of this, toxicity equivalency factors (TEFs) have been developed to estimate the relative toxicity of the dioxin and dioxin-like compounds to 2,3,7,8-TCDD (Van den Berg et al., 1998). There are substantial inter- and intraspecific differences in sensitivity and toxic responses to 2,3,7,8-TCDD (Eisler, 1986b).

Two species of earthworms showed no adverse effects at soil concentrations of 5 mg/kg; however, they died at 10 mg/kg of 2,3,7,8-TCDD (Eisler, 1986b). This indicates that terrestrial invertebrates may be resistant to 2,3,7,8-TCDD. Eisler (1986b) also reported that aquatic invertebrates, plants, and amphibians were comparatively resistant to 2,3,7,8-TCDD; however, accumulation from the aquatic environment was evident.

Although there presently is no evidence of biomagnification of PCDDs in birds, it is suspected that piscivorous birds have a greater potential to accumulate PCDDs than the fish that they eat (Eisler, 1986b). The BSAF value for the chlordanes as reported in USEPA (1997b) was 0.059.

1,2,4,5,7,8-hexachloro(9H)xanthene

No information was located in the literature for 1,2,4,5,7,8-hexachloro(9H)xanthene. However, one study was located the discussed the toxicity of a similar compound (2,3,6,7-tetrachloroxanthene) (Zabel and Peterson, 1996). 2,3,6,7-Tetrachloroxanthene is structurally similar to TCDD. It differs from TCDD in that it has a carbon atom instead of a second oxygen atom joining the two phenyl rings (Zabel and Peterson, 1996). A study was conducted to determine the mortality of rainbow trout fry sac from 2,3,6,7-tetrachloroxanthene, and how the toxicity of 2,3,6,7-tetrachloroxanthene compared to the toxicity of TCDD (Zabel and Peterson, 1996). The study indicated that the toxic equivalency factor (TEF) for 2,3,6,7-tetrachloroxanthene were 1.09 to 2.29, indicating that 2,3,6,7-tetrachloroxanthene was slightly more toxic than TCDD. Because no other data were available, the TEF of 2.29 was used to estimate the toxicity of 2,3,6,7-tetrachloroxanthene for all the soil, surface water, and sediment screening values.

2.3 Identification of Exposure Pathways and Potential Receptors for Analysis

The potential pathways by which ecological receptors may be exposed to contaminants in each media was identified along with the species that could be adversely affected by these chemicals. Several potential exposure pathways may exist at the site as shown in the Ecological Conceptual Model presented as Figure C-2.

Conceptual Site Model

Figure C-2 presents the Ecological Conceptual Site Model for the site. The potential sources of contamination at the site are presumed to be a result of releases from the former chemical manufacturing operations that were once present at the Centredale Manor and Brook Village properties. The contaminants were primarily disposed of in the soil and sediment of the river and wetlands, and then were likely to have transported with sediments and migrated to other media within the watershed via settling or deposition. Section 1.4 of the EE/CA report provides a summary of the characterization of contaminants found.

Terrestrial and aquatic species may be exposed to contaminants via different pathways including direct contact, ingestion of contaminated media, inhalation of contaminants. Exposure of terrestrial wildlife to contaminants in the soil via dermal contact may occur, but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons probably minimize transfer of contaminants across dermal tissue (note that this may not be true for amphibians). Therefore, the dermal pathway was not evaluated in this SERA, with the exception of aquatic organisms (i.e., benthic invertebrates, fish, amphibians) since the surface water criteria take dermal contact into account through the nature of the tests. In addition, the inhalation pathway was not evaluated because air concentrations are expected to be minimal since that majority of the area is vegetated and/or wet. Also note that the dermal and inhalation pathways typically are not evaluated in SERAs because of the uncertainty in exposures and effects concentrations. Terrestrial vegetation may be exposed to contaminants via direct aerial deposition and root translocation.

Terrestrial and semi-aquatic animals may be exposed to soil/sediment contaminants through ingestion of contaminated food items (i.e., plants, invertebrates, mammals, birds, fish, etc.). Animals can also incidentally ingest soil/sediment while grooming fur, preening feathers, digging, grazing close to the soil/sediment, or feeding on items to which soil/sediment has adhered (such as roots and tubers). Terrestrial animal receptors may also come into contact with contaminants in surface water by using drinking the water, although this exposure route represents a negligible portion of total exposure for most receptors because of the relatively low contaminant concentrations in surface water as compared to other media.

Terrestrial invertebrates and vegetation may be exposed to contaminants in the surface soil via direct contact. Finally, aquatic organisms may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items.

Based on the identification of contaminants and exposure pathways, five species groups were selected for evaluation in the risk assessment. These include terrestrial plants, terrestrial invertebrates, mammals, birds, and aquatic life as shown on Figure C-2.

Selection of Receptor Species

Many receptors in the soil and aquatic environments are adequately described in general categories such as soil invertebrates, vegetation, and sediment-dwelling (benthic) invertebrates. This is due to the nature of the threshold values, effects values, or water quality criteria that are typically used to characterize risk for such organisms. For vertebrate receptors, selection of particular species may be required so that intake through eating, drinking, and other routes can be estimated.

Receptor identification is influenced by the contaminants, their likely mode of transport, ultimate fate, and toxicity. For example, most metals (with notable exceptions of cadmium and mercury) typically do not bioaccumulate. For contaminants that bioaccumulate, such as mercury compounds and chlorinated pesticides, effects on upper trophic level receptors need to be assessed. For contaminants that do not bioaccumulate, organisms that are in direct contact with soil/sediment (i.e., sediment- and soil-dwelling organisms and plants) and animals that may incidentally ingest soil particles are selected as receptors for metals if exposure pathways are complete. Sensitivity to particular contaminants is also considered. For example, birds and mammals may have different sensitivities to organic compounds, so each group, or the most sensitive group for a particular contaminant, is assessed.

As previously mentioned, for most receptor species, ingestion is the primary route of exposure. Indicator species are selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservativeness, indicator species may be small and have small home ranges. Species known to be sensitive to particular contaminants may be selected or toxicity values for those species may be used. For example, mink are sensitive to PCBs for reproductive endpoints and therefore mink TRVs would be selected for a scenario involving exposure to PCBs from an aquatic or sedimentary source. The availability of exposure parameters such as body mass, feeding rate, and drinking rate may also be a factor in selecting indicator species.

2.4 Identification of Assessment Endpoints and Measures of Effects

Assessment endpoints are an explicit expression of the environmental value that is to be protected (USEPA 1997a). The selection of these endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors. Measures of effects are estimates of biological impacts (i.e., mortality, reproduction) that are used to evaluate the assessment endpoints. The selection of measurement endpoints is based on available data.

As already discussed in Section 2.1, the habitat at the site consists of wooded areas, open fields with grasses, wetlands areas, scrub-scrub areas, and various aquatic habitats. Although different receptors may preferentially inhabit one particular habitat type, the assessment endpoints selected for this SERA are general enough to ensure that all the habitat types are evaluated. Therefore, for this SERA, the assessment endpoints are protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Soil invertebrates
- Terrestrial Vegetation
- Herbivorous mammals
- Herbivorous birds
- Carnivorous Birds
    - Soil invertebrate-eating birds
    - Piscivorous birds
    - Small mammal and bird-eating birds
- Carnivorous Mammals
    - Soil invertebrate-eating mammals
    - Piscivorous mammals
    - Small mammal and bird-eating mammals
- Omnivorous mammals
- Omnivorous birds
- Benthic invertebrates

- Fish
- Amphibians and reptiles

The following paragraphs discuss why assessment endpoints were selected for these groups of receptors for this SERA.

Soil Invertebrates: Soil invertebrates are expected to be present in the soil throughout the area. They aid in the formation of soil, redistribution and decomposition of organic matter in the soil and serve as a food source for higher trophic level organisms. They also can accumulate some contaminants, which can then be transferred to the higher trophic level organisms that consume invertebrates.

Terrestrial Vegetation: Terrestrial vegetation in the area consists of grasses, shrubs, and trees. They serve as a food source and provide shade and cover for many organisms, and help prevent soil erosion, among other important functions. They also can accumulate some contaminants, which can then be transferred to the higher trophic level organisms that consume plants.

Herbivorous Birds and Mammals: Herbivorous birds and mammals (animals that consume only plant tissue) are present throughout the area in the different terrestrial habitats (i.e., forested, open field). Their role in the community is essential because without them, higher trophic level could not exist (Smith, 1966). They may be exposed to, and accumulate contaminants (such as) that are present in the plants they consume.

Carnivorous Birds and Mammals: Carnivorous birds and mammals consist of birds and mammals that consume, invertebrates, fish, and other mammals/birds. Soil invertebrate-eating birds and mammals are present throughout the area in the different terrestrial habitats (i.e., forested, open field). These animals are considered first-level carnivores and they serve as a food source for higher trophic level carnivores. Piscivorous birds and mammals may be present adjacent to the sites that are located along larger water bodies that can support a fish population. Finally, carnivorous birds and mammals that feed on other birds and mammals are at the top of the food chain. The top carnivores typically are less densely distributed than the herbivores and first-level carnivores because they require a larger area to hunt for their food. All of the carnivores may be

exposed to and accumulate contaminants that are present in the food items they consume.

Omnivorous Birds and Mammals: Omnivorous birds and mammals (that consume both plant and animal tissue) are present throughout the area in the different terrestrial habitats (i.e., forested, open field). They may be exposed to, and accumulate contaminants that are present in the plants and animals they consume.

Benthic Invertebrates: Benthic invertebrates are similar to the soil invertebrates in that they serve as a food source for higher trophic level organisms (i.e., fish, amphibians, birds, mammals). They also can accumulate some contaminants, which can then be transferred to the higher trophic level organisms that consume invertebrates. Healthy benthic macroinvertebrate populations would be expected in the water bodies.

Fish: Fish may present in the nearby water bodies. Fish feed primarily on invertebrates, plants, and/or other fish, which is why the lower trophic level species are important. Fish are exposed to and can accumulate contaminants from the food items they consume, or from the surface water in which they live.

Amphibians and Reptiles: Amphibians are expected to inhabit water bodies and the surrounding areas near the water, while reptiles can inhabit both aquatic and terrestrial areas that are away from water bodies. These species feed primarily on invertebrates, plants, fish, and/or small mammals which is why the lower trophic level species are important. Amphibians and reptiles are exposed to and can accumulate contaminants from the food items they consume, or from the surface water/sediment in which they live.

The omnivores were not selected as assessment endpoints because exposure to contaminants in plants will be highest for herbivores and exposure to contaminants in animals will be highest for carnivores. Therefore, the omnivores should be protected by protecting the herbivores and carnivores.

The following text summarizes the assessment endpoints, poses the risk questions, and presents the measures of effects to answer the risk questions.

Assessment endpoint #1: Aquatic and floodplain invertebrate communities exposed to surface water and sediment, which are a forage resource for fish and wildlife populations.

- Question 1-1: Do measured concentrations of analytes in surface water exceed appropriate criteria and/or guidelines for the protection of aquatic life, with special consideration of reproduction and early life stage survival?
  - Measure of Effect: Compare surface water concentrations to federal recommended water quality criteria, and/or data from aquatic toxicology literature.

- Question 1-2: Do measured concentrations of analytes in whole sediment exceed appropriate guidelines for the protection of benthic macroinvertebrate populations?
  - Measure of Effect: Compare sediment concentrations to available sediment benchmarks and/or data from sediment toxicology literature.

Assessment endpoint #2: Soil invertebrate and plant communities exposed to surface soil, which are a forage resource for wildlife populations.

- Question 2-1: Do measured concentrations of analytes in surface soil exceed appropriate criteria and/or guidelines for the protection of soil invertebrates and plant, with special consideration of reproduction and early life stage survival?
  - Measure of Effect: Compare surface soil concentrations to available soil benchmarks and/or data from soil toxicology literature.

Assessment Endpoint #3: Piscivorous mammal and bird populations exposed to sediment.

- Question 3-1: Do estimated ingestion doses to piscivorous wildlife (such as mink, kingfisher, great blue heron, etc.) exceed Toxic Reference Values (TRVs) for adverse effects on survival, growth or reproduction?
  - Measure of Effect: Compare sediment concentrations to calculated concentrations in food items that are not expected to cause adverse impacts to piscivorous wildlife that ingest the food items associated with sediment. The assumption that the contaminant concentrations in the sediment are equal to the contaminant concentrations in the food items is discussed in the uncertainty analysis section of this report.

Assessment Endpoint #4: Insectivorous and herbivorous mammal and bird populations exposed to soil.

- Question 4-1: Do estimated ingestion doses to insectivorous wildlife (such as shrew, meadow vole, American woodcock, American robin, etc.) exceed TRVs for adverse effects on survival, growth or reproduction?
- Measure of Effect: Compare soil concentrations to calculated concentrations in food items that are not expected to cause adverse impacts to insectivorous or herbivorous wildlife that ingest the food items associated with soil. The assumption that the contaminant concentrations in the soil are equal to the contaminant concentrations in the food items is discussed in the uncertainty analysis section of this report.

3.0 Ecological Exposure Assessment

This portion of the SERA includes identification of contaminant concentration data used to represent ecological exposure in various media, and the selection of exposure point concentrations from the data. For each exposure pathway selected for quantitative evaluation, concentrations at the exposure point were estimated and the receptor-specific exposure will be quantified. Exposure point concentrations were estimated using environmental sampling data.

3.1 Characterization of Exposure

This section describes the potential or actual contact or co-occurrence of the contaminants with the receptors to determine their exposure dose. As discussed earlier in this report, soil, surface water, and sediment samples were divided into several groupings. The following sections describe the groupings that were used for the ecological screening, and which criteria were used to evaluate each grouping.

Residential Samples: These samples were collected from the surface soil in the residential-use areas (i.e., lawns and adjacent ground). They were evaluated using the lower of the terrestrial plant, invertebrate, or wildlife screening values (see Table C-4).

Bank Samples: These samples were collected from the stream/river and pond banks. These samples are not inundated with water and therefore are considered to be surface

soils. As such, they were evaluated using the lower of the terrestrial plant, invertebrate, of wildlife screening value (see Table C-5).

Floodplain Samples: These samples were collected from areas that are periodically inundated with shallow water (less than one foot). Therefore, to evaluate ecological risks under current conditions, the data were evaluated using the lower of the terrestrial plant, invertebrate, of wildlife screening value (see Table C-6). To evaluate ecological risks under future conditions (should the Allendale Dam be repaired), the data were evaluated using the lower of the aquatic and semi-aquatic screening values for the dioxins (and 1,2,4,5,7,8-hexachloro(9H)xanthene, and the aquatic screening values for the other parameters see Table C-7). The semi-aquatic screening values were not used to evaluate the floodplain samples for the non-dioxin parameters in Table C-7 because the semi-aquatic screening values for these parameters are the same as the terrestrial wildlife values that were included in Table C-6.

Sediment Samples: These samples were collected from the stream and pond in areas that were interpreted by the field sampling team to be under more than one foot of water for a period greater than 1 month per year. They were evaluated using the lower of the aquatic and semi-aquatic screening values for all parameters (see Table C-8).

Surface Water Samples: The surface water samples were grouped into Centredale Manor Brook Village Property (source area) samples (see Table C-9), floodplain samples (see Table C-10), and downstream samples (see Table C-11). They were evaluated using the lower of the aquatic and semi-aquatic screening values for all parameters

Reference Samples: Soil, sediment, and surface water samples from reference locations (upstream of the Centredale Manor and Brook Village Properties, or un-impacted tributaries) also were collected. The reference samples were grouped into bank soil samples (see Table C-12), floodplain soil/sediment samples (see Table C-13), sediment samples (see Table C-14), and surface water samples (see Table C-15).

4.0 Ecological Effects Assessment

In this step, the toxicity of the contaminants to terrestrial and aquatic organisms is characterized using screening values. The following sections discuss the sources of the screening values, and why they were selected as the screening values.

Soil

COPCs in soil based on potential risks to terrestrial invertebrates, plants, and wildlife were selected by comparing the contaminant concentrations in the surface soil to various screening values (see Table C-2). The following text discusses the screening values that were selected for each receptor. Note that the lowest screening value across all of the receptors was used for the selection of COPCs.

Invertebrates

Screening values for invertebrates were obtained from the Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision (Efroymson R.A. et al., 1997a). These benchmarks were intended to be used as screening values, and as such, may be overly conservative. They are based on a 20 percent reduction in growth, reproduction, or activity of invertebrates (Efroymson R.A. et al., 1997a).

Plants

Screening values for invertebrates were obtained from the ORNL Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson R.A. et al., 1997b). They are based on a 20 percent reduction in growth or yield for plants as the threshold for significant effects (Efroymson R.A. et al., 1997b).

The following study was used to obtain toxicity data for contaminants that were not included in the ORNL document: "Phytotoxicity Studies with Lactuca Sativa in Soil and

Nutrient Solution" (Hulzebos et al., 1993). The study developed Effects Concentrations 50 (EC50s) for growth.

Terrestrial Wildlife

Screening values for wildlife were obtained from the ORNL document: Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996). This document developed concentrations in food items that are not expected to cause adverse impacts to terrestrial wildlife that ingest these food items. The concentrations were developed for several mammal and bird species using body weight scaling adjustments. The lowest acceptable concentration in the food items were used to select COPCs with the assumption that the concentration in the food item is equal to the concentration in the soil. As is discussed in the uncertainty analysis section, this assumption will tend to overestimate the exposure for some contaminants and underestimate it for others.

The screening values for 2,3,7,8-TCDD and several other dioxins were obtained from Sample et al., (1996) (see Table C-2). The screening values for the remaining dioxins were calculated using the TEFs in the "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife" (Van den Berg et al., 1998). The TEFs for mammals were used because the value for 2,3,7,8-TCDD obtained from Sample et al., (1996) was based on a mammal study. Also, as indicated in Section .2.1, the TEF of 2.29 for 1,2,4,5,7,8-hexachloro(9H)xanthene was obtained from Zabel and Peterson (1996).

Surface Water

COPCs in surface water based on potential risks to aquatic receptors (i.e., fish, benthic invertebrates) and semi-aquatic wildlife (i.e., mink, kingfishers) were selected by comparing the contaminant concentrations in the surface water to various screening values (see Table C-3). The following text discusses the screening values that were selected for each receptor. Note that the lowest screening value across all of the receptors was used for the selection of COPCs.

Aquatic Receptors

The first choice for screening values selected to protect aquatic receptors (i.e., fish, invertebrates) were the most recent version of the Water Quality Criteria (WQC) that were developed by USEPA (USEPA, 1999). These WQC are expected to protect 95% of the exposed species from mortality, reproductive effects, and other adverse effects. The chronic WQC were used, when available.

When WQC were not available, chronic values from the Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1996 Revision (Suter and Tsao 1996) were used. The Suter and Tsao (1996) benchmarks were calculated using Tier II methodology as described in the U.S. USEPA's Proposed Water Quality Guidance for the Great Lakes System (U.S. USEPA, 1993a). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the U.S. USEPA AWQC.

The screening value for 2,3,7,8-TCDD was obtained from the Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Risks to Aquatic Life and Associated Wildlife (USEPA, 1993b). For aquatic receptors, the 2,3,7,8-TCDD water concentration associated with low risk to fish, in waters with particulate organic carbon concentrations of 0.2 mg/L was selected as the screening value. The screening values for the other dioxins were calculated using the TEFs for fish in the "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife" (Van den Berg et al., 1998). Also, as indicated in Section .2.1, the TEF of 2.29 for 1,2,4,5,7,8-hexachloro(9H)xanthene was obtained from Zabel and Peterson (1996).

Semi-Aquatic Receptors

The first choice for screening values selected to protect semi-aquatic receptors (i.e., mink, kingfisher) were the drinking water or piscivore benchmarks (whichever were lower) in Sample et al., (1996). This document developed contaminant concentrations in water that are not expected to cause adverse impacts to terrestrial wildlife that ingest water and/or fish. The concentrations were developed for several mammal and bird species using body weight scaling adjustments. The lowest acceptable concentrations

were used to select COPCs. Note that for some contaminants, only drinking water benchmarks were available.

The screening values for 2,3,7,8-TCDD was obtained from the Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Risks to Aquatic Life and Associated Wildlife (USEPA, 1993b). For semi-aquatic receptors, the 2,3,7,8-TCDD water concentration associated with low risk to mammals, in waters with particulate organic carbon concentrations of 0.2 mg/L was selected as the screening value. The screening values for the other dioxins were calculated using the TEFs for mammals in the "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife" (Van den Berg et al., 1998). Also, as indicated in Section .2.1, the TEF of 2.29 for 1,2,4,5,7,8-hexachloro(9H)xanthene was obtained from Zabel and Peterson (1996).

Sediment

COPCs in sediment based on potential risks to aquatic receptors (i.e., fish, benthic invertebrates) and semi-aquatic wildlife (i.e., mink, kingfishers) were selected by comparing the contaminant concentrations in the sediment to various screening values (see Table C-2). The following text discusses the screening values that were selected for each receptor. Note that the lowest screening value across all of the receptors was used for the selection of COPCs.

Aquatic Receptors

The first choice for screening values selected to protect aquatic receptors (i.e., fish, invertebrates) were the draft USEPA Sediment Quality Criteria (SQC) that have been established for dieldrin and endrin (USEPA, 1993c and d). The draft SQC for the three PAHs were not used because USEPA had indicated that they would be withdrawn in favor of a total PAH SQC document (Riley, 1999).

The second choice for screening values selected to protect aquatic receptors was the Effects Range-Low (ER-L) value from the "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments" (Long et al.,

1995). These values are generally accepted by many state agencies and U.S. USEPA regions, even though they are based primarily on estuarine and marine studies. The ER-L is defined as the minimal-effects range that is a concentration below which adverse effects would be rarely observed.

The Lowest Effects Level (LEL) from the "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario" (OMOE, 1993) were used for contaminants that did not have ER-Ls. The LELs are based on freshwater studies and are defined as concentrations where sediment is considered marginally polluted but will not affect the majority of sediment-dwelling organisms.

Finally, sediment quality benchmarks that were calculated for the Ecotox Thresholds (USEPA, 1996 were used for contaminants that did not have any of the above screening values. These contaminants were calculated using equilibrium partitioning and assuming a total organic carbon concentration of 1 percent.

Semi-Aquatic Receptors

For the semi-aquatic receptors, the screening values for 2,3,7,8-TCDD was obtained from the Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Risks to Aquatic Life and Associated Wildlife (USEPA, 1993b). The 2,3,7,8-TCDD sediment concentration associated with low risk to mammals was selected as the screening value. The screening values for the other dioxins were calculated using the TEFs for mammals in the "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife" (Van den Berg et al., 1998). Also, as indicated in Section .2.1, the TEF of 2.29 for 1,2,4,5,7,8-hexachloro(9H)xanthene was obtained from Zabel and Peterson (1996).

For the other contaminants, the screening values for semi-aquatic receptors are the same value as the one for the terrestrial receptors and were obtained from the ORNL document: Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996). The lowest acceptable concentration in the food items were used to select COPCs with the assumption that the concentration in the food item is equal to the concentration in

the sediment. As is discussed in the uncertainty analysis section, this assumption will tend to overestimate the exposure for some contaminants and underestimate it for others.

5.0 Ecological Risk Characterization

The risk characterization is the final phase of a risk assessment that compares exposure estimates to ecological effects estimates. It is at this phase of the SERA that the likelihood of adverse effects occurring as a result of exposure to a stressor will be evaluated. A Hazard Quotient (HQ) approach was used to characterize the risk to ecological receptors.

When the ratio of the exposure point concentration to its respective benchmark value (the HQ value) exceeds 1.0, adverse impacts are considered possible. The HQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an exposure point concentration exceeds or is less than a benchmark. A HQ value greater than 1.0 indicates that ecological receptors are potentially at risk and additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most benchmarks are conservative. The maximum soil, sediment, and surface water, were compared to the applicable screening values using the following equations to determine which contaminants exceeded the screening values:

$$HQ = \frac{Cc}{\text{Screening Value}}$$

Where: HQ = Hazard Quotient, (unitless)

C_C = Maximum contaminant concentration in soil, sediment, or surface water

Contaminants with HQs greater that 1.0 are retained as contaminants of potential concern (COPCs) for further evaluation because they have a potential to cause risk. Calcium, magnesium, potassium, and sodium were not retained as COPCs in any medium because of their relatively low toxicity to ecological receptors, and their high natural

variability in concentrations. Contaminants without screening values are retained as COPCs but are only evaluated qualitatively. The following sections present the contaminants that were retained as COPCs in each of the media.

Residential Soil HQs

Table C-4 presents the ecological screening for the residential soil samples. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 227,667 for PCDD/Fs), followed by the inorganics (up to55,686 for aluminum 2,617 for lead), PCBs (up to 676 for total PCBs), pesticides (up to 650 for 4,4'-DDT), and PAHs (up to 152 for fluoranthene). Attachment 3 of this SERA contains graphs that present the Log HQs for the following parameters plotted with the soil criteria for terrestrial receptors.

- 1,2,4,5,7,8-hexachloro(9H)xanthene
- Total PCDD/Fs
- Total TCDD
- Chromium
- Copper
- Lead
- Mercury
- Zinc
- Total PAHs
- Total PCBs
- 4,4'-DDE
- 4,4'-DDT
- Endosulfan II

The above parameters were selected because they had some of the higher HQs in each of the contaminant classes (i.e., dioxins, metals, and pesticides). The samples in the graphs are generally plotted from upstream to downstream. Parameters that were not detected in a sample are presented as blank values in the graphs. In general, for the contaminants that were graphed, the highest concentrations and the highest number of samples that exceeded the screening values occurred in the samples closest to the

Centredale Manor and Brook Village Properties, with slightly lower concentrations in the samples downstream (see Attachment 3). This trend was more apparent for some parameters than others.

Maximum detected concentrations of the COPCs in residential soil pose a potential risk to soil invertebrates, plant communities, and insectivorous and herbivorous mammal and bird populations (Assessment Endpoints 2 and 4).

Bank Soil HQs

Table C-5 presents the ecological screening for the bank soil samples. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 386,667 for 2,3,7,8-TCDD), followed by the inorganics (up to 2850 for aluminum and 397 for lead). The maximum HQ for the organic parameters was 4.8 for fluoranthene. In general, the HQs were significantly lower for the bank soil samples compared to the residential soil samples. For example, the HQs for the 3 of the dioxins for the bank samples were greater than 1,000 with none over 10,100, while the HQs for 11 of the dioxins in the residential samples were over 1,000, with several over 100,000. Also, the average upstream or reference sample concentrations for several contaminants were higher than the average concentrations (and sometimes the maximum concentrations) of the bank samples. Attachment 3 contains graphs that present the results for the following parameters, plotted with the soil criteria for terrestrial receptors.

- 1,2,4,5,7,8-hexachloro(9H)xanthene
- Total TCDD
- Lead
- Total PAHs

The above parameters were selected because they had some of the higher HQs in each of the contaminant classes. The samples in the graphs are generally plotted from upstream to downstream and include reference samples that were collected upstream of the site (sample numbers beginning with RCC- and RAB-). The concentrations of 1,2,4,5,7,8-hexachloro(9H)xanthene and total TCDD are lower in the reference samples,

while the concentrations of lead and total PAHs are similar to slightly higher in the reference samples (see Attachment 3).

Maximum detected concentrations of the COPCs in bank soil pose a potential risk to soil invertebrates, plant communities, and insectivorous and herbivorous mammal and bird populations (Assessment Endpoints 2 and 4).

Flood Plain Soil HQs

Table C-6 presents the ecological screening for the floodplain samples using the terrestrial screening values. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 2,805,830 for 1,2,4,5,7,8-hexachloro(9H)xanthene), followed by the inorganics (up to 4026 for aluminum and 1,160 for lead), PCBs (up to 110 for total PCBs). The maximum HQ for the PAHs and pesticides was 11.5 for 4,4'-DDE. Table C-7 presents the ecological screening for the floodplain samples using the aquatic or semi-aquatic screening values. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 334,640 for 1,2,4,5,7,8-hexachloro(9H)xanthene), followed by the PCBs (up to 344 for total PCBs) and PAHs (up to 105 for fluoranthene). The maximum HQ for the inorganics and pesticides was 23.3 for lead. Note that the average reference concentrations for several contaminants were higher than the average concentrations (and sometimes the maximum concentrations) of the floodplain samples. Attachment 3 contains graphs that present the results for the following parameters, plotted with the criteria for aquatic, semi-aquatic, and terrestrial receptors.

- 1,2,4,5,7,8-hexachloro(9H)xanthene
- Total PCDD/Fs
- Total TCDD
- Lead
- Mercury
- Low Molecular Weight PAHs
- High Molecular Weight PAHs
- Total PAHs
- Total PCBs

The above parameters were selected because they generally had some of the higher HQs in each of the contaminant classes. The samples in the graphs are generally plotted from upstream to downstream and include background samples that were collected upstream of the Centredale Manor and Brook Village Properties (samples including and to the left of SD-29). In general, for the contaminants that were graphed, the highest concentrations and the highest number of samples that exceeded the screening values occurred in the samples closest to the site, with slightly lower concentrations in the samples further from the site (see Attachment 3). However, the concentrations of lead and low molecular weight PAHs were similar between the upstream and downstream samples. Also, for some parameters, the highest concentrations were in the upstream samples.

Maximum detected concentrations of the COPCs in flood plain soil pose a potential (A) current risk to soil invertebrates, plant communities, and piscivorous insectivorous and herbivorous mammal and bird populations (Assessment Endpoints #2, #3 and #4); and (B) future risk to aquatic invertebrate communities which would be a forage resource for fish and wildlife (Assessment endpoint #1).

Sediment HQs

Table C-8 presents the ecological screening for the sediment samples using the aquatic or semi-aquatic screening values. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 45,276 for 1,2,4,5,7,8-hexachloro(9H)xanthene), followed by the inorganics (4,889 for aluminum and 765 for lead), PCBs (up to 1,234 for total PCBs), pesticides (up to 85 for 4,4'-DDE) and PAHs (up to 84 for fluorene). Attachment 3 contains graphs that present the results for the following parameters, plotted with the criteria for aquatic or semi-aquatic receptors.

- 1,2,4,5,7,8-hexachloro(9H)xanthene
- Total PCDD/Fs
- Total TCDD
- Lead
- Mercury
- Low Molecular Weight PAHs
- High Molecular Weight PAHs

- Total PCBs

The above parameters were selected because they had some of the higher HQs in each of the contaminant classes. The samples in the graphs are generally plotted from upstream to downstream and include background samples that were collected upstream of the site. In general, for the contaminants that were graphed, the contaminant concentrations appear to decrease in the Allendale Dam samples (those beginning with AD-). The concentrations in the samples downstream of Allendale Dam then increased to levels that were generally higher than those detected in the samples collected upstream of Allendale Dam.

Maximum detected concentrations of the COPCs in sediment pose a potential risk to aquatic invertebrate communities which are a forage resource for fish and wildlife (Assessment endpoint #1); or piscivorous mammal and bird populations (Assessment endpoint #3).

Surface Water HQs

Table C-9 presents the ecological screening for the surface water samples associated with the site using the aquatic or semi-aquatic screening values. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 1,608,750 for total TCDD), followed by the PCBs (up to 23,958 for total PCBs), inorganics (up to 344 for aluminum in unfiltered samples), pesticides (up to 160 for endrin). Note that the concentrations of several metals in the filtered samples were much lower that their corresponding detections in the unfiltered samples.

Table C-10 presents the ecological screening for the surface water samples associated with the floodplain using the aquatic or semi-aquatic screening values. In general, the contaminant concentrations were much lower in these samples than they were in the site surface water samples. The maximum HQ for the dioxins was 120 for total HxCDD, and the maximum HQ for the inorganics was 25 for selenium in the unfiltered samples. Note that selenium was not detected in the filtered samples, and the maximum HQ in the filtered samples was 7 for thallium.

Table C-11 presents the ecological screening for the downstream surface water samples using the aquatic or semi-aquatic screening values. In general, dioxins and 1,2,4,5,7,8-hexachloro(9H)xanthene had the highest HQs (up to 512,500 for total TCDD), followed by the bis(2-ethylhexyl)phthalate (210,720), pesticides (up to 954 for 4,4'-DDT) and inorganics (up to 282 for aluminum in the unfiltered samples). Note that the concentrations of several metals in the filtered samples were much lower that their corresponding detections in the unfiltered samples.

As noted above, contaminants that did not exceed the screening values are not expected to pose an adverse ecological risk and do not need to be further evaluated. Contaminants that do exceed a screening value, even with a high HQ, are not necessarily causing a risk to ecological receptors because the screening values are very conservative. Therefore, additional evaluation of the data, and/or collection of additional data is needed to obtain a better estimate of potential risks.

Maximum detected concentrations of the COPCs in surface water pose a potential risk to aquatic invertebrate communities which are a forage resource for fish and wildlife (Assessment endpoint #1); or piscivorous mammal and bird populations (Assessment endpoint #3).

6.0 Ecological Risk Uncertainty Analysis

This section presents some of the uncertainties associated with ecological risk assessments. It is at this step in the process where any exceedences of the benchmarks will be further evaluated to determine possible over- or under-estimates in the evaluation performed.

6.1 Assessment Endpoints and Measures of Effects

Measures of effects are used to evaluate the assessment endpoints that are selected for the SERA. For this SERA, the measures of effects are not the same as the assessment endpoints. The measures are used to predict effects to the assessment endpoints by selecting surrogate species that will be evaluated. For example, risks to small mammals for some contaminants was predicted using surrogate species such are the shrew. However, predicting mortality to a shrew may either under or overprotect the small

mammal population, resulting from differences in ingestion rates, toxicity, food preferences, etc. between different species.

Several endpoints were not quantitatively evaluated in this SERA. For example, risks to reptiles and amphibians were not quantitatively evaluated because exposure factors are not established for most species, and toxicity data are very limited. Therefore, potential risks to these species are not known.

6.2 Ecological Exposure Assessment

The food benchmarks presented in Sample et al., (1996) were generated by calculating contaminant doses to terrestrial wildlife using equations that incorporate ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors were obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary between species, especially between species inhabiting different areas that add to the uncertainty in the food benchmarks.

Most of the screening values for terrestrial and semi-aquatic wildlife (i.e., mammals, birds) do not account for potential uptake of contaminants in the food items (plants, invertebrates, fish). In other words, they simply assume the contaminant concentrations in the food items are the same as the contaminant concentrations in the media that they are associated with. For example, for the contaminant concentrations in soil invertebrates is assumed to be equal to the contaminant concentration in the soil. The only exceptions to this are the dioxin sediment screening values for semi-aquatic receptors, and most of the surface water screening values for semi-aquatic receptors. These values are based on potential bioaccumulation through the food chain.

Because of the relatively high HQs for many of the contaminants, the application of uptake factors is not expected to substantially change the overall number of contaminants that are retained as COPCs. However, the following text describes how the HQs may be affected by the application of uptake factors in each of the media. A more detailed discussion of the uptake factors is presented in Section 2.1 of this report.

As indicated above, the uptake factors are applied to the dioxin screening values for the semi-aquatic receptors so the HQs using those screening values would not change. Because, the 90th percentile soil-to-invertebrate factor for dioxins is above 1.0, the HQs for the dioxins in the residential soil sample tables, the bank soil sample tables, and floodplain soil sample tables would increase if uptake factors were used.

Most of the inorganics do not have 90th percentile soil-to-invertebrate uptake factors that are greater than 1.0 after accounting for wet weight of the invertebrate. The exceptions would be cadmium, mercury, and zinc. Mercury is the only inorganic chemical that has a 90th percentile soil-to-plant uptake factor that is greater than 1.0 after accounting for wet weight of the plant. Sediment-to fish uptake factors are not available for inorganics, so a default value of 1.0 is typically assumed. Therefore, the HQs for most of the metals in the residential soil sample tables, the bank soil sample tables, and floodplain soil sample tables would decrease if uptake factors were used. The only exceptions would be for cadmium, mercury, and zinc, which would increase, and chromium which would stay the same because the screening values that was used was based on risks to soil invertebrates. Also note that uptake factors have not been developed for a few inorganics so their HQs also would not change. The HQs for the inorganics in the floodplain sediment and sediment screening tables would not change because the screening values are either based on impacts to aquatic receptors (which do not used uptake factors) or the uptake factors for the food chain models would be set equal to 1.0.

Soil-to-invertebrate uptake factors have not been developed for the SVOCs, although a table in Beyer (1990) indicates the factors would be less than 1.0. Other sources indicate that soil-to-plant uptake factors are expected to be less than 1.0 (ORNL, 2000). Therefore, the HQs in the residential soil sample tables, the bank soil sample tables, and floodplain soil sample tables would decrease if uptake factors were used. However, because no uptake factors have been developed for invertebrates, a screening evaluation would typically use a default value of 1.0. The biota-to-sediment accumulation factor (BSAF) for PAHs reported in USEPA (1997b) is 0.29. In order to apply this factor, the percentage of organic carbon in the sediment must be used along with the percentage of lipids in the food item. Based on the average TOC concentration in the sediment and floodplain samples (between 5 and 6%), and the percent lipids of most fish species

between 2 and 10 percent, the HQs for the PAHs in the floodplain and sediment sample tables would be expected to decrease slightly if BSAFs were used.

Soil-to-invertebrate uptake factors have not been developed for the pesticides, although based on their high Kow values, they would be expected to bioaccumulate in invertebrates. Because of their high Kow values, they are not expected to bioaccumulate in plants (ORNL, 2000). Therefore, the HQs in the residential soil sample tables, the bank soil sample tables, and floodplain soil sample tables would increase if uptake factors were used. However, because no uptake factors have been developed for invertebrates, a screening evaluation would typically use a default value of 1.0. The biota-to-sediment accumulation factor (BSAF) for pesticides reported in USEPA (1997b) range from 1.67 to 7.7. Based on the average TOC concentration in the sediment and floodplain samples, and the percent lipids in fish, the HQs for the pesticides in the floodplain and sediment sample tables would be expected to increase if BSAFs were used.

PCBs have 90th percentile soil-to-invertebrate uptake factors that are greater than 1.0 after accounting for wet weight of the invertebrate (Sample et. al., 1998). Because of their high Kow values, PCBs are not expected to bioaccumulate in plants (ORNL, 2000). Therefore, the HQs in the residential soil sample tables, the bank soil sample tables, and floodplain soil sample tables would increase if uptake factors were used. The biota-to-sediment accumulation factor (BSAF) for PCBs reported in USEPA (1997b) is 1.85. Based on the average TOC concentration in the sediment and floodplain samples, and the percent lipids in fish, the HQs for the PCBs in the floodplain and sediment sample tables would be expected to increase slightly if BSAFs were used.

There is uncertainty in the chemical data that are collected at the site. Measured levels of chemicals are only estimates of the true site chemical concentrations. For samples that are deliberately biased toward known or suspected high concentrations, predicted doses probably will be higher than actual doses.

Finally, the maximum concentrations are used in this screening evaluation. Very few receptors are exposed to the maximum concentrations for all (or even most) of the time. Using the maximum concentration significantly overestimates risk. Most of the screening values that were used in this evaluation are based on food-chain modeling. Because the

wildlife receptors will move across the site, average contaminant concentrations better represent their actual exposure.

6.3 Ecological Effects Data Assessment

There is uncertainty in the ecological toxicity value comparison. The water quality criteria developed by USEPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species may be present at the site that are not protected by the use of these criteria. There also may be situations where the surface water screening values are over-predictive of risk if the sensitive species used to develop the criteria do not inhabit the site. Finally, with the exception of hardness for a few metals, the screening values do not account for site-specific factors, such as TOC or pH, which may affect toxicity.

Potential adverse impacts to aquatic receptors from constituents in the sediment are evaluated by comparing the COPC concentration to sediment screening values. The sediment screening values have more uncertainty associated with them than do the surface water screening values for the following reasons: The procedures for developing them are not as well established so screening levels have been developed using different methodologies and there are fewer sediment toxicity data than surface water toxicity data. Sediment characteristics (i.e., pH, acid volatile sulfides, and total organic carbon) also will have a large impact on the bioavailability and toxicity of constituents.

Potentially adverse impacts to terrestrial plants and invertebrates from constituents in the surface soil are evaluated by comparing the COPC concentration to surface soil screening values. The surface soil screening values are similar to the sediment screening values in that they are less established than the surface water screening values. Fewer studies and fewer data are available for establishing surface soil screening values and many of the screening values are based on the results of only a few studies. In addition, the surface soil screening values are based on different endpoints, depending on the preference of the agency that developed them. Therefore, they have more uncertainty than surface water and sediment screening values.

The NOAELS that were selected for the wildlife endpoint species were based on species other than the endpoint species (i.e., rats, mice, ducks). There is uncertainty in the application of toxicity data across species because the contaminant may be more or less toxic to the endpoint species than it was to the test study species.

Much of the toxicity data that is used to develop screening values and NOAELs are based on bioavailable forms of the contaminants. For example, many of the soil screening values for invertebrates are based on soluble salts being added to the soil. Also, studies used to develop the NOAELs typically use a very bioavailable form of a contaminant to ensure that it is absorbed by the animal. Because contaminants in soil, sediment, and even surface water are typically less bioavailable than they are in the chemical forms used in toxicity tests, many of the screening values tend to be lower than what would be expected to actually cause risks to most species in the environment.

The toxicity of chemical mixtures is not well understood. All the toxicity information used in the ERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Finally, toxicological data for a few of the COPCs are limited or do not exist. Therefore, there is uncertainty in any conclusions involving the potential impacts to ecological receptors from these constituents.

6.4 Risk Characterization

Risks are projected if an HQ is greater than or equal to unity regardless of the magnitude of the HQ. Although the relationship between the magnitude of an HQ and toxicity is not necessarily linear, the magnitude of an HQ can be used as rough approximation of the extent of potential risks, especially if there is sufficient confidence in the guideline used. Finally, there is uncertainty in how the predicted risks to a species at the site translate into risk to the population in the area as a whole.

6.5 Risk From Background Conditions

As is evident in Attachment 3, there are contaminants in the upstream areas that may contribute to ecological risk on site. Therefore there is uncertainty in the use of the HQs calculated that the contaminants did not all originate at the site. The potential risks in these upstream areas would need to be further investigated and quantified as would the risks in different subareas of the site to determine possible association of the ecological risk.

7.0 Summary and Recommendations

The following text summarizes the COPCs that were retained in each media and area. Tables C-4 through C-12 list each of the contaminants that were retained as COPCs.

Residential Soil

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 15 Individual Dioxins
- 25 Inorganics
- 17 SVOCs
- 6 Pesticides
- 3 PCBs

Bank Soil

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 10 Individual Dioxins
- 15 Inorganics
- 14 SVOCs
- 2 Pesticides
- 1 PCB

Floodplain Soil

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 13 Individual Dioxins
- 18 Inorganics
- 19 SVOCs
- 5 Pesticides
- 2 PCBs
- 1 herbicide

Floodplain Sediment

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 14 Individual Dioxins
- 17 Inorganics
- 22 SVOCs
- 10 Pesticides
- 2 PCBs
- 1 herbicide

Sediment

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 16 Individual Dioxins
- 19 Inorganics
- 20 SVOCs
- 14 Pesticides
- 8 PCBs

Source Area Surface Water

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 17 Individual Dioxins
- 10 Inorganics
- 3 Pesticides
- 1 PCB

Floodplain Surface Water

- 5 Individual Dioxins
- 6 Inorganics

Downstream Surface Water

- 1,2,4,5,7,8-Hexachloro(9H)xanthene
- 16 Individual Dioxins
- 10 Inorganics
- 1 SVOC
- 7 Pesticides

As seen from the above list, multiple contaminants from each contaminant class (i.e., dixoins, inorganics, SVOCs, etc) were retained as COPCs in most sample groupings. As indicated earlier in this SERA, the screening values are very conservative (i.e. over-estimate ecological risk), and are even below background levels for some contaminants. They are intended to be used as screening tools to ensure that contaminants that are detected at concentrations below the screening values are not posing a risk to ecological receptors. Therefore, contaminants that are detected at concentrations above the screening values (even with high HQs) do not necessarily pose a risk to ecological receptors. There are a lot of factors that influence toxicity of the contaminants, many of which were discussed in the uncertainty analysis section. Also, the screening was conducted using the maximum concentrations while most of the ecological receptors will not be exposed to the maximum concentrations 100 percent of the time.

The frequency and range of the HQs calculated that are greater than 1 indicate a widespread presence of contaminants at concentrations above the benchmarks. The extent and distribution of the exceedences as shown in Attachment 3 do not indicate the presence of localized "hot-spots" where removal actions can be performed under a NTCRA. In addition, the extent and distribution of the HQs do not justify a removal action without full characterization of ecological risk.

Although the magnitude of the HQ does not indicate the magnitude of risk, the very large HQs for many COPCs indicates that additional investigations must be conducted to more accurately estimate potential risks. The following recommendations are suggested to better define the ecological risks:

- Re-evaluate the data in a Baseline Ecological Risk Assessment that assesses the exposure of specific receptor species that occur on site using average and maximum contaminant concentrations, where appropriate.

- Conduct appropriate toxicity tests and biological sampling to determine if adverse effects or exposures are occurring to ecological receptors and to aid in the development of cleanup levels if necessary.

- Perform a further evaluation of the background conditions for certain COPCs such that site-specific risks can be characterized in the context of contributions from background.

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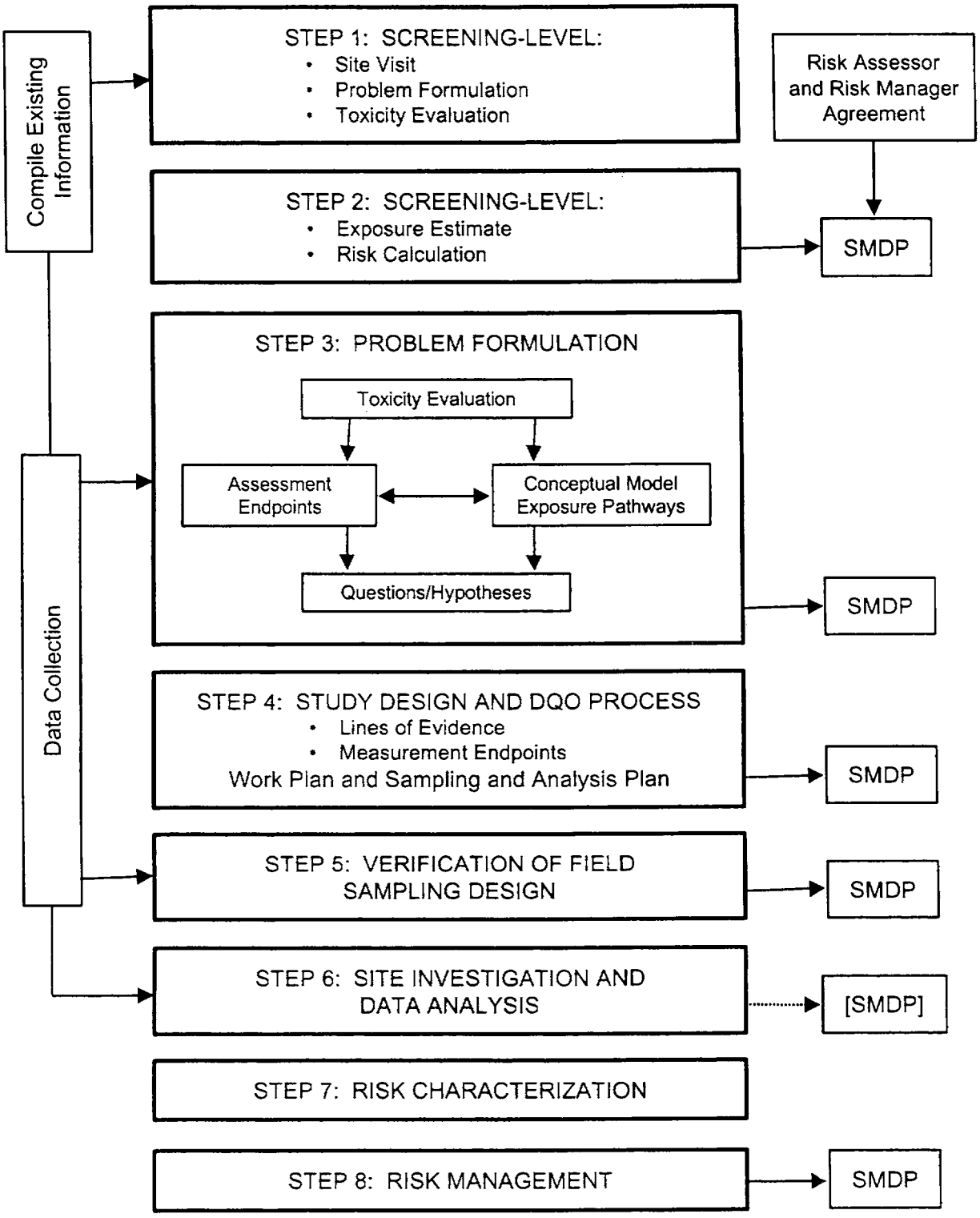

FIGURE C-1

EIGHT STEP ECOLOGICAL RISK ASSESSMENT PROCESS FOR SUPERFUND

Source: USEPA, 1997a

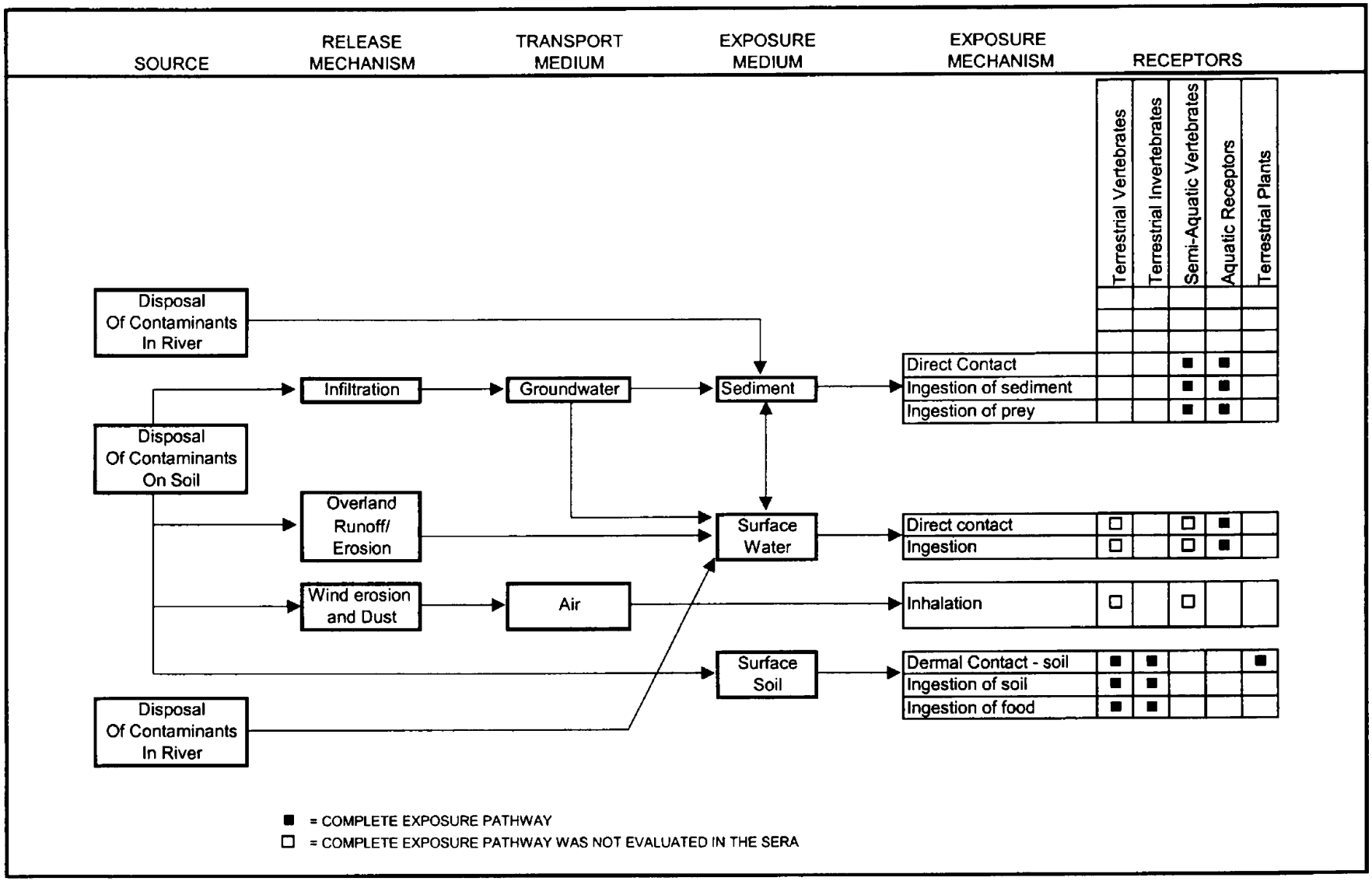

FIGURE C-2

ECOLOGICAL CONCEPTUAL SITE MODEL
CENTREDALE MANOR SITE

TABLE C-1.1

OBSERVED VEGETATION
Woonsquatucket River- Centredale Manor Site Study Area

TREES/SAPLINGS

Common Name	Scientific Name
American Beech	*Fagus grandifolia*
Big-toothed Aspen	*Populus grandidenta*
Black Birch	*Betula lenta*
Black Cherry	*Prunus serotina*
Black Gum	*Nyssa Sylvatica*
Black Locust	*Robinia pseudo-acacia*
Black Willow	*Salix nigra*
Black Willow	*Salix nigra*
Box Elder	*Acer negundo*
Eastern Hemlock	*Tsuga canadensis*
Gray Birch	*Betula populifolia*
Green Ash	*Fraxinus pennsylvanica*
Norway Maple	*Acer plantanoides*
Quaking Aspen	*Populus tremuloides*
Red Maple	*Acer rubrum*
Red Oak	*Quercus rubra*
Red Pine	*Pinus resinosa*
Silver Maple	*Acer saccharinum*
Slippery Elm	*Ulmus rubra*
Slippery Elm	*Ulmus rubra*
Speckled Alder	*Alnus rugosa*
Staghorn Sumac	*Rhus typhina*
Sycamore	*Plantanus occidentalis*
Tartarian Honeysuckle	*Lonicera tatarica*
Tree of Heaven	*Ailanthus altissima*
White Pine	*Pinus strobus*
Willows	*Salix spp.*

TABLE C-1.1
OBSERVED VEGETATION
Woonsquatucket River- Centredale Manor Site Study Area

SHRUBS and VINES

Common Name	Scientific Name
Bittersweet, Asiatic	*Celatrus orbiculatus*
Blueberry	*Vaccinium corymbosum*
Common Elderberry	*Sambucus canadensis*
Common Witch-hazel	*Hamamelis virginiana*
Grape	*Vitis sp.*
Greenbriar	*Smilax sp.*
Meadowsweet	*Spirea latifolia.*
Multiflora Rose	*Rosa multiflora*
Nortern Arrowood	*Viburnum cassinoides*
Northern Arrowood	*Viburnum recognitum*
Poison Ivy	*Toxicodendron radicans*
Pussy Willow	*Salix discolor*
Serviceberry	*Amelanchier sp.*
Sheep Laural	*Kalmia angustifolia*
Silky Dogwood	*Cornus amomum*
Staghorn Sumac	*Rhus typhina*
Sweet Pepperbush	*Clethra alnifolia*
Sweetfern	*Comptinia peregrina*
Waterwillow	*Decodon verticillatus*

HERBACEOUS PLANTS

Common Name	Scientific Name
Blue Flag	*Iris versicolor*
Blue vervain	*Verbena hastata*
Canada Rush	*Juncus canadensis*
Cattail	*Typha latifolia*
Common Reed	*Phragmites australis*
Curled Dock	*Rumex crispus*
Goldenrods	*Solidago spp.*
Japanese Knotweed	*Polygonum cuspidatum*
Purple Loosestrife	*Lythrum salicaria*
Reed Canarygrass	*Phalaris arundicea*
Sensitive Fern	*Regalis sinsibilis*
Skunk Cabbage	*Symplocarpus foetidus*
Soft rush	*Juncus effusus*
Swamp milkweed	*Asclepias incarnata*
Tussock Sedge	*Carex stricta*
Virgin's bower	*Clematis virginiana*
Woolgrass	*Scirpus cyperinus*

TABLE C-1.2
WILDLIFE
Woonsquatucket River- Centredale Manor Site Study Area

BIRDS

Common Name	Scientific Name
American black duck	*Anas rubripes*
American crow	*Corvus brachyrynchos*
American goldfinch	*Carduelis tristis*
American robin	*Turdus migratorius*
American woodcock	*Philohela minor*
Barn swallow	*Hirundo rustica*
Belted kingfisher	*Megaceryle alcyon*
Black-capped chickadee	*Parus atricapillus*
Blue jay	*Cyanocitta cristata*
Brown-headed cowbird	*Molothrus ater*
Canada goose	*Branta canadensis*
Chipping sparrow	*Spizella passerina*
Common grackle	*Quiscalus quiscula*
Downy woodpecker	*Picoides pubescens*
Eastern Meadowlark	*Sturnella magna*
European starling	*Sturnus vulgaris*
Gadwell	*Anas strepera*
Great Blue Heron (reported)	*Ardea herodius*
Killdeer	*Charadrius vociferus*
Mallard	*Anas platyrynchos*
Marsh hawk (Northern Harrier)	*Circus cyaneus*
Mourning dove	*Zenaida macroura*
Mute Swan	*Cygnus olor*
Northern flicker	*Colaptes auratus*
Northern mockingbird	*Mimus polyglottos*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*

TABLE C-1.2
WILDLIFE
Woonsquatucket River- Centredale Manor Site Study Area

Birds Continued

Song sparrow	*Melospiza melodia*
Tree swallow	*Techycineta bicolor*
Tufted titmouse	*Parus bicolor*
White-breasted nuthatch	*Sitta carolinensis*
Wood duck	*Aix sponsa*

(Note: sources include TtNUS, RIDEM FWS, EPA and Public)

Mammals

Common Name	Scientific Name	Status
Coyote	*Canis latrans*	Reported
Eastern Cottontail	*Sylvilagus floridanus*	Reported
Mink	*Mustela vison*	Probable /Potential
Muskrat	*Ondatra zibethica*	Sign
Opossum	*Didelphis marsupialis*	Observed
Racoon	*Procylon lotor*	Sign
Red Fox	*Vulpes fulpa*	Observed, sign
River Otter	*Lutra canadensis*	Sign
Skunk, Striped	*Mephitis mephitis*	Reported
Whitetail deer	*Odocorleus viginianus*	Sign

(Note: sources include TtNUS, RIDEM FWS, EPA and Public)

REPTILES and AMPHIBIANS

Common Name	Scientific Name
Bullfrog	Rana catesbeiana
Eastern American toad	*Bufo a. americanus*
Eastern garter snake	*Thamnophis s. sirtalis*
Eastern Painted Turtle	*Chrysemys picta*
Green frog	*Rana clamitans melanota*
Snapping turtle (reported)	*Chelydra serpentina*
Spotted Turtle	*Clemmys guttata*

(Note: sources include TtNUS, RIDEM FWS, EPA and Public)

TABLE C-1.2
WILDLIFE
Woonsquatucket River- Centredale Manor Site Study Area

FISH

Common Name	Scientific Name	Status
Bluegill	*Lepomis macrochirus*	*
White sucker	*Catostomus commersoni*	Observed and *
Tessellated darter	*Etheostoma olmstedi*	*
Largemouth bass	*Micropterus salmoides*	*
American eel	*Anguilla rostrata*	*
Pumkinseed	*Lepomis gibbosus*	*
Golden shiner	*Notemigonus crysoleucas*	*
Fallfish	*Semotilus corporalis*	*
Chain pickerel	*Esox niger*	*
Yellow bullhead	*Ictalurus matalis*	*
White perch	*Morone americana*	Reported

*Fish species are from RIDEM FWS Woonsquatucket River locations upstream and downstream of study area
Reported – reported to EPA by public

TABLE C-2

SURFACE SOIL AND SEDIMENT SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Soil Screening Values						Sediment Screening Values			
	Plant		Invertebrate		Wildlife		Aquatic Receptors		Semi-Aquatic Receptors	
	Value	Source	Value	Source	Value	Source	Value		Value	Source
Dioxins (ng/kg)										
1,2,3,4,6,7,8-HpCDD					30 (14)	Sample, 1996	60000 (14)	USEPA, 1993b	250 (14)	USEPA, 1993b
1,2,3,4,6,7,8-HpCDF					30 (14)	Sample, 1996	6000 (14)	USEPA, 1993b	250 (14)	USEPA, 1993b
1,2,3,4,7,8,9-HpCDF					30 (14)	Sample, 1996	6000 (14)	USEPA, 1993b	250 (14)	USEPA, 1993b
1,2,3,4,7,8-HxCDD					3 (14)	Sample, 1996	120 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,4,7,8-HxCDF					3 (14)	Sample, 1996	600 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,6,7,8-HxCDD					3 (14)	Sample, 1996	6000 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,6,7,8-HxCDF					590	Sample, 1996	600 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,7,8,9-HxCDD					3 (14)	Sample, 1996	6000 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,7,8,9-HxCDF					3 (14)	Sample, 1996	600 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
1,2,3,7,8-PeCDD					0.3 (14)	Sample, 1996	60 (14)	USEPA, 1993b	2.5 (14)	USEPA, 1993b
1,2,3,7,8-PeCDF					590	Sample, 1996	1200 (14)	USEPA, 1993b	50 (14)	USEPA, 1993b
1,2,4,5,7,8-hexachloro(9H)xanthene					0.13 (13)	Zabel 1996	26.20087 (13)	Zabel 1996	1.09 (13)	Zabel 1996
2,3,4,6,7,8-HxCDF					3 (14)	Sample, 1996	600 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
2,3,4,7,8-PeCDF					60	Sample, 1996	120 (14)	USEPA, 1993b	5 (14)	USEPA, 1993b
2,3,7,8-TCDD					0.3	Sample, 1996	60	USEPA, 1993b	2.5	USEPA, 1993b
2,3,7,8-TCDF					0.8	Sample, 1996	1200 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
OCDD					3,000 (14)	Sample, 1996	600000 (14)	USEPA, 1993b	25,000 (14)	USEPA, 1993b
OCDF					3,000 (14)	Sample, 1996	600000 (14)	USEPA, 1993b	25,000 (14)	USEPA, 1993b
PCDD/Fs					0.3 (14)	Sample, 1996	60 (14)	USEPA, 1993b	2.5 (14)	USEPA, 1993b
Total HpCDD					30 (14)	Sample, 1996	60000 (14)	USEPA, 1993b	250 (14)	USEPA, 1993b
Total HpCDF					30 (14)	Sample, 1996	6000 (14)	USEPA, 1993b	250 (14)	USEPA, 1993b
Total HxCDD					3 (14)	Sample, 1996	120 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
Total HxCDF					3 (14)	Sample, 1996	600 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b
Total PeCDD					0.3 (14)	Sample, 1996	60 (14)	USEPA, 1993b	2.5 (14)	USEPA, 1993b
Total PeCDF					0.6 (14)	Sample, 1996	120 (14)	USEPA, 1993b	5 (14)	USEPA, 1993b
Total TCDD					0.3 (14)	Sample, 1996	60 (14)	USEPA, 1993b	2.5 (14)	USEPA, 1993b
Total TCDF					3 (14)	Sample, 1996	1200 (14)	USEPA, 1993b	25 (14)	USEPA, 1993b

TABLE C-2

SURFACE SOIL AND SEDIMENT SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

	Soil Screening Values						Sediment Screening Values			
	Plant		Invertebrate		Wildlife		Aquatic Receptors		Semi-Aquatic Receptors	
Parameter	Value	Source	Value	Source	Value	Source	Value		Value	Source
Inorganics (mg/kg)										
Aluminum	50	Efroymson, 1997b			3.825	Sample, 1996	58030	ARCS, 1996	3.825	Sample, 1996
Antimony	5	Efroymson, 1997b			0.248	Sample, 1996	2	ER-L (Long, 1991)	0.248	Sample, 1996
Arsenic	10	Efroymson, 1997b	60	Efroymson, 1997a	0.25	Sample, 1996	8.2	ER-L (Long, 1995)	0.25	Sample, 1996
Barium	500	Efroymson, 1997b			17.2	Sample, 1996			17.2	Sample, 1996
Beryllium	10	Efroymson, 1997b			2.42	Sample, 1996			2.42	Sample, 1996
Cadmium	4	Efroymson, 1997b	20	Efroymson, 1997a	1.2	Sample, 1996	1.2	ER-L (Long, 1995)	1.2	Sample, 1996
Calcium										
Chromium	1	Efroymson, 1997b	0.4	Efroymson, 1997a	0.83 [3]	Sample, 1996	81	ER-L (Long, 1995)	0.83 [3]	Sample, 1996
Cobalt	20	Efroymson, 1997b					50	LEL (OMOE, 1993)		
Copper	100	Efroymson, 1997b	50	Efroymson, 1997a	38.9	Sample, 1996	34	ER-L (Long, 1995)	38.9	Sample, 1996
Iron							20,000	LEL (OMOE, 1993)		
Lead	50	Efroymson, 1997b	500	Efroymson, 1997a	0.94	Sample, 1996	46.7	ER-L (Long, 1995)	0.94	Sample, 1996
Magnesium										
Manganese	500	Efroymson, 1997b			322	Sample, 1996	460	LEL (OMOE, 1993)	322	Sample, 1996
Mercury	0.3	Efroymson, 1997b	0.1	Efroymson, 1997a	0.005	Sample, 1996	0.15	ER-L (Long, 1995)	0.005	Sample, 1996
Molybdenum	2	Efroymson, 1997b			0.52	Sample, 1996			0.52	Sample, 1996
Nickel	30	Efroymson, 1997b	200	Efroymson, 1997a	64	Sample, 1996	20.9	ER-L (Long, 1995)	64	Sample, 1996
Potassium										
Selenium	1	Efroymson, 1997b	70	Efroymson, 1997a	0.331	Sample, 1996			0.331	Sample, 1996
Silver	2	Efroymson, 1997b					1	ER-L (Long, 1995)		
Sodium										
Thallium	1	Efroymson, 1997b			0.027	Sample, 1996			0.027	Sample, 1996
Vanadium	2	Efroymson, 1997b			0.714	Sample, 1996			0.714	Sample, 1996
Zinc	50	Efroymson, 1997b	200	Efroymson, 1997a	12	Sample, 1996	150	ER-L (Long, 1995)	12	Sample, 1996

TABLE C-2

SURFACE SOIL AND SEDIMENT SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
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	Soil Screening Values						Sediment Screening Values			
	Plant		Invertebrate		Wildlife		Aquatic Receptors		Semi-Aquatic Receptors	
Parameter	Value	Source	Value	Source	Value	Source	Value		Value	Source
Semivolatile Organic Compounds (ug/kg)										
1,2,4-Trichlorobenzene	48,000	Hulzebos, 1993								
2,4,5-Trichlorophenol	4,000	Efroymson, 1997b	9000	Efroymson, 1997a						
2-Methylnaphthalene					1980 [15]	Sample, 1996	70	ER-L (Long, 1995)	1980 [15]	Sample, 1996
2-Nitrophenol										
Acenaphthene	20,000	Efroymson, 1997b			1980 [15]	Sample, 1996	16	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Acenaphthylene					1980 [15]	Sample, 1996	44	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Anthracene							85.3	ER-L (Long, 1995)		
Benzaldehyde										
Benzo(a)anthracene					1980 [15]	Sample, 1996	261	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Benzo(a)pyrene					1980	Sample, 1996	430	ER-L (Long, 1995)	1980	Sample, 1996
Benzo(b)fluoranthene					1980 [15]	Sample, 1996			1980 [15]	Sample, 1996
Benzo(g,h,i)perylene					1980 [15]	Sample, 1996	170	LEL (OMOE, 1993)	1980 [15]	Sample, 1996
Benzo(k)fluoranthene					1980 [15]	Sample, 1996	240	LEL (OMOE, 1993)	1980 [15]	Sample, 1996
bis(2-Ethylhexyl)phthalate	1,000,000	Hulzebos, 1993			910	Sample, 1996			910	Sample, 1996
Butylbenzylphthalate							11000	USUSEPA, 1996		
Carbazole										
Chrysene					1980 [15]	Sample, 1996	384	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Di-n-Butylphthalate	200,000	Efroymson, 1997b			90	Sample, 1996	11000	USUSEPA, 1996	90	Sample, 1996
Di-n-octylphthalate										
Dibenzo(a,h)anthracene					1980 [15]	Sample, 1996	63.4	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Dibenzofuran							2000	USEPA, 1996		
Fluoranthene					1980 [15]	Sample, 1996	600	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Fluorene			30,000	Efroymson, 1997a	1980 [15]	Sample, 1996	19	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Indeno(1,2,3-cd)pyrene					1980 [15]	Sample, 1996	200	LEL (OMOE, 1993)	1980 [15]	Sample, 1996
Naphthalene	100,000	Hulzebos, 1993			1980 [15]	Sample, 1996	160	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Pentachlorophenol	3,000	Efroymson, 1997b	6,000	Efroymson, 1997a	879	Sample, 1996			879	Sample, 1996
Phenanthrene					1980 [15]	Sample, 1996	240	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Pyrene					1980 [15]	Sample, 1996	665	ER-L (Long, 1995)	1980 [15]	Sample, 1996
Low Molecular Weight PAHs							552	ER-L (Long, 1995)		
High Molecular Weight PAHs							1700	ER-L (Long, 1995)		
Total PAHs					1980 [15]	Sample, 1996			1980 [15]	Sample, 1996
Volatile Organic Compounds (ug/kg)										
Chlorobenzene			40,000	Efroymson, 1997a			820	USEPA, 1996		
Toluene	200,000	Efroymson, 1997b			51,500	Sample, 1996	670	USEPA, 1996	51,500	Sample, 1996

TABLE C-2

SURFACE SOIL AND SEDIMENT SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

	Soil Screening Values						Sediment Screening Values			
	Plant		Invertebrate		Wildlife		Aquatic Receptors		Semi-Aquatic Receptors	
Parameter	Value	Source	Value	Source	Value	Source	Value		Value	Source
Pesticides/PCBs (ug/kg)										
4,4'-DDD					2 [4]	Sample, 1996	8	LEL (OMOE, 1993)	2 [4]	Sample, 1996
4,4'-DDE					2 [4]	Sample, 1996	2.2	ER-L (Long, 1995)	2 [4]	Sample, 1996
4,4'-DDT					2 [4]	Sample, 1996	1.58 [1]	ER-L (Long, 1995)	2 [4]	Sample, 1996
Aldrin					733	Sample, 1996	2	LEL (OMOE, 1993)	733	Sample, 1996
alpha-BHC					70 [11]	Sample, 1996	6	LEL (OMOE, 1993)	70 [11]	Sample, 1996
alpha-Chlordane					1800 [2]	Sample, 1996	7 [2]	LEL (OMOE, 1993)	1800 [2]	Sample, 1996
Aroclor, Total	40,000	Efroymson, 1997b			71 [18]	Sample, 1996	22.7	ER-L (Long, 1995)	71 [18]	Sample, 1996
Aroclor-1016					6520	Sample, 1996	7	LEL (OMOE, 1993)	6520	Sample, 1996
Aroclor-1221					71 [18]	Sample, 1996	5 [17]	LEL (OMOE, 1993)	71 [18]	Sample, 1996
Aroclor-1232					71 [18]	Sample, 1996	5 [17]	LEL (OMOE, 1993)	71 [18]	Sample, 1996
Aroclor-1242					329	Sample, 1996	5 [17]	LEL (OMOE, 1993)	329	Sample, 1996
Aroclor-1248					71	Sample, 1996	30	LEL (OMOE, 1993)	71	Sample, 1996
Aroclor-1254					111	Sample, 1996	60	LEL (OMOE, 1993)	111	Sample, 1996
Aroclor-1260					71 [18]	Sample, 1996	5	LEL (OMOE, 1993)	71 [18]	Sample, 1996
beta-BHC					1470	Sample, 1996	5	LEL (OMOE, 1993)	1470	Sample, 1996
delta-BHC					70 [11]	Sample, 1996	3 [9]	LEL (OMOE, 1993)	70 [11]	Sample, 1996
Dieldrin					64	Sample, 1996	52	USEPA, 1996	64	Sample, 1996
Endosulfan I	1,000,000	Hulzebos, 1993			550 [5]	Sample, 1996	2.9	USEPA, 1996	550 [5]	Sample, 1996
Endosulfan II	1,000,000	Hulzebos, 1993			550 [5]	Sample, 1996	14	USEPA, 1996	550 [5]	Sample, 1996
Endosulfan Sulfate	1,000,000	Hulzebos, 1993			550 [5]	Sample, 1996	5.4	USEPA, 1996	550 [5]	Sample, 1996
Endrin					8	Sample, 1996	20	USEPA, 1996	8	Sample, 1996
Endrin Aldehyde					8 [12]	Sample, 1996	20 [12]	USEPA, 1996	8 [12]	Sample, 1996
Endrin Ketone					8 [12]	Sample, 1996	20 [12]	USEPA, 1996	8 [12]	Sample, 1996
gamma-BHC					1660	Sample, 1996	3	LEL (OMOE, 1993)	1660	Sample, 1996
gamma-Chlordane					1800 [2]	Sample, 1996	7 [2]	LEL (OMOE, 1993)	1800 [2]	Sample, 1996
Heptachlor					476	Sample, 1996	5 [10]	LEL (OMOE, 1993)	476	Sample, 1996
Heptachlor Epoxide					476 [6]	Sample, 1996	5	LEL (OMOE, 1993)	476 [6]	Sample, 1996
Methoxychlor					14,700	Sample, 1996	19	USEPA, 1996	14,700	Sample, 1996
Technical Chlordane					1800 [2]	Sample, 1996	7 [2]	USEPA, 1996	1800 [2]	Sample, 1996
Toxaphene					29,300	Sample, 1996	28	USEPA, 1996	29,300	Sample, 1996
3,3',4,4'-Tetrachlorobiphenyl										

TABLE C-2

SURFACE SOIL AND SEDIMENT SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

	Soil Screening Values						Sediment Screening Values			
	Plant		Invertebrate		Wildlife		Aquatic Receptors		Semi-Aquatic Receptors	
Parameter	Value	Source	Value	Source	Value	Source	Value		Value	Source
Herbicides (ug/kg)										
Dalapon										

1 - Value is based on Total DDT value
2 - Value is based on chlordane value
3 - Value is based on hexavalent chromium value
4 - Value is based on DDT and metabolites
5 - Value is based on endosulfan value
6 - Value is based on heptachlor value
7 - Value is based on 1,2-dichloroethene value
8 - Value is based on xylene mixed isomers - value
9 - Value is based on gamma-BHC value
10 - Value is based on heptachlor epoxide value
11 - Value is based on BHC-mixed isomers
12 - Value is based on endrin value
13 - Based on TEF of 2.29 for 2,3,6,7-tetrachloroxanthene Zubel and Peterson, 1996 -
14 - Value is based on 2,3,7,8-TCDD with TEFs from Vanderberg et al. 1998 -
15 - Value is based on benzoa -pyrene value
16 - Value is based on Aroclor-1248 value
17 - Value is based on Aroclor-1260 value

TABLE C-3

SURFACE WATER SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Surface Water Screening Value			
	Semi-Aquatic Receptors		Aquatic Receptors	
	Value	Source[8]	Value	Source
Dioxins (pg/L)				
1,2,3,4,6,7,8-HpCDD	0.8 [7]	USEPA, 1993b	600 [7]	USEPA, 1993b
1,2,3,4,6,7,8-HpCDF	0.8 [7]	USEPA, 1993b	60 [7]	USEPA, 1993b
1,2,3,4,7,8,9-HpCDF	0.8 [7]	USEPA, 1993b	60 [7]	USEPA, 1993b
1,2,3,4,7,8-HxCDD	0.08 [7]	USEPA, 1993b	1.2 [7]	USEPA, 1993b
1,2,3,4,7,8-HxCDF	0.08 [7]	USEPA, 1993b	6 [7]	USEPA, 1993b
1,2,3,6,7,8-HxCDD	0.08 [7]	USEPA, 1993b	60 [7]	USEPA, 1993b
1,2,3,6,7,8-HxCDF	0.08 [7]	USEPA, 1993b	6 [7]	USEPA, 1993b
1,2,3,7,8,9-HxCDD	0.08 [7]	USEPA, 1993b	60 [7]	USEPA, 1993b
1,2,3,7,8,9-HxCDF	0.08 [7]	USEPA, 1993b	6 [7]	USEPA, 1993b
1,2,3,7,8-PeCDD	0.008 [7]	USEPA, 1993b	0.6 [7]	USEPA, 1993b
1,2,3,7,8-PeCDF	0.16 [7]	USEPA, 1993b	12 [7]	USEPA, 1993b
1,2,4,5,7,8-hexachloro(9H)xanthene	0.0035 [6]	USEPA, 1993b	0.26200873 [6]	Zabel 1996
2,3,4,6,7,8-HxCDF	0.08 [7]	USEPA, 1993b	6 [7]	USEPA, 1993b
2,3,4,7,8-PeCDF	0.016 [7]	USEPA, 1993b	1.2 [7]	USEPA, 1993b
2,3,7,8-TCDD	0.008	USEPA, 1993b	0.6	USEPA, 1993b
2,3,7,8-TCDF	0.08 [7]	USEPA, 1993b	12 [7]	USEPA, 1993b
OCDD	80 [7]	USEPA, 1993b	6000 [7]	USEPA, 1993b
OCDF	80 [7]	USEPA, 1993b	6000 [7]	USEPA, 1993b
Total HpCDD	**0.8** [7]	USEPA, 1993b	600 [7]	USEPA, 1993b
Total HpCDF	0.8 [7]	USEPA, 1993b	60 [7]	USEPA, 1993b
Total HxCDD	**0.08** [7]	USEPA, 1993b	1.2 [7]	USEPA, 1993b
Total HxCDF	0.08 [7]	USEPA, 1993b	6 [7]	USEPA, 1993b
Total PeCDD	**0.008** [7]	USEPA, 1993b	0.6 [7]	USEPA, 1993b
Total PeCDF	**0.016** [7]	USEPA, 1993b	1.2 [7]	USEPA, 1993b
Total TCDD	**0.008** [7]	USEPA, 1993b	0.6 [7]	USEPA, 1993b
Total TCDF	0.08 [7]	USEPA, 1993b	12 [7]	USEPA, 1993b

TABLE C-3

SURFACE WATER SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 2 OF 3

Parameter	Surface Water Screening Value			
	Semi-Aquatic Receptors		Aquatic Receptors	
	Value	Source[8]	Value	Source
Inorganics (ug/L)				
Aluminum	18	Sample, 1996	87	USEPA, 1999
Arsenic	16	Sample, 1996	150	USUSEPA, 1999
Barium	23100	Sample, 1996	4	Suter, 1996
Beryllium	136	Sample, 1996	0.66	Suter, 1996
Cadmium	0.2307	Sample, 1996	2.2	USEPA, 1999
Calcium				
Chromium	3593	Sample, 1996	11	USEPA, 1999
Cobalt			23	Suter, 1996
Copper	213	Sample, 1996	9	USEPA, 1999
Iron			1000	USEPA, 1999
Lead	49	Sample, 1996	2.5	USEPA, 1999
Magnesium				
Manganese	377000	Sample, 1996	120	Suter, 1996
Nickel	1438	Sample, 1996	52	USEPA, 1999
Potassium				
Selenium	0.2363	Sample, 1996	5	USEPA, 1999
Silver			3.4	USEPA, 1999
Sodium				
Thallium	1	Sample, 1996	12	Suter, 1996
Vanadium	835	Sample, 1996	20	Suter, 1996
Zinc	30	Sample, 1996	120	USEPA, 1999
Semivolatile Organic Compounds (ug/L)				
bis(2-Ethylhexyl)phthalate	0.0007593	Sample, 1996	3	Suter, 1996
Phenol			110	Suter, 1996
Pesticides/PCBs (ug/L)				
4,4'-DDE	0.00001048 [3]	Sample, 1996	0.001 [3]	USEPA, 1999
4,4'-DDT	0.00001048	Sample, 1996	0.001	USEPA, 1999
Aldrin	0.001	Sample, 1996	3	USEPA, 1999
alpha-BHC	0.0003971 [2]	Sample, 1996	0.95 [2]	USEPA, 1999
alpha-Chlordane	0.00889 [1]	Sample, 1996	0.0043 [1]	USEPA, 1999

TABLE C-3

SURFACE WATER SCREENING VALUES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

	Surface Water Screening Value			
	Semi-Aquatic Receptors		Aquatic Receptors	
Parameter	Value	Source[8]	Value	Source
Aroclor-1254	0.000192	Sample, 1996	0.014	USEPA, 1999
delta-BHC	0.0003971 [2]	Sample, 1996	0.95 [2]	USEPA, 1999
Endosulfan Sulfate	1 [5]	Sample, 1996	0.056 [5]	USEPA, 1999
Endrin	0.001313	Sample, 1996	0.036	USEPA, 1999
Endrin Aldehyde	0.001313 [4]	Sample, 1996	0.036 [4]	USEPA, 1999
gamma-Chlordane	0.00889 [1]	Sample, 1996	0.0043 [1]	USEPA, 1999

1 - Value based on chlordane
2 - Value based on gamma-BHC
3 - Value based on DDT
4 - Value based on Endrin
5 - Value based on Endosulfan
6 - Based on TEF of 2.29 for 2,3,6,7-tetrachloroxanthene Zubel and Peterson, 1996 -
7 - Based on 2,3,7,8-TCDD with TEFs from Van der berg et al. 1998 -
8 - The values from Sample et al., 1996 -were based on the lower of the piscivorous wildlife or the drinking water value.

TABLE C-4

RESIDENTIAL SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (ng/kg)												
1,2,3,4,6,7,8-HpCDD	179	169	94	2.09 EMPC	5300	333	0	30	107	177	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	179	163	91	1.2 EMPC	2920 $	100	0	30	64	97.3	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	179	127	71	0.24	694	9.6	0	30	8	23.1	Yes	> Criteria
1,2,3,4,7,8-HxCDD	179	134	75	0.201	167	7.7	0	3	49	55.7	Yes	> Criteria
1,2,3,4,7,8-HxCDF	179	134	75	0.199 EMPC	1720 EB$	24.9	0	3	96	573	Yes	> Criteria
1,2,3,6,7,8-HxCDD	179	126	70	0.347 EMPC	284	20.2	0	3	77	94.7	Yes	> Criteria
1,2,3,6,7,8-HxCDF	178	147	83	0.22 EMPC	797	14.4	0	590	1	1.4	Yes	> Criteria
1,2,3,7,8,9-HxCDD	179	128	72	0.247 EMPC	580	21.1	0	3	82	193	Yes	> Criteria
1,2,3,7,8,9-HxCDF	176	77	44	0.177	51.8	1.7	0	3	20	17.3	Yes	> Criteria
1,2,3,7,8-PeCDD	179	108	60	0.0826 EMPC	187	8	0	0.3	107	623	Yes	> Criteria
1,2,3,7,8-PeCDF	179	136	76	0.12 EMPC	239	7.2	0	590	0	0.4	No	< Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	62	62	100	0.59 J	5150	266	0	0.13	62	39615	Yes	> Criteria
2,3,4,6,7,8-HxCDF	179	160	89	0.167 EMPC	1260	20.3	0	3	95	420	Yes	> Criteria
2,3,4,7,8-PeCDF	179	138	77	0.064 EMPC	745	15.8	0	60	7	12.4	Yes	> Criteria
2,3,7,8-TCDD	203	180	89	0.0948 EMPC	57310	1540	0	0.3	176	191033	Yes	> Criteria
2,3,7,8-TCDF	179	142	79	0.146 EMPC	811 $	24.3	0	0.8	134	1014	Yes	> Criteria
OCDD	179	177	99	19.1	29200 J&	1780	0	3000	25	9.7	Yes	> Criteria
OCDF	179	177	99	1.3 EMPC	2240 J	114	0	3000	0	0.7	No	< Criteria
PCDD/Fs	48	48	100	212	68300	6860	0	0.3	48	227667	Yes	> Criteria
Total HpCDD	174	158	91	6.8	9750	623	0	30	134	325	Yes	> Criteria
Total HpCDF	174	159	91	1.8 EMPC	4540 J$	200	0	30	94	151	Yes	> Criteria
Total HxCDD	173	141	82	2	3360 J$	176	0	3	138	1120	Yes	> Criteria
Total HxCDF	174	158	91	1.7 EMPC	4950 J$	224	0	3	157	1650	Yes	> Criteria
Total PeCDD	174	152	87	0.83 EMPC	2620 J	75.4	0	0.3	152	8733	Yes	> Criteria
Total PeCDF	172	164	95	0.99 EMPC	7370 J	280	0	0.6	164	12283	Yes	> Criteria
Total TCDD	174	162	93	0.78 EMPC	59560	1470	0	0.3	162	198533	Yes	> Criteria
Total TCDF	170	162	95	0.7 EMPC	6810	324	0	3	156	2270	Yes	> Criteria
Inorganics (mg/kg)												
Aluminum	61	61	100	2160	213000	11400	0	3.825	61	55686	Yes	> Criteria
Antimony	61	21	34	1.6 J	38.2 J	3.1	0	0.248	21	154	Yes	> Criteria
Arsenic	61	60	98	1.7 J	55.6	7.2	0	0.25	60	222	Yes	> Criteria
Barium	61	61	100	17.7	874	128	0	17.2	61	50.8	Yes	> Criteria
Beryllium	59	24	41	0.36	2.9 J	0.5	0	2.42	1	1.2	Yes	> Criteria
Cadmium	59	26	44	0.32 J	7.9	0.94	0	1.2	13	6.6	Yes	> Criteria
Calcium	61	58	95	714	48700	4750	0	NA	---	---	No	Nontoxic[2]
Chromium	61	61	100	4.6	536 J	84.6	0	0.4	61	1340	Yes	> Criteria
Cobalt	61	60	98	1.9	21.7	5.7	0	20	2	1.1	Yes	> Criteria
Copper	61	60	98	8.2	25500	551	0	38.9	41	656	Yes	> Criteria
Iron	61	61	100	5350	89700	18400	0	NA	---	---	Yes	No Criteria
Lead	61	61	100	10.4	2460	370	0	0.94	61	2617	Yes	> Criteria
Magnesium	61	61	100	886 J	10100	2110	0	NA	---	---	No	Nontoxic[2]

TABLE C-4

RESIDENTIAL SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 2 OF 3

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Manganese	61	61	100	66.5	2880	334	0	322	22	8.9	Yes	> Criteria
Mercury	58	24	41	0.05 J	3	0.32	0	0.005	25	600	Yes	> Criteria
Nickel	61	61	100	3.2	71.6	19.5	0	30	12	2.4	Yes	> Criteria
Potassium	61	61	100	313	4380	749	0	NA	---	---	No	Nontoxic[2]
Selenium	58	16	28	0.58 J	4.7	1.2	0	0.331	17	14.2	Yes	> Criteria
Silver	61	26	43	0.26 J	6.4 J	1.1	0	2	10	3.2	Yes	> Criteria
Sodium	61	41	67	94.8	2010	234	0	NA	---	---	No	Nontoxic[2]
Thallium	58	2	3	2.4 J	6.8 J	1.2	0	0.027	3	252	Yes	> Criteria
Vanadium	61	61	100	5.9	79.3	26.8	0	0.714	61	111	Yes	> Criteria
Zinc	61	61	100	17.9	1730	284	0	12	61	144	Yes	> Criteria
Semivolatile Organic Compounds (ug/kg)												
1,1'-Biphenyl	57	1	2	120 J	120 J	2500	0				Yes	No Criteria
2-Methylnaphthalene	57	2	4	44 J	1100	2400	0	1980	0	0.6	No	< Criteria
Acenaphthene	57	7	12	80 J	14000 J	1700	0	1980	1	7.1	Yes	> Criteria
Acenaphthylene	58	6	10	160 J	3100	2400	0	1980	1	1.6	Yes	> Criteria
Anthracene	59	32	54	17 J	40000 J	1500	0	1980	????	20.2	Yes	> Criteria
Benzaldehyde	58	11	19	52 J	800 J	2300	0	NA	---	---	Yes	No Criteria
Benzo(a)anthracene	61	51	84	30 J	140000	3800	0	1980	13	70.7	Yes	> Criteria
Benzo(a)pyrene	61	50	82	62 J	110000 J	3500	0	1980	12	55.6	Yes	> Criteria
Benzo(b)fluoranthene	61	53	87	38 J	120000	3800	0	1980	13	60.6	Yes	> Criteria
Benzo(g,h,i)perylene	61	39	64	71 J	58000 J	2400	0	1980	10	29.3	Yes	> Criteria
Benzo(k)fluoranthene	61	53	87	42 J	100000 J	3500	0	1980	15	50.5	Yes	> Criteria
bis(2-Ethylhexyl)phthalate	61	29	48	49 JEB	10000	2700	0	910	11	11.0	Yes	> Criteria
Butylbenzylphthalate	58	4	7	140 J	620 J	2400	0	NA	---	---	Yes	No Criteria
Carbazole	58	13	22	77 J	26000 J	1800	0	NA	---	---	Yes	No Criteria
Chrysene	61	54	89	42 J	150000	4500	0	1980	17	75.8	Yes	> Criteria
Di-n-Butylphthalate	58	6	10	37 J	610 EB	2400	0	90	2	6.8	Yes	> Criteria
Di-n-octylphthalate	58	1	2	800 J	800 J	2500	0	NA	---	---	Yes	No Criteria
Dibenzo(a,h)anthracene	60	16	27	77 J	26000 J	1800	0	1980	4	13.1	Yes	> Criteria
Dibenzofuran	57	5	9	77 J	5200	2400	0	NA	---	---	Yes	No Criteria
Fluoranthene	61	56	92	51 J	300000 J	8700	0	1980	19	152	Yes	> Criteria
Fluorene	57	11	19	59 J	16000 J	1600	0	1980	2	8.1	Yes	> Criteria
Indeno(1,2,3-cd)pyrene	61	39	64	56 J	56000 J	2400	0	1980	11	28.3	Yes	> Criteria
Naphthalene	57	3	5	65 J	2300	2500	0	1980	1	1.2	Yes	> Criteria
Pentachlorophenol	58	1	2	18000 J	18000 J	6500	0	879	1	20.5	Yes	> Criteria
Phenanthrene	60	46	77	72 J	180000 J	5800	0	1980	15	90.9	Yes	> Criteria
Pyrene	61	56	92	55 J	280000 J	8000	0	1980	21	141	Yes	> Criteria
Pesticides/PCBs (ug/kg)												
4,4'-DDD	57	13	23	4.4	38	5.7	0	2	13	19.0	Yes	> Criteria
4,4'-DDE	58	33	57	3.6 J	1100	60	0	2	33	550	Yes	> Criteria
4,4'-DDT	58	29	50	2.9 J	1300	30	0	2	29	650	Yes	> Criteria
Aldrin	57	1	2	3.4 P	3.4 P	2	0	733	0	0.0	No	< Criteria

TABLE C-4

RESIDENTIAL SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 3 OF 3

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
alpha-Chlordane	60	34	57	1.6 J	62	8.9	0	1800	0	0.0	No	< Criteria
Aroclor, Total	60	37	62	30	48000	1400	0	71	32	676	Yes	> Criteria
Aroclor-1242	58	3	5	140	11000	220	0	329	1	33.4	Yes	> Criteria
Aroclor-1254	60	37	62	30 J	37000 *	1200	0	111	29	333	Yes	> Criteria
Aroclor-1260	57	3	5	30 J	140	40	0	71	2	2.0	Yes	> Criteria
Dieldrin	57	4	7	6.3	81	5.6	0	64	1	1.3	Yes	> Criteria
Endosulfan II	59	14	24	12	3400 *	90	0	550	1	6.2	Yes	> Criteria
Endosulfan Sulfate	57	3	5	6.4	18	4.3	0	550	0	0.0	No	< Criteria
Endrin Ketone	58	7	12	15	62	7.4	0	8	7	7.8	Yes	> Criteria
gamma-Chlordane	60	33	55	2.4	260	14	0	1800	0	0.1	No	< Criteria
Heptachlor	57	2	4	2.1	4.4	2	0	476	0	0.0	No	< Criteria
Heptachlor Epoxide	57	5	9	3	26	2.7	0	476	0	0.1	No	< Criteria
Methoxychlor	57	2	4	26	35 J	20	0	14700	0	0.0	No	< Criteria

Notes:
1 - The ecological criteria are the lower of the plant, soil invertebrate, or terrestrial wildlife screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-5

BANK SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 1 OF 2

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (ng/kg)												
1,2,3,4,6,7,8-HpCDD	18	15	83	14.3	418	115	263	30	11	13.9	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	18	15	83	7.2	192	43.5	106	30	8	6.4	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	18	11	61	0.29 J	9.8 EMPC	2.2	11.8	30	0	0.3	No	< Criteria
1,2,3,4,7,8-HxCDD	18	13	72	0.38 J	9.8	2.5	3.4	3	4	3.3	Yes	> Criteria
1,2,3,4,7,8-HxCDF	18	13	72	4.2 J	49.8	10.3	26.5	3	13	16.6	Yes	> Criteria
1,2,3,6,7,8-HxCDD	18	12	67	1.3 J	24.4	6.5	14.9	3	9	8.1	Yes	> Criteria
1,2,3,6,7,8-HxCDF	18	12	67	2.2 J	21.4	4.8	10.9	590	0	0.04	No	< Criteria
1,2,3,7,8,9-HxCDD	17	15	88	0.64 J	28.1	7.7	13.4	3	9	9.4	Yes	> Criteria
1,2,3,7,8,9-HxCDF	18	6	33	0.18 J	0.67 EMPC	0.52	0	3	0	0.2	No	< Criteria
1,2,3,7,8-PeCDD	18	14	78	0.55 J	12.4	2.6	2.7	0.3	14	41.3	Yes	> Criteria
1,2,3,7,8-PeCDF	18	13	72	2.3 J	20 EMPC	4.8	9.6	590	0	0.03	No	< Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	10	10	100	1.46 J	1198.35 J	249	2.8	0.13	10	9218	Yes	> Criteria
2,3,4,6,7,8-HxCDF	18	15	83	0.2 EMPC	28.7	5.9	25.5	3	10	9.6	Yes	> Criteria
2,3,4,7,8-PeCDF	18	13	72	1.7 EMPC	20.6	5.2	17	60	0	0.3	No	< Criteria
2,3,7,8-TCDD	65	64	98	0.59 J	116000	2770	13.2	0.3	64	386667	Yes	> Criteria
2,3,7,8-TCDF	18	13	72	5.9	38.4	11.8	12.6	0.8	13	48.0	Yes	> Criteria
OCDD	18	17	94	18.8	2780 J	697	1230	3000	0	0.9	No	< Criteria
OCDF	18	13	72	11.8 EBJ	175	49.2	203	3000	0	0.1	No	< Criteria
Total HpCDD	18	15	83	30	827 J	227	471	30	14	27.6	Yes	> Criteria
Total HpCDF	18	17	94	1.4 EMPC	364 J	84.2	347	30	9	12.1	Yes	> Criteria
Total HxCDD	18	13	72	5 EMPC	253 J	64.7	120	3	13	84.3	Yes	> Criteria
Total HxCDF	18	18	100	2.1 EMPC	422 J	98.3	201	3	17	141	Yes	> Criteria
Total PeCDD	17	15	88	3.4 EMPC	68.8 J	25.9	43.1	0.3	15	229	Yes	> Criteria
Total PeCDF	18	17	94	2.9 EMPC	328 J	91.2	157	0.6	17	547	Yes	> Criteria
Total TCDD	18	17	94	3.4 EMPC	3020 J&	455	25	0.3	17	10067	Yes	> Criteria
Total TCDF	18	17	94	5.1 EMPC	405 J	89.2	87.3	3	17	135	Yes	> Criteria
Inorganics (mg/kg)												
Aluminum	18	18	100	1690	10900	5330	3340	3.825	18	2850	Yes	> Criteria
Antimony	18	4	22	1.3 J	1.8 J	0.6	0	0.248	4	7.3	Yes	> Criteria
Arsenic	18	18	100	0.89	10.5	3.9	2.7	0.25	18	42.0	Yes	> Criteria
Barium	18	18	100	10	262	54.2	95.5	17.2	16	15.2	Yes	> Criteria
Beryllium	18	17	94	0.19 J	0.96	0.45	0.67	2.42	0	0.4	No	< Criteria
Cadmium	17	3	18	0.21 J	5.1	0.37	0.3	1.2	1	4.3	Yes	> Criteria
Calcium	18	18	100	158	2920 J	1140	736	NA	---	---	No	Nontoxic[2]
Chromium	18	18	100	2.8 J	104	22.6	119	0.4	18	260	Yes	> Criteria
Copper	18	17	94	8.4	67.6	28.5	53.7	38.9	3	1.7	Yes	> Criteria
Iron	18	18	100	4890	14600	8410	7650	NA	---	---	Yes	No Criteria
Lead	18	18	100	17.8	373	118	117	0.94	18	397	Yes	> Criteria
Magnesium	18	18	100	358	1520 J	971	710	NA	---	---	No	Nontoxic[2]
Manganese	18	18	100	44.1 J	885	183	448	322	1	2.7	Yes	> Criteria
Mercury	17	17	100	0.03 J	0.48 J	0.12	0.073	0.005	17	96.0	Yes	> Criteria
Potassium	18	18	100	224	756 J	507	380	NA	---	---	No	Nontoxic[2]
Selenium	17	1	6	0.97 J	0.97 J	0.57	1.2	0.331	1	2.9	Yes	> Criteria

TABLE C-5

BANK SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 2 OF 2

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Sodium	18	2	11	17.4 J	28.5	60.6	34.6	NA	---	---	No	Nontoxic[2]
Thallium	17	1	6	0.59 J	0.59 J	0.27	0.34	0.027	1	21.9	Yes	> Criteria
Vanadium	18	18	100	8.5	56.1	26.1	50.6	0.714	18	78.6	Yes	> Criteria
Zinc	18	17	94	32.9	144 J	76.6	94.8	12	17	12.0	Yes	> Criteria
Semivolatile Organic Compounds (ug/kg)												
Acenaphthene	18	1	6	530 J	530 J	760	820	1980	0	0.3	No	< Criteria
Anthracene	18	3	17	210 J	1400 J	760	630	1980	0	0.7	No	< Criteria
Benzo(a)anthracene	18	14	78	59 J	3800	730	1900	1980	1	1.9	Yes	> Criteria
Benzo(a)pyrene	18	14	78	45 J	3400 J	680	1500	1980	1	1.7	Yes	> Criteria
Benzo(b)fluoranthene	18	14	78	76 J	3600 J	730	1500	1980	1	1.8	Yes	> Criteria
Benzo(g,h,i)perylene	18	9	50	43 J	2100 J	720	840	1980	1	1.1	Yes	> Criteria
Benzo(k)fluoranthene	18	14	78	45 J	2400 J	630	1200	1980	1	1.2	Yes	> Criteria
bis(2-Ethylhexyl)phthalate	18	10	56	47 J	460 J	640	1000	910	0	0.5	No	< Criteria
Carbazole	18	2	11	150	790 J	760	490	NA	---	---	Yes	No Criteria
Chrysene	18	16	89	48 J	4100	750	2000	1980	1	2.1	Yes	> Criteria
Di-n-Butylphthalate	18	2	11	47 J	130 J	810	1100	90	1	1.4	Yes	> Criteria
Dibenzo(a,h)anthracene	18	5	28	54	960 J	720	840	1980	0	0.5	No	< Criteria
Fluoranthene	18	17	94	39 J	9500	1300	3900	1980	1	4.8	Yes	> Criteria
Fluorene	18	1	6	560 J	560 J	770	430	1980	0	0.3	No	< Criteria
Indeno(1,2,3-cd)pyrene	18	12	67	60 J	2200 J	610	1100	1980	1	1.1	Yes	> Criteria
Naphthalene	18	1	6	110	110	820	0	1980	0	0.1	No	< Criteria
Phenanthrene	18	15	83	69 J	7000	890	2900	1980	1	3.5	Yes	> Criteria
Pyrene	18	15	83	110 J	8100	1200	3200	1980	1	4.1	Yes	> Criteria
1,2,4-Trimethylbenzene	2	1	50	1.7 J	1.7 J	3	0	NA	---	---	Yes	No Criteria
Naphthalene	2	1	50	66 J	66 J	35	0	100000	0	0.001	No	< Criteria
Tetrachloroethene	2	2	100	2.7 J	28	15	0	NA	---	---	Yes	No Criteria
Pesticides/PCBs (ug/kg)												
4,4'-DDE	16	1	6	4.9	4.9	2.2	0	2	1	2.5	Yes	> Criteria
4,4'-DDT	16	4	25	5.1 P	7.8	3	11	2	4	3.9	Yes	> Criteria
Aroclor, Total	21	9	43	13	300	61	190	71	3	4.2	Yes	> Criteria
Aroclor-1254	20	8	40	13 JP	300	53	180	111	2	2.7	Yes	> Criteria
Aroclor-1260	20	1	5	24	24	23	0	71	0	0.3	No	< Criteria
Dieldrin	16	5	31	4.4 P	17 P	4.1	0	64	0	0.3	No	< Criteria
Endosulfan II	16	1	6	4	4	2.1	0	550	0	0.0	No	< Criteria
Endrin	16	1	6	5.6 P	5.6 P	2.2	0	8	0	0.7	No	< Criteria

Notes:
1 - The ecological criteria are the lower of the plant, soil invertebrate, or terrestrial wildlife screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-6

FLOODPLAIN SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 1 OF 3

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (ng/kg)												
1,2,3,4,6,7,8-HpCDD	37	16	43	175.58 J	2140 $	484	664	30	16	71.3	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	34	29	85	4.6 EMPC	644.3 J	127	247	30	19	21.5	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	36	20	56	1.02 J	47.6 EMPC	8.4	12.9	30	2	1.6	Yes	> Criteria
1,2,3,4,7,8-HxCDD	37	25	68	0.5 EMPC	35.64 EMPC	8.4	11.1	3	17	11.9	Yes	> Criteria
1,2,3,4,7,8-HxCDF	26	26	100	0.6 EMPC	148.93 J	26.7	33.7	3	21	49.6	Yes	> Criteria
1,2,3,6,7,8-HxCDD	32	32	100	1.97 EMPC	104	30.6	37.6	3	28	34.7	Yes	> Criteria
1,2,3,6,7,8-HxCDF	29	29	100	0.33 EMPC	60.38 J	15.9	22.7	590	0	0.1	No	< Criteria
1,2,3,7,8,9-HxCDD	37	32	86	0.48 EMPC	549.73 EMPC	42.1	31.9	3	28	183	Yes	> Criteria
1,2,3,7,8,9-HxCDF	8	7	88	4.45	46.3 J	19.8	1.1	3	7	15.4	Yes	> Criteria
1,2,3,7,8-PeCDD	35	19	54	0.41 J	22.8	6	5.7	0.3	19	76.0	Yes	> Criteria
1,2,3,7,8-PeCDF	27	27	100	0.22 EMPC	151.03 J	14.1	6.1	590	0	0.3	No	< Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	35	16	46	17.46 J	364758 J	37000	9.6	0.13	16	2805831	Yes	> Criteria
2,3,4,6,7,8-HxCDF	29	24	83	0.66 EMPC	37.5	8.1	27.3	3	14	12.5	Yes	> Criteria
2,3,4,7,8-PeCDF	37	29	78	0.6 EMPC	52.4 J	7.9	12.3	60	0	0.9	No	< Criteria
2,3,7,8-TCDD	105	92	88	0.988	21800	2030	30.1	0.3	92	72667	Yes	> Criteria
2,3,7,8-TCDF	37	31	84	0.7 EMPC	587.64 J	31.5	29.7	0.8	29	735	Yes	> Criteria
OCDD	37	14	38	2560 EB	13200 J	3030	5010	3000	13	4.4	Yes	> Criteria
OCDF	33	9	27	163 EB	1158.08 J	182	330	3000	0	0.4	No	< Criteria
PCDD/Fs	1	1	100	21500	21500	21500	0	0.3	1	71667	Yes	> Criteria
Total HpCDD	7	7	100	768 J	3640 J	2160	1330	30	7	121	Yes	> Criteria
Total HpCDF	7	7	100	244	913 J	641	583	30	7	30.4	Yes	> Criteria
Total HxCDD	7	7	100	158	644 J	407	294	3	7	215	Yes	> Criteria
Total HxCDF	7	7	100	129	850	534	443	3	7	283	Yes	> Criteria
Total PeCDD	7	7	100	20.2	170	85.3	37.4	0.3	7	567	Yes	> Criteria
Total PeCDF	7	7	100	51.6	697 J	391	257	0.6	7	1162	Yes	> Criteria
Total TCDD	7	7	100	5	16890	4260	58.5	0.3	7	56300	Yes	> Criteria
Total TCDF	7	7	100	23.4	912 J	404	270	3	7	304	Yes	> Criteria
Inorganics (mg/kg)												
Aluminum	11	11	100	3210	15400	9390	12100	3.825	11	4026	Yes	> Criteria
Antimony	11	7	64	1.1 J	6.3 J	2.1	2.3	0.248	7	25.4	Yes	> Criteria
Arsenic	11	11	100	1.8	10.9	5.3	7.7	0.25	11	43.6	Yes	> Criteria
Barium	11	11	100	34.4 J	244	143	182	17.2	11	14.2	Yes	> Criteria
Beryllium	11	9	82	0.41 J	3.3	1.6	2.7	2.42	3	1.4	Yes	> Criteria
Cadmium	10	7	70	0.51	4.9	1.3	0.46	1.2	4	4.1	Yes	> Criteria
Calcium	11	11	100	666 J	4530 J	1600	2080	NA	---	---	No	Nontoxic[2]
Chromium	11	11	100	16.4	329	135	143	0.4	11	823	Yes	> Criteria
Cobalt	11	11	100	2.4 J	10.1	6.2	9.1	20	0	0.5	No	< Criteria
Copper	11	11	100	21.7	231	134	187	38.9	8	5.9	Yes	> Criteria
Iron	11	11	100	4960	28800	18000	22400	NA	---	---	Yes	No Criteria
Lead	11	11	100	138	1090	465	278	0.94	11	1160	Yes	> Criteria
Magnesium	11	11	100	701 J	4820 J	2120	1930	NA	---	---	No	Nontoxic[2]

TABLE C-6

FLOODPLAIN SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 2 OF 3

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Manganese	11	11	100	52.1	1700 J	450	1360	322	6	5.3	Yes	> Criteria
Mercury	11	11	100	0.18	1.4	0.54	0.28	0.005	11	280	Yes	> Criteria
Molybdenum	1	1	100	1.9 J	1.9 J	1.9	0	0.52	1	3.7	Yes	> Criteria
Nickel	11	11	100	3.7	66.4	29.7	99	30	5	2.2	Yes	> Criteria
Potassium	11	11	100	369 J	1340 J	785	1220	NA	---	---	No	Nontoxic[2]
Silver	11	9	82	2.6	8.4	5.2	7.7	2	9	4.2	Yes	> Criteria
Sodium	11	6	55	34.4 J	342 J	147	123	NA	---	---	No	Nontoxic[2]
Thallium	11	1	9	0.6 J	0.6 J	13.9	0	0.027	1	22.2	Yes	> Criteria
Vanadium	11	11	100	10.3	93.8	39.8	65.7	0.714	11	131	Yes	> Criteria
Zinc	11	11	100	154	587 J	336	255	12	11	48.9	Yes	> Criteria
Semivolatile Organic Compounds (ug/kg)												
2,4,5-Trichlorophenol	21	1	5	170 J	170 J	2600	0	4000	0	0.0	No	< Criteria
2-Methylnaphthalene	21	2	10	80 J	440 J	1000	0	1980	0	0.2	No	< Criteria
2-Nitrophenol	21	1	5	5000	5000	1200	0	NA	---	---	Yes	No Criteria
Acenaphthene	21	3	14	150 J	1600	1100	1800	1980	0	0.8	No	< Criteria
Acenaphthylene	21	2	10	190 J	280 J	1000	0	1980	0	0.1	No	< Criteria
Anthracene	21	8	38	67 J	3100	1100	2000	1980	????	1.6	Yes	> Criteria
Benzo(a)anthracene	21	19	90	93 J	8600 *	1300	1700	1980	4	4.3	Yes	> Criteria
Benzo(a)pyrene	21	19	90	110 J	6200 *	1200	1600	1980	3	3.1	Yes	> Criteria
Benzo(b)fluoranthene	21	20	95	170 J	8400 *	1400	1700	1980	4	4.2	Yes	> Criteria
Benzo(g,h,i)perylene	21	14	67	64 J	2600	1100	1000	1980	1	1.3	Yes	> Criteria
Benzo(k)fluoranthene	21	19	90	66 J	2400	850	1800	1980	4	1.2	Yes	> Criteria
bis(2-Ethylhexyl)phthalate	21	11	52	43 J	3300 J	1200	0	910	2	3.6	Yes	> Criteria
Butylbenzylphthalate	21	4	19	240	660 J	860	1900	NA	---	---	Yes	No Criteria
Carbazole	21	6	29	80 J	2000 J	1100	1900	NA	---	---	Yes	No Criteria
Chrysene	21	20	95	120 J	7900 *	1500	2100	1980	6	4.0	Yes	> Criteria
Di-n-Butylphthalate	21	2	10	120	130 J	1000	1800	90	2	1.4	Yes	> Criteria
Di-n-octylphthalate	21	1	5	140 J	140 J	1000	0	NA	---	---	Yes	No Criteria
Dibenzo(a,h)anthracene	21	9	43	46 J	880	900	2100	1980	0	0.4	No	< Criteria
Dibenzofuran	21	3	14	66 J	1300	1100	0	NA	---	---	Yes	No Criteria
Fluoranthene	21	21	100	49 J	17000 *	2700	3400	1980	9	8.6	Yes	> Criteria
Fluorene	21	4	19	190 J	2000	1100	1900	1980	1	1.0	Yes	> Criteria
Indeno(1,2,3-cd)pyrene	21	19	90	74 J	2700	800	1100	1980	1	1.4	Yes	> Criteria
Naphthalene	21	1	5	930	930	1100	0	1980	0	0.5	No	< Criteria
Phenanthrene	21	19	90	140 J	17000 *	1800	2000	1980	4	8.6	Yes	> Criteria
Pyrene	21	20	95	190 J	17000 *	2400	3200	1980	7	8.6	Yes	> Criteria
Volatile Organic Compounds (ug/kg)												
1,2,4-Trichlorobenzene	1	1	100	1.8 J	1.8 J	2	0	20000	0	0.0	No	< Criteria
Chlorobenzene	1	1	100	3.1 J	3.1 J	3	0	40000	0	0.0	No	< Criteria
Toluene	1	1	100	2.2 J	2.2 J	2	0	51500	0	0.0	No	< Criteria
Pesticides/PCBs (ug/kg)												
4,4'-DDD	35	13	37	0.89 J	5.6 J	2.6	0	2	6	2.8	Yes	> Criteria

TABLE C-6

FLOODPLAIN SOIL SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
PAGE 3 OF 3

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
4,4'-DDE	40	24	60	0.31 J	23 J	3.7	0	2	18	11.5	Yes	> Criteria
4,4'-DDT	36	5	14	1.6 J	11 J	3.3	3.5	2	3	5.5	Yes	> Criteria
Aldrin	35	2	6	0.58 J	1.9 J	1.4	0	733	0	0.0	No	< Criteria
alpha-Chlordane	35	23	66	0.21 J	25 J	5.5	3.1	1800	0	0.0	No	< Criteria
Aroclor, Total	42	25	60	23	7800	440	210	71	20	110	Yes	> Criteria
Aroclor-1248	37	3	8	330	720	69	0	71	3	10.1	Yes	> Criteria
Aroclor-1254	41	25	61	23 J	7800 *J	400	180	111	20	70.3	Yes	> Criteria
beta-BHC	30	3	10	1.4 J	32	2.6	0	1470	0	0.0	No	< Criteria
delta-BHC	37	2	5	0.12 J	2.4 J	1.4	0	70	0	0.0	No	< Criteria
Dieldrin	36	9	25	1.4 J, EB	47	7.9	0	64	0	0.7	No	< Criteria
Endosulfan I	36	1	3	0.25 J	0.25 J	2.2	0	550	0	0.0	No	< Criteria
Endosulfan II	36	3	8	10	170 *	8.9	0	550	0	0.3	No	< Criteria
Endosulfan sulfate	32	10	31	1.7 J	23	4.1	0	550	0	0.0	No	< Criteria
Endrin	36	6	17	1.4 J	28	4.6	0	8	4	3.5	Yes	> Criteria
Endrin Aldehyde	35	4	11	0.77 J	5.2 J	2.7	0	8	0	0.7	No	< Criteria
Endrin Ketone	34	3	9	1.9 J	20 J	3.5	0	8	1	2.5	Yes	> Criteria
gamma-Chlordane	30	22	73	1.4 J	22	7	4	1800	0	0.0	No	< Criteria
Heptachlor	36	2	6	0.43 J	0.62 J	1.3	0	476	0	0.0	No	< Criteria
Heptachlor Epoxide	32	2	6	2.2 J	3.8 J	1.8	0	476	0	0.0	No	< Criteria
Methoxychlor	40	14	35	2.3 J	16 J	15	0	14700	0	0.0	No	< Criteria
Herbicides (ug/kg)												
Dalapon	1	1	100	66	66	66	0	NA	---	---	Yes	No Criteria
Miscellaneous Parameters (mg/kg)												
Total Organic Carbon	39	39	100	1010	202000	61000	73000	NA	---	---	---	---

Notes:
1 - The ecological criteria are the lower of the plant, soil invertebrate, or terrestrial wildlife screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-7

FLOODPLAIN SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (ng/kg)														
1,2,3,4,6,7,8-HpCDD	37	16	43.2	175.58	J	2140	$	484	664	250	15	8.6	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	34	29	85.3	4.6	EMPC	644.3	J	127	247	250	8	2.6	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	36	20	55.6	1.02	J	47.6	EMPC	8.4	12.9	250	0	0.2	No	< Criteria
1,2,3,4,7,8-HxCDD	37	25	67.6	0.5	EMPC	35.64	EMPC	8.4	11.1	25	3	1.4	Yes	> Criteria
1,2,3,4,7,8-HxCDF	26	26	100.0	0.6	EMPC	148.93	J	26.7	33.7	25	11	6.0	Yes	> Criteria
1,2,3,6,7,8-HxCDD	32	32	100.0	1.97	EMPC	104		30.6	37.6	25	15	4.2	Yes	> Criteria
1,2,3,6,7,8-HxCDF	29	29	100.0	0.33	EMPC	60.38	J	15.9	22.7	25	9	2.4	Yes	> Criteria
1,2,3,7,8,9-HxCDD	37	32	86.5	0.48	EMPC	549.73	EMPC	42.1	31.9	25	16	22.0	Yes	> Criteria
1,2,3,7,8,9-HxCDF	8	7	87.5	4.45		46.3	J	19.8	1.1	25	3	1.9	Yes	> Criteria
1,2,3,7,8-PeCDD	35	19	54.3	0.41	J	22.8		6	5.7	2.5	14	9.1	Yes	> Criteria
1,2,3,7,8-PeCDF	27	27	100.0	0.22	EMPC	151.03	J	14.1	6.1	50	2	3.0	Yes	> Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	35	16	45.7	17.46	J	364758	J	37000	9.6	1.09	16	334640	Yes	> Criteria
2,3,4,6,7,8-HxCDF	29	24	82.8	0.66	EMPC	37.5		8.1	27.3	25	3	1.5	Yes	> Criteria
2,3,4,7,8-PeCDF	37	29	78.4	0.6	EMPC	52.4	J	7.9	12.3	5	13	10.5	Yes	> Criteria
2,3,7,8-TCDD	105	92	87.6	0.988		21800		2030	30.1	2.5	90	8720	Yes	> Criteria
2,3,7,8-TCDF	37	31	83.8	0.7	EMPC	587.64	J	31.5	29.7	25	10	23.5	Yes	> Criteria
OCDD	37	14	37.8	2560	EB	13200	J	3030	5010	25000	0	0.5	No	< Criteria
OCDF	33	9	27.3	163	EB	1158.08	J	182	330	25000	0	0.0	No	< Criteria
PCDD/Fs	1	1	100.0	21500		21500		21500	0	2.5	1	8600	Yes	> Criteria
Total HpCDD	7	7	100.0	768	J	3640	J	2160	1330	250	7	14.6	Yes	> Criteria
Total HpCDF	7	7	100.0	244		913	J	641	583	250	6	3.7	Yes	> Criteria
Total HxCDD	7	7	100.0	158		644	J	407	294	25	7	25.8	Yes	> Criteria
Total HxCDF	7	7	100.0	129		850		534	443	25	7	34.0	Yes	> Criteria
Total PeCDD	7	7	100.0	20.2		170		85.3	37.4	2.5	7	68.0	Yes	> Criteria
Total PeCDF	7	7	100.0	51.6		697	J	391	257	5	7	139	Yes	> Criteria
Total TCDD	7	7	100.0	5		16890		4260	58.5	2.5	7	6756	Yes	> Criteria
Total TCDF	7	7	100.0	23.4		912	J	404	270	25	6	36.5	Yes	> Criteria
Inorganics (mg/kg)														
Aluminum	11	11	100.0	3210		15400		9390	12100	58030	0	0.3	No	< Criteria
Antimony	11	7	63.6	1.1	J	6.3	J	2.1	2.3	2	5	3.2	Yes	> Criteria
Arsenic	11	11	100.0	1.8		10.9		5.3	7.7	8.2	2	1.3	Yes	> Criteria
Barium	11	11	100.0	34.4	J	244		143	182	NA	---	---	Yes	No Criteria
Beryllium	11	9	81.8	0.41	J	3.3		1.6	2.7	NA	---	---	Yes	No Criteria
Cadmium	10	7	70.0	0.51		4.9		1.3	0.46	1.2	4	4.1	Yes	> Criteria
Calcium	11	11	100.0	666	J	4530	J	1600	2080	NA	---	---	No	Nontoxic[2]
Chromium	11	11	100.0	16.4		329		135	143	81	7	4.1	Yes	> Criteria
Cobalt	11	11	100.0	2.4	J	10.1		6.2	9.1	50	0	0.2	No	< Criteria
Copper	11	11	100.0	21.7		231		134	187	34	8	6.8	Yes	> Criteria
Iron	11	11	100.0	4960		28800		18000	22400	20000	6	1.4	Yes	> Criteria
Lead	11	11	100.0	138		1090		465	278	46.7	11	23.3	Yes	> Criteria
Magnesium	11	11	100.0	701	J	4820	J	2120	1930	NA	---	---	No	Nontoxic[2]

TABLE C-7

FLOODPLAIN SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Manganese	11	11	100.0	52.1	1700 J	450	1360	460	3	3.7	Yes	> Criteria
Mercury	11	11	100.0	0.18	1.4	0.54	0.28	0.15	11	9.3	Yes	> Criteria
Molybdenum	1	1	100.0	1.9 J	1.9 J	1.9	0	NA	---	---	Yes	No Criteria
Nickel	11	11	100.0	3.7	66.4	29.7	99	20.9	7	3.2	Yes	> Criteria
Potassium	11	11	100.0	369 J	1340 J	785	1220	NA	---	---	No	Nontoxic[2]
Silver	11	9	81.8	2.6	8.4	5.2	7.7	1	9	8.4	Yes	> Criteria
Sodium	11	6	54.5	34.4 J	342 J	147	123	NA	---	---	No	Nontoxic[2]
Thallium	11	1	9.1	0.6 J	0.6 J	13.9	0	NA	---	---	Yes	No Criteria
Vanadium	11	11	100.0	10.3	93.8	39.8	65.7	NA	---	---	Yes	No Criteria
Zinc	11	11	100.0	154	587 J	336	255	150	11	3.9	Yes	> Criteria
Semivolatile Organic Compounds (ug/kg)												
2,4,5-Trichlorophenol	21	1	4.8	170 J	170 J	2600	0	NA	---	---	Yes	No Criteria
2-Methylnaphthalene	21	2	9.5	80 J	440 J	1000	0	70	2	6.3	Yes	> Criteria
2-Nitrophenol	21	1	4.8	5000	5000	1200	0	NA	---	---	Yes	No Criteria
Acenaphthene	21	3	14.3	150 J	1600	1100	1800	16	3	100	Yes	> Criteria
Acenaphthylene	21	2	9.5	190 J	280 J	1000	0	44	2	6.4	Yes	> Criteria
Anthracene	21	8	38.1	67 J	3100	1100	2000	85.3	6	36.3	Yes	> Criteria
Benzo(a)anthracene	21	19	90.5	93 J	8600 *	1300	1700	261	14	33.0	Yes	> Criteria
Benzo(a)pyrene	21	19	90.5	110 J	6200 *	1200	1600	430	11	14.4	Yes	> Criteria
Benzo(b)fluoranthene	21	20	95.2	170 J	8400 *	1400	1700	NA	---	---	Yes	No Criteria
Benzo(g,h,i)perylene	21	14	66.7	64 J	2600	1100	1000	170	9	15.3	Yes	> Criteria
Benzo(k)fluoranthene	21	19	90.5	66 J	2400	850	1800	240	12	10.0	Yes	> Criteria
bis(2-Ethylhexyl)phthalate	21	11	52.4	43 J	3300 J	1200	0	NA	---	---	Yes	No Criteria
Butylbenzylphthalate	21	4	19.0	240	660 J	860	1900	11000	0	0.1	No	< Criteria
Carbazole	21	6	28.6	80 J	2000 J	1100	1900	NA	---	---	Yes	No Criteria
Chrysene	21	20	95.2	120 J	7900 *	1500	2100	384	13	20.6	Yes	> Criteria
Di-n-Butylphthalate	21	2	9.5	120	130 J	1000	1800	11000	0	0.0	No	< Criteria
Di-n-octylphthalate	21	1	4.8	140 J	140 J	1000	0	NA	---	---	Yes	No Criteria
Dibenzo(a,h)anthracene	21	9	42.9	46 J	880	900	2100	63.4	8	13.9	Yes	> Criteria
Dibenzofuran	21	3	14.3	66 J	1300	1100	0	2000	0	0.7	No	< Criteria
Fluoranthene	21	21	100.0	49 J	17000 *	2700	3400	600	15	28.3	Yes	> Criteria
Fluorene	21	4	19.0	190 J	2000	1100	1900	19	4	105	Yes	> Criteria
Indeno(1,2,3-cd)pyrene	21	19	90.5	74 J	2700	800	1100	200	13	13.5	Yes	> Criteria
Naphthalene	21	1	4.8	930	930	1100	0	160	1	5.8	Yes	> Criteria
Phenanthrene	21	19	90.5	140 J	17000 *	1800	2000	240	17	70.8	Yes	> Criteria
Pyrene	21	20	95.2	190 J	17000 *	2400	3200	665	12	25.6	Yes	> Criteria
Volatile Organic Compounds (ug/kg)												
1,2,4-Trichlorobenzene	1	1	100.0	1.8 J	1.8 J	2	0	9200	0	0.0	No	< Criteria
Chlorobenzene	1	1	100.0	3.1 J	3.1 J	3	0	820	0	0.0	No	< Criteria
Toluene	1	1	100.0	2.2 J	2.2 J	2	0	670	0	0.0	No	< Criteria
Pesticides/PCBs (ug/kg)												
4,4'-DDD	35	13	37.1	0.89 J	5.6 J	2.6	0	8	0	0.7	No	< Criteria

TABLE C-7

FLOODPLAIN SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
4,4'-DDE	40	24	60.0	0.31	J	23	J	3.7	0	2.2	18	10.5	Yes	> Criteria
4,4'-DDT	36	5	13.9	1.6	J	11	J	3.3	3.5	1.58	5	7.0	Yes	> Criteria
Aldrin	35	2	5.7	0.58	J	1.9	J	1.4	0	2	0	1.0	Yes	> Criteria
alpha-Chlordane	35	23	65.7	0.21	J	25	J	5.5	3.1	7	9	3.6	Yes	> Criteria
Aroclor, Total	42	25	59.5	23		7800		440	210	22.7	25	344	Yes	> Criteria
Aroclor-1248	37	3	8.1	330		720		69	0	30	3	24.0	Yes	> Criteria
Aroclor-1254	41	25	61.0	23	J	7800	*J	400	180	60	21	130	Yes	> Criteria
beta-BHC	30	3	10.0	1.4	J	32		2.6	0	5	2	6.4	Yes	> Criteria
delta-BHC	37	2	5.4	0.12	J	2.4	J	1.4	0	3	0	0.8	No	< Criteria
Dieldrin	36	9	25.0	1.4	J, EB	47		7.9	0	52	0	0.9	No	< Criteria
Endosulfan I	36	1	2.8	0.25	J	0.25	J	2.2	0	2.9	0	0.1	No	< Criteria
Endosulfan II	36	3	8.3	10		170	*	8.9	0	14	2	12.1	Yes	> Criteria
Endosulfan sulfate	32	10	31.3	1.7	J	23		4.1	0	5.4	2	4.3	Yes	> Criteria
Endrin	36	6	16.7	1.4	J	28		4.6	0	20	1	1.4	Yes	> Criteria
Endrin Aldehyde	35	4	11.4	0.77	J	5.2	J	2.7	0	20	0	0.3	No	< Criteria
Endrin Ketone	34	3	8.8	1.9	J	20	J	3.5	0	20	0	1.0	Yes	> Criteria
gamma-Chlordane	30	22	73.3	1.4	J	22		7	4	7	11	3.1	Yes	> Criteria
Heptachlor	36	2	5.6	0.43	J	0.62	J	1.3	0	5	0	0.1	No	< Criteria
Heptachlor Epoxide	32	2	6.3	2.2	J	3.8	J	1.8	0	5	0	0.8	No	< Criteria
Methoxychlor	40	14	35.0	2.3	J	16	J	15	0	19	0	0.8	No	< Criteria
Herbicides (ug/kg)														
Dalapon	1	1	100.0	66		66		66	0	NA	---	---	Yes	No Criteria
Miscellaneous Parameters (mg/kg)														
Total Organic Carbon	39	39	100.0	1010		202000		61000	73000	NA	---	---	---	---
AVS/SEM (umol/g)														
Cadmium	8	6	75.0	0.004	J	0.04149	J	0.014	0.009	NA	---	---	---	---
Copper	9	9	100.0	0.4069		4.02506		2	2.6	NA	---	---	---	---
Lead	9	9	100.0	0.65408		3.23622		1.9	1.2	NA	---	---	---	---
Mercury	9	3	33.3	0.00005		0.00043		0.0001	0.00024	NA	---	---	---	---
Nickel	9	9	100.0	0.14879		6.85786	J	1.3	1.8	NA	---	---	---	---
Zinc	9	9	100.0	1.3934		9.71184		4.3	3.3	NA	---	---	---	---
Acid Volatile Sulfide	9	6	66.7	1.03		314.55588		37	0.12	NA	---	---	---	---
Simultaneously Extracted Metal	9	9	100.0	3.73775		20.59823		9.6	8.9	NA	---	---	---	---
SEM/AVS	9	9	100.0	0.06548		81.12411		24	69	NA	---	---	---	---

Notes:
1 - The ecological criteria are the aquatic receptor (i.e., fish, benthic invertebrates) screening values except for the dioxins. The screening values for the dioxins are for semi-aquatic receptors (i.e., mink, kingfisher) because they are lower than the screening values for the aquatic receptors. The screening values for the semi-aquatic receptors for the other parameters are the same as the screening values for the terrestrial wildlife receptors and are included in the floodplain soils table.
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-8

SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (ng/kg)														
1,2,3,4,6,7,8-HpCDD	56	49	87.5	3.8		5600		612	321	250	31	22.4	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	56	52	92.9	3		670		183	118	250	19	2.7	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	54	30	55.6	0.91	EMPC	43		9.6	6.9	250	0	0.2	No	< Criteria
1,2,3,4,7,8-HxCDD	55	35	63.6	1.4	J	100		10.6	5.9	25	8	4.0	Yes	> Criteria
1,2,3,4,7,8-HxCDF	51	42	82.4	1.26	J	90		21.2	16	25	19	3.6	Yes	> Criteria
1,2,3,6,7,8-HxCDD	53	48	90.6	0.41		200		30.2	18.8	25	25	8.0	Yes	> Criteria
1,2,3,6,7,8-HxCDF	49	45	91.8	1.1	J	70		16.3	10.5	25	14	2.8	Yes	> Criteria
1,2,3,7,8,9-HxCDD	54	46	85.2	0.9	EMPC	230		28.9	17	25	23	9.2	Yes	> Criteria
1,2,3,7,8,9-HxCDF	46	19	41.3	1.1		26.7		3	0.46	25	1	1.1	Yes	> Criteria
1,2,3,7,8-PeCDD	54	33	61.1	0.52	EMPC	81		8.1	3	2.5	26	32.4	Yes	> Criteria
1,2,3,7,8-PeCDF	51	38	74.5	0.62	EMPC	58.5	EMPC	8.3	3.2	50	1	1.2	Yes	> Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	44	38	86.4	1.94	J	49351	J	3610	7.5	1.09	38	45276	Yes	> Criteria
2,3,4,6,7,8-HxCDF	52	35	67.3	0.98	EMPC	51.4		13.5	13.1	25	14	2.1	Yes	> Criteria
2,3,4,7,8-PeCDF	53	41	77.4	0.57	EMPC	84.5		10	6.6	5	24	16.9	Yes	> Criteria
2,3,7,8-TCDD	99	96	97.0	0.68		93000		5160	3	2.5	95	37200	Yes	> Criteria
2,3,7,8-TCDF	54	43	79.6	0.88	J	110		19.9	15.9	25	17	4.4	Yes	> Criteria
3,3',4,4'-Tetrachlorobiphenyl (77)	7	7	100.0	253		1500		732	0	NA	---	---	Yes	No Criteria
OCDD	56	47	83.9	17		38000		3950	1720	25000	1	1.5	Yes	> Criteria
OCDF	54	45	83.3	4.2		980		317	152	25000	0	0.0	No	< Criteria
PCDD/Fs	1	1	100.0	61300		61300		61300	0	2.5	1	24520	Yes	> Criteria
Total HpCDD	38	37	97.4	7.7		9400		1390	621	250	24	37.6	Yes	> Criteria
Total HpCDF	38	38	100.0	3		1500		471	271	250	22	6.0	Yes	> Criteria
Total HxCDD	38	34	89.5	3.2		1900		274	149	25	30	76.0	Yes	> Criteria
Total HxCDF	38	35	92.1	4.6		1900		387	207	25	31	76.0	Yes	> Criteria
Total PeCDD	38	34	89.5	0.92		480		64.4	22.2	2.5	31	192	Yes	> Criteria
Total PeCDF	38	36	94.7	1.4	EMPC	1900		297	122	5	34	380	Yes	> Criteria
Total TCDD	38	38	100.0	0.68		96000		5650	16.4	2.5	37	38400	Yes	> Criteria
Total TCDF	37	37	100.0	0.73		3000		370	145	25	25	120.0	Yes	> Criteria
Inorganics (mg/kg)														
Aluminum	41	41	100.0	1260		18700		8550	7160	3.825	41	4889	Yes	> Criteria
Antimony	41	20	48.8	0.87	J	8.2	J	2.4	1.6	0.248	20	33.1	Yes	> Criteria
Arsenic	47	28	59.6	1.1	J	11.4		8	3.8	0.25	28	45.6	Yes	> Criteria
Barium	47	41	87.2	9.8		375		121	89.6	17.2	39	21.8	Yes	> Criteria
Beryllium	41	38	92.7	0.23	J	5.4		1.7	1.7	2.42	12	2.2	Yes	> Criteria
Cadmium	47	28	59.6	0.17		5.5		1.4	0.67	1.2	18	4.6	Yes	> Criteria
Calcium	41	39	95.1	338		5860		2420	2470	NA	---	---	No	Nontoxic[2]
Chromium	47	47	100.0	2.5	J	385		108	104	0.83	47	464	Yes	> Criteria
Cobalt	41	38	92.7	1	J	23.4	J	8.1	7.6	50	0	0.5	No	< Criteria
Copper	41	40	97.6	5.5		388		105	87.3	34	29	11.4	Yes	> Criteria
Iron	41	41	100.0	3200		65000		16600	12400	20000	12	3.3	Yes	> Criteria
Lead	47	47	100.0	9.2		719		237	121	0.94	47	765	Yes	> Criteria
Magnesium	41	41	100.0	497		3620		1810	1340	NA	---	---	No	Nontoxic[2]

TABLE C-8

SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Manganese	41	41	100.0	39.1		2050		595	430	322	25	6.4	Yes	> Criteria
Mercury	45	42	93.3	0.02	, J	3.6		0.41	0.096	0.005	42	720	Yes	> Criteria
Molybdenum	1	1	100.0	1.7	J	1.7	J	1.7	0	0.52	1	3.3	Yes	> Criteria
Nickel	41	40	97.6	2	J	113		32.7	38.9	20.9	25	5.4	Yes	> Criteria
Potassium	34	33	97.1	261		1980	J	870	848	NA	---	---	No	Nontoxic[2]
Selenium	47	10	21.3	1.1	J	2.9	J	4.3	1.3	0.331	10	8.8	Yes	> Criteria
Silver	47	22	46.8	0.33		16		4.1	3.2	1	21	16.0	Yes	> Criteria
Sodium	34	8	23.5	38.1		415		114	116	NA	---	---	No	Nontoxic[2]
Thallium	40	3	7.5	0.47	J	0.78	J	4.1	0	0.027	3	28.9	Yes	> Criteria
Vanadium	41	39	95.1	5.1		89.3		28.8	31.4	0.714	39	125	Yes	> Criteria
Zinc	41	39	95.1	38.6		1930		427	268	12	39	161	Yes	> Criteria
Semivolatile Organic Compounds (ug/kg)														
2-Methylnaphthalene	49	5	10.2	55	J	190		1100	0	70	3	2.7	Yes	> Criteria
Acenaphthene	56	21	37.5	68	, J	1100	J	980	0	16	21	68.8	Yes	> Criteria
Acenaphthylene	56	14	25.0	86	J	770		1000	0	44	14	17.5	Yes	> Criteria
Anthracene	56	30	53.6	54	J	3500	J	1100	970	85.3	27	41.0	Yes	> Criteria
Benzo(a)anthracene	56	49	87.5	33		8500		1800	1300	261	41	32.6	Yes	> Criteria
Benzo(a)pyrene	56	50	89.3	63	J	8900		1700	1300	430	38	20.7	Yes	> Criteria
Benzo(b)fluoranthene	56	52	92.9	54		9400		2300	1300	1980	22	4.7	Yes	> Criteria
Benzo(g,h,i)perylene	56	37	66.1	45	J	5300		1400	690	170	31	31.2	Yes	> Criteria
Benzo(k)fluoranthene	56	51	91.1	44	J	8800		1700	1400	240	44	36.7	Yes	> Criteria
bis(2-Ethylhexyl)phthalate	43	31	72.1	21	J	12000		1400	1500	910	8	13.2	Yes	> Criteria
Butylbenzylphthalate	43	8	18.6	78	J	660		1200	0	11000	0	0.1	No	< Criteria
Carbazole	42	15	35.7	79	J	2000	J	1200	920	NA	---	---	Yes	No Criteria
Chrysene	56	51	91.1	74	J	11000		2200	1700	384	42	28.6	Yes	> Criteria
Di-n-butylphthalate	43	5	11.6	45	J	99	J	1300	1300	90	1	1.1	Yes	> Criteria
Dibenzo(a,h)anthracene	56	31	55.4	65	J	2200		980	1300	63.4	31	34.7	Yes	> Criteria
Dibenzofuran	43	7	16.3	54	J	920	J	1200	0	2000	0	0.5	No	< Criteria
Fluoranthene	56	54	96.4	80		24000	*	4100	3200	600	45	40.0	Yes	> Criteria
Fluorene	56	24	42.9	53	J	1600	J	990	0	19	24	84.2	Yes	> Criteria
Indeno(1,2,3-cd)pyrene	56	49	87.5	35		5400		1400	710	200	41	27.0	Yes	> Criteria
Naphthalene	56	12	21.4	60		290		1000	0	160	3	1.8	Yes	> Criteria
Phenanthrene	56	47	83.9	71	J	14000		2300	1900	240	42	58.3	Yes	> Criteria
Pyrene	56	52	92.9	70		23000	*	3500	2300	665	41	34.6	Yes	> Criteria
Pesticides/PCBs (ug/kg)														
4,4'-DDD	55	15	27.3	0.37	J	35	J	6.5	0	2	13	17.5	Yes	> Criteria
4,4'-DDE	55	20	36.4	0.43	J	170		16	0	2	17	85.0	Yes	> Criteria
4,4'-DDT	49	13	26.5	1.8	J	22	J	6.4	0	1.58	13	13.9	Yes	> Criteria
Aldrin	48	2	4.2	0.51	J	2.4	J	2.4	0	2	1	1.2	Yes	> Criteria
alpha-BHC	48	1	2.1	2.4	J	2.4	J	2.4	0	6	0	0.4	No	< Criteria
alpha-Chlordane	55	29	52.7	0.5	J	40		6.8	4.1	7	15	5.7	Yes	> Criteria
Aroclor, Total	92	76	82.6	11	J	28000		1900	89	22.7	74	1233	Yes	> Criteria
Aroclor-1016	82	1	1.2	46	J	46	J	330	0	7	1	6.6	Yes	> Criteria

TABLE C-8

SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE
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Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Aroclor-1221	82	1	1.2	93	J	93	J	290	0	5	1	18.6	Yes	> Criteria
Aroclor-1232	82	1	1.2	46	J	46	J	560	0	5	1	9.2	Yes	> Criteria
Aroclor-1242	84	3	3.6	46	J	250		370	0	5	3	50.0	Yes	> Criteria
Aroclor-1248	83	19	22.9	16	J	140		450	0	30	11	4.7	Yes	> Criteria
Aroclor-1254	90	74	82.2	11	J	28000		1900	74	60	66	467	Yes	> Criteria
Aroclor-1260	82	7	8.5	29	J	270		340	0	5	7	54.0	Yes	> Criteria
Aroclor-1268	5	5	100.0	17		120		87	0	NA	---	---	Yes	No Criteria
beta-BHC	48	2	4.2	2.4	J	2.6		5.2	0	5	0	0.5	No	< Criteria
delta-BHC	48	1	2.1	2.4	J	2.4	J	2.4	0	3	0	0.8	No	< Criteria
Dieldrin	52	10	19.2	1.4	J, EB	170		13	0	52	2	3.3	Yes	> Criteria
Endosulfan I	50	5	10.0	2.4	J	28		2.6	0	2.9	4	9.7	Yes	> Criteria
Endosulfan II	52	22	42.3	6.1		160	*	13	5.4	14	7	11.4	Yes	> Criteria
Endosulfan Sulfate	45	2	4.4	4.6	J	11		11	0	5.4	1	2.0	Yes	> Criteria
Endrin	48	3	6.3	1.9	J	5.7		4.9	0	8	0	0.7	No	< Criteria
Endrin Aldehyde	50	4	8.0	0.15	J	5.4		4.7	0	8	0	0.7	No	< Criteria
Endrin Ketone	44	4	9.1	4.6	J	23		11	0	8	1	2.9	Yes	> Criteria
gamma-BHC	48	1	2.1	2.4	J	2.4	J	2.4	0	3	0	0.8	No	< Criteria
gamma-Chlordane	52	26	50.0	2.4	J	31		5.8	4.1	7	14	4.4	Yes	> Criteria
Heptachlor	48	3	6.3	0.38	J	2.4	J	2.4	0	5	0	0.5	No	< Criteria
Heptachlor Epoxide	48	3	6.3	0.2	J	2.7	J	2.4	0	5	0	0.5	No	< Criteria
Methoxychlor	45	1	2.2	24	J	24	J	54	0	19	1	1.3	Yes	> Criteria
Technical Chlordane	6	3	50.0	17		30		12	0	7	3	4.3	Yes	> Criteria
Toxaphene	48	1	2.1	240	J	240	J	160	0	28	1	8.6	Yes	> Criteria
Miscellaneous Parameters (mg/kg)														
Total Organic Carbon	54	54	100.0	2690		235000		59000	39000	NA	---	---	---	---
AVS/SEM (umol/g)														
Cadmium	32	25	78.1	0.00192	J	0.058	J	0.013	0.0073	NA	---	---	---	---
Copper	32	32	100.0	0.16621		5.61336	J	1.5	0.91	NA	---	---	---	---
Lead	32	31	96.9	0.06919		3.597		1	0.38	NA	---	---	---	---
Mercury	32	1	3.1	0.0022		0.0022		0.0001	0	NA	---	---	---	---
Nickel	32	29	90.6	0.08334	J	4.52961	J	1.1	0.54	NA	---	---	---	---
Zinc	32	32	100.0	0.25048	J	22.36	J	5.7	3.1	NA	---	---	---	---
Acid Volatile Sulfide	32	27	84.4	0.14665		73.03		12	7.2	NA	---	---	---	---
Simultaneously Extracted Metal	32	32	100.0	0.96139		28.64		9.4	4.9	NA	---	---	---	---
SEM/AVS	32	32	100.0	0.14593		126.7502		12	5.4	NA	---	---	---	---

Notes:
1 - The ecological criteria are the lower of the aquatic (I.e., fish) or semi-aquatic (i.e., kingfisher) screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-9

SOURCE AREA SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (pg/L)												
1,2,3,4,6,7,8-HpCDD	2	2	100	122	4780	2450	0	0.8	2	5975	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	2	2	100	29.5 J	991	510	0	0.8	2	1239	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	2	1	50	59.6 EMPC	59.6 EMPC	30.9	0	0.8	1	74.5	Yes	> Criteria
1,2,3,7,8,9-HxCDD	2	2	100	7.2 J	196	102	0	0.08	2	2450	Yes	> Criteria
1,2,3,7,8,9-HxCDF	2	1	50	6.3 J	6.3 J	3.8	0	0.08	1	78.8	Yes	> Criteria
1,2,3,7,8-PeCDD	2	1	50	35.4 J	35.4 J	18.7	0	0.008	1	4425	Yes	> Criteria
1,2,3,7,8-PeCDF	2	1	50	14.1 J	14.1 J	7.7	0	0.16	1	88.1	Yes	> Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	1	1	100	398 J	398 J	398	0	0.0035	1	113714	Yes	> Criteria
2,3,4,6,7,8-HxCDF	2	1	50	78.2	78.2	39.7	0	0.08	1	978	Yes	> Criteria
2,3,4,7,8-PeCDF	2	1	50	28.2 J	28.2 J	14.7	0	0.016	1	1763	Yes	> Criteria
2,3,7,8-TCDD	2	2	100	28.5	12740 J	6380	0	0.008	2	1592500	Yes	> Criteria
1,2,3,4,7,8-HxCDD	2	1	50	81.7	81.7	41.7	0	0.08	1	1021	Yes	> Criteria
1,2,3,4,7,8-HxCDF	2	2	100	2.8 EMPC	73	37.9	0	0.08	2	913	Yes	> Criteria
1,2,3,6,7,8-HxCDD	2	2	100	6.4 EMPC	232	119	0	0.08	2	2900	Yes	> Criteria
1,2,3,6,7,8-HxCDF	2	2	100	2.8 J	57.9	30.4	0	0.08	2	724	Yes	> Criteria
2,3,7,8-TCDF	2	1	50	53.1 J	53.1 J	27.3	0	0.08	1	664	Yes	> Criteria
OCDD	2	2	100	726	27700 J	14200	0	80	2	346	Yes	> Criteria
OCDF	2	2	100	56 J	1950 J	1000	0	80	1	24.4	Yes	> Criteria
Total HpCDD	2	2	100	223 J	8090 J	4160	0	0.8	2	10113	Yes	> Criteria
Total HpCDF	2	2	100	56.3 J	2310 J	1180	0	0.8	2	2888	Yes	> Criteria
Total HxCDD	2	2	100	7.2 J	1380 J	694	0	0.08	2	17250	Yes	> Criteria
Total HxCDF	2	2	100	28.2 J	1370 J	699	0	0.08	2	17125	Yes	> Criteria
Total PeCDD	2	1	50	104 J	104 J	53	0	0.008	1	13000	Yes	> Criteria
Total PeCDF	2	2	100	8.9 EMPC	493 J	251	0	0.016	2	30813	Yes	> Criteria
Total TCDD	2	2	100	28.5 J	12870 J	6450	0	0.008	2	1608750	Yes	> Criteria
Total TCDF	2	1	50	555 J	555 J	278	0	0.08	1	6938	Yes	> Criteria
Inorganics (unfiltered) (ug/L)												
Aluminum	2	2	100	174	6190	3180	0	18	2	344	Yes	> Criteria
Arsenic	2	2	100	6.1 J	10.9	8.5	0	16	0	0.68	No	< Criteria
Barium	2	2	100	17.8	91.7	54.8	0	4	2	22.9	Yes	> Criteria
Calcium	2	2	100	15900	23500	19700	0	NA	---	---	No	Nontoxic[2]
Chromium	2	1	50	23.1	23.1	11.8	0	11	1	2.1	Yes	> Criteria
Copper	2	2	100	16.6	91.4	54	0	9	2	10.2	Yes	> Criteria
Iron	2	2	100	1540	29100	15300	0	1000	2	29.1	Yes	> Criteria
Lead	2	1	50	223	223	112	0	2.5	1	89.2	Yes	> Criteria
Magnesium	2	2	100	1410	4750	3080	0	NA	---	---	No	Nontoxic[2]
Manganese	2	2	100	226	1030	628	0	120	2	8.6	Yes	> Criteria
Nickel	2	2	100	5.5	18.8	12.2	0	52	0	0.36	No	< Criteria
Potassium	2	2	100	1650 J	5370 J	3510	0	NA	---	---	No	Nontoxic[2]
Selenium	2	1	50	7.8	7.8	5.2	0	0.2363	1	33.0	Yes	> Criteria
Silver	2	1	50	1.5 J	1.5 J	1	0	3.4	0	0.44	No	< Criteria

TABLE C-9

SOURCE AREA SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Sodium	2	2	100	19000	39700	29400	0	NA	---	---	No	Nontoxic[2]
Vanadium	2	1	50	22	22	11.5	0	20	1	1.1	Yes	> Criteria
Zinc	2	2	100	35.4	292	164	0	30	2	9.7	Yes	> Criteria
Inorganics (filtered) (ug/L)												
Arsenic	2	2	100	7.4 J	8.1 J	7.8	0	16	0	0.51	No	< Criteria
Barium	2	2	100	183	206	194	0	4	2	51.5	Yes	> Criteria
Calcium	2	2	100	15000	22700	18900	0	NA	---	---	No	Nontoxic[2]
Copper	2	2	100	5.7	16	10.8	0	9	1	1.8	Yes	> Criteria
Iron	2	2	100	760	7950	4350	0	1000	1	8.0	Yes	> Criteria
Magnesium	2	2	100	1270	2860	2060	0	NA	---	---	No	Nontoxic[2]
Manganese	2	2	100	272	862	567	0	120	2	7.2	Yes	> Criteria
Nickel	2	2	100	3.8 J	8.2	6	0	52	0	0.16	No	< Criteria
Potassium	2	2	100	1690 J	4410 J	3050	0	NA	---	---	No	Nontoxic[2]
Sodium	2	2	100	23800	47500	35600	0	NA	---	---	No	Nontoxic[2]
Zinc	2	2	100	78.2 J	88.7 J	83.4	0	30	2	2.96	Yes	> Criteria
Semivolatile Organic Compounds (ug/L)												
Phenol	2	1	50	2 J	2 J	4	0	110	0	0.02	No	< Criteria
Pesticides/PCBs (ug/L)												
Aroclor, Total	2	1	50	4.6	4.6	2.8	0	0.000192	1	23958	Yes	> Criteria
Aroclor-1254	2	1	50	4.6	4.6	2.6	0	0.000192	1	23958	Yes	> Criteria
Endosulfan Sulfate	2	1	50	0.49	0.49	0.27	0	0.056	1	8.8	Yes	> Criteria
Endrin	2	1	50	0.21	0.21	0.13	0	0.001313	1	160	Yes	> Criteria
gamma-Chlordane	2	1	50	0.12	0.12	0.072	0	0.0043	1	27.9	Yes	> Criteria

Notes:
1 - The ecological criteria are the lower of the aquatic (i.e., fish) or semi-aquatic (i.e., kingfisher) screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
— Not Applicable

TABLE C-10

FLOODPLAIN SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (pg/L)												
1,2,3,7,8,9-HxCDF	1	1	100	2.2 J	2.2 J	2.2	0	0.08	1	27.5	Yes	> Criteria
OCDF	1	1	100	20.9 J	20.9 J	20.9	0	80	0	0.26	No	< Criteria
Total HpCDD	1	1	100	13.9 J	13.9 J	13.9	0	0.8	1	17	Yes	> Criteria
Total HpCDF	1	1	100	9.1 J	9.1 J	9.1	0	0.8	1	11.4	Yes	> Criteria
1,2,3,4,6,7,8-HpCDD	1	1	100	7.9 J	7.9 J	7.9	0	0.8	1	9.9	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	1	1	100	4.3 J	4.3 J	4.3	0	0.8	1	5.4	Yes	> Criteria
Total HxCDD	1	1	100	9.6 EMPC	9.6 EMPC	9.6	0	0.08	1	120	Yes	> Criteria
Total HxCDF	1	1	100	4.8 J	4.8 J	4.8	0	0.08	1	60	Yes	> Criteria
Inorganics (unfiltered) (ug/L)												
Arsenic	2	2	100	7.3 J	9.5 J	8.4	0	16	0	0.59	No	< Criteria
Barium	2	2	100	22.4	33.1	27.7	0	4	2	8.3	Yes	> Criteria
Calcium	2	2	100	14300	21000	17600	0	NA	---	---	No	Nontoxic[2]
Copper	2	2	100	2.5	14.8	8.6	0	9	1	1.6	Yes	> Criteria
Iron	2	2	100	1110	3810	2460	0	1000	2	3.8	Yes	> Criteria
Magnesium	2	2	100	1280	2180	1730	0	NA	---	---	No	Nontoxic[2]
Manganese	2	2	100	172	244	208	0	120	2	2.0	Yes	> Criteria
Nickel	2	2	100	4.4	5.5	5	0	52	0	0.11	No	< Criteria
Potassium	2	2	100	1490 J	2730 J	2110	0	NA	---	---	No	Nontoxic[2]
Selenium	2	1	50	5.9	5.9	4.2	0	0.2363	1	25.0	Yes	> Criteria
Silver	2	1	50	1.2 J	1.2 J	0.85	0	3.4	0	0.35	No	< Criteria
Sodium	2	2	100	15600	37100	26400	0	NA	---	---	No	Nontoxic[2]
Thallium	2	1	50	11.2 J	11.2 J	7.4	0	1	1	11.2	Yes	> Criteria
Zinc	2	2	100	27.9	28.7	28.3	0	30	0	0.96	No	< Criteria
Inorganics (filtered) (ug/L)												
Arsenic	2	2	100	7.7 J	7.9 J	7.8	0	16	0	0.49	No	< Criteria
Calcium	2	2	100	5380	21300	13300	0	NA	---	---	No	Nontoxic[2]
Copper	2	2	100	2.2	3.2	2.7	0	9	0	0.36	No	< Criteria
Iron	2	2	100	547	877	712	0	1000	0	0.88	No	< Criteria
Magnesium	2	2	100	462	2230	1350	0	NA	---	---	No	Nontoxic[2]
Manganese	2	2	100	88.7	170	129	0	120	1	1.4	Yes	> Criteria
Nickel	2	2	100	3.4 J	4.6	4	0	52	0	0.09	No	< Criteria
Potassium	2	2	100	613 J	3150 J	1880	0	NA	---	---	No	Nontoxic[2]
Silver	2	1	50	1.6 J	1.6 J	1.1	0	3.4	0	0.47	No	< Criteria
Sodium	2	1	50	41900	41900	22900	0	NA	---	---	No	Nontoxic[2]
Thallium	2	1	50	7 J	7 J	5.2	0	1	1	7.00	Yes	> Criteria
Zinc	2	1	50	105	105	55.4	0	30	1	3.50	Yes	> Criteria

Notes:
1 - The ecological criteria are the lower of the aquatic (i.e., fish) or semi-aquatic (i.e., kingfisher) screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-11

DOWNSTREAM SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Dioxins (pg/L)												
1,2,3,4,6,7,8-HpCDD	30	16	53	3 EMPC	2190 J	105	0	0.8	16	2738	Yes	> Criteria
1,2,3,4,6,7,8-HpCDF	30	12	40	2.4 J	580 J	32.3	0	0.8	12	725	Yes	> Criteria
1,2,3,4,7,8,9-HpCDF	27	3	11	6.1 EMPC	50 J	5.4	0	0.8	3	63	Yes	> Criteria
1,2,3,4,7,8-HxCDD	30	3	10	1.6 J	28.3 EMPC	3.3	0	0.08	3	354	Yes	> Criteria
1,2,3,4,7,8-HxCDF	30	3	10	2.4 EMPC	42.7 J	3.5	0	0.08	3	534	Yes	> Criteria
1,2,3,6,7,8-HxCDD	30	3	10	6.1 J	95.3 J	5.9	0	0.08	3	1191	Yes	> Criteria
1,2,3,6,7,8-HxCDF	30	3	10	1.9 EMPC	34.2 J	3.1	0	0.08	3	428	Yes	> Criteria
1,2,3,7,8,9-HxCDD	30	6	20	1.8 EMPC	93.5 J	6.1	0	0.08	6	1169	Yes	> Criteria
1,2,3,7,8-PeCDD	30	1	3	14 EMPC	14 EMPC	2.4	0	0.008	1	1750	Yes	> Criteria
1,2,3,7,8-PeCDF	30	1	3	36.4 EMPC	36.4 EMPC	2.8	0	0.16	1	228	Yes	> Criteria
1,2,4,5,7,8-hexachloro(9H)xanthene	5	5	100	18.76 J	271 J	123	0	0.0035	5	77429	Yes	> Criteria
2,3,4,6,7,8-HxCDF	30	3	10	5.9 J	43.6 J	3.6	0	0.08	3	545	Yes	> Criteria
2,3,4,7,8-PeCDF	30	1	3	18.3 J	18.3 J	2.2	0	0.016	1	1144	Yes	> Criteria
2,3,7,8-TCDD	30	15	50	2.9 EMPC	4000 J	205	0	0.008	15	500000	Yes	> Criteria
2,3,7,8-TCDF	28	3	11	7.7 J	30.9 J	3.6	0	0.08	3	386	Yes	> Criteria
OCDD	30	23	77	9.3 EMPC	14890 J	713	0	80	10	186	Yes	> Criteria
OCDF	30	14	47	2.4 , EMPC	1180 J	60.4	0	80	3	14.8	Yes	> Criteria
Total HpCDD	30	18	60	5.3 EMPC	4130 J	196	0	0.8	18	5163	Yes	> Criteria
Total HpCDF	29	14	48	1.7 EMPC	1400 J	73.4	0	0.8	14	1750	Yes	> Criteria
Total HxCDD	30	8	27	3.1 J	626 J	30.3	0	0.08	8	7825	Yes	> Criteria
Total HxCDF	30	9	30	1.3	741 J	36.7	0	0.08	9	9263	Yes	> Criteria
Total PeCDD	30	3	10	8.4 EMPC	49.5 J	4.3	0	0.008	3	6188	Yes	> Criteria
Total PeCDF	30	5	17	1.3 EMPC	270 J	12.2	0	0.016	5	16875	Yes	> Criteria
Total TCDD	30	15	50	2.9 EMPC	4100 J	210	0	0.008	15	512500	Yes	> Criteria
Total TCDF	30	5	17	1.2 EMPC	234 J	13.8	0	0.08	5	2925	Yes	> Criteria
Inorganics (unfiltered) (ug/L)												
Aluminum	30	21	70	35.8 J	5070	317	0	18	21	282	Yes	> Criteria
Arsenic	30	9	30	2.4	12.5	3.6	0	16	0	0.78	No	< Criteria
Barium	30	29	97	15.6	271	34.6	0	4	29	67.8	Yes	> Criteria
Beryllium	30	1	3	0.2	0.2	0.32	0	0.66	0	0.30	No	< Criteria
Calcium	30	30	100	7230	36800	11600	0	NA	---	---	No	Nontoxic[2]
Chromium	30	8	27	1 J	42	2.7	0	11	1	3.8	Yes	> Criteria
Cobalt	30	3	10	0.6 J	5.4	0.59	0	23	0	0.23	No	< Criteria
Copper	30	30	100	1.3	83.1	10	0	9	9	9.2	Yes	> Criteria
Iron	30	30	100	219	113000	4510	0	1000	5	113	Yes	> Criteria
Lead	30	9	30	3.4 J	156	9.2	0	2.5	9	62.4	Yes	> Criteria
Magnesium	30	30	100	1190	5920	1860	0	NA	---	---	No	Nontoxic[2]
Manganese	30	30	100	14.1	2600	276	0	120	10	21.7	Yes	> Criteria
Nickel	30	18	60	1.6 J	34.3 J	3.4	0	52	0	0.66	No	< Criteria
Potassium	30	30	100	1710 J	4650 J	2430	0	NA	---	---	No	Nontoxic[2]
Selenium	30	2	7	3.1 J	10.8	2	0	0.2363	2	45.7	Yes	> Criteria
Silver	30	7	23	1 J	1.8 J	0.57	0	3.4	0	0.53	No	< Criteria

TABLE C-11

DOWNSTREAM SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.	Ecological Criteria[1]	Number of Samples > Criteria	Hazard Quotient	Retained as COPC	Rational for Selection
Sodium	29	29	100	18300	31800	22800	0	NA	---	---	No	Nontoxic[2]
Thallium	30	6	20	2.2 J	14.5	3.5	0	1	6	14.5	Yes	> Criteria
Vanadium	30	6	20	0.5	18.3	1.5	0	20	0	0.92	No	< Criteria
Zinc	30	24	80	13.2 J	500	46.9	0	30	10	16.7	Yes	> Criteria
Inorganics (filtered) (ug/L)												
Aluminum	30	15	50	38.8 J	143	44.8	0	18	15	7.9	Yes	> Criteria
Arsenic	30	7	23	5.9	11.3	3.5	0	16	0	0.71	No	< Criteria
Barium	30	20	67	184	286	150	0	4	20	71.5	Yes	> Criteria
Calcium	30	30	100	7620	37100	11300	15400	NA	---	---	No	Nontoxic[2]
Chromium	30	1	3	1.6	1.6	0.43	0	11	0	0.15	No	< Criteria
Cobalt	30	1	3	1 J	1 J	0.42	0	23	0	0.04	No	< Criteria
Copper	30	29	97	1.4	12.7	4.6	3.1	9	4	1.4	Yes	> Criteria
Iron	30	30	100	126	2960	369	282	1000	2	3.0	Yes	> Criteria
Lead	30	1	3	4.7	4.7	1	0	2.5	1	1.9	Yes	> Criteria
Magnesium	30	30	100	1240	6240	1790	2720	NA	---	---	No	Nontoxic[2]
Manganese	30	30	100	9.6	1570	215	184	120	6	13.1	Yes	> Criteria
Nickel	30	13	43	1.3 J	7.3	1.9	7.2	52	0	0.14	No	< Criteria
Potassium	30	30	100	1800	4900	2410	2570	NA	---	---	No	Nontoxic[2]
Selenium	30	2	7	3.9 J	5.3	1.9	0	0.2363	2	22.4	Yes	> Criteria
Silver	30	7	23	1.1 J	1.8	0.58	0	3.4	0	0.53	No	< Criteria
Sodium	30	30	100	20800	31900	25300	14900	NA	---	---	No	Nontoxic[2]
Thallium	30	6	20	7.3 J	10.6 J	3.2	0	1	6	10.6	Yes	> Criteria
Vanadium	30	2	7	0.8 J	0.8 J	0.65	0	20	0	0.04	No	< Criteria
Zinc	30	29	97	20.9	121	66.1	24.9	30	1	4.0	Yes	> Criteria
Semivolatile Organic Compounds (ug/L)												
bis(2-Ethylhexyl)phthalate	30	1	3	160 *	160 *	10	0	0.0007593	1	210720	Yes	> Criteria
Pesticides (ug/L)												
4,4'-DDE	30	1	3	0.0043 J	0.0043 J	0.048	0	0.00001048	1	410	Yes	> Criteria
4,4'-DDT	30	1	3	0.01 J	0.01 J	0.049	0	0.00001048	1	954	Yes	> Criteria
Aldrin	30	6	20	0.003 J	0.069	0.026	0	0.001	6	69.0	Yes	> Criteria
alpha-Chlordane	30	1	3	0.019 J	0.019 J	0.025	0	0.0043	1	4.4	Yes	> Criteria
delta-BHC	30	3	10	0.0017 J	0.0096 J	0.023	0	0.0003971	0	24.2	Yes	> Criteria
Endosulfan Sulfate	30	2	7	0.0026 J	0.0032 J	0.047	0	0.056	0	0.06	No	< Criteria
Endrin Aldehyde	23	5	22	0.0013 J	0.005 J	0.04	0	0.001313	4	3.8	Yes	> Criteria
gamma-Chlordane	30	1	3	0.021 J	0.021 J	0.025	0	0.0043	1	4.9	Yes	> Criteria

Notes:
1 - The ecological criteria are the lower of the aquatic (i.e., fish) or semi-aquatic (i.e., kingfisher) screening values
2 - These parameters are not expected to be toxic at the detected concentrations
NA - Not Available
--- Not Applicable

TABLE C-12

REFERENCE BANK SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.
Dioxins (ng/kg)							
1,2,3,4,6,7,8-HpCDD	6	6	100	14.8	959	263	0
1,2,3,4,6,7,8-HpCDF	6	6	100	5.8	260	106	0
1,2,3,4,7,8,9-HpCDF	6	6	100	0.52 J	43.1	11.8	0
1,2,3,4,7,8-HxCDD	6	4	67	1.9 J	8.5	3.4	0
1,2,3,4,7,8-HxCDF	6	5	83	1.2 EMPC	101	26.5	0
1,2,3,6,7,8-HxCDD	6	5	83	1.3 J	35.8	14.9	0
1,2,3,6,7,8-HxCDF	6	5	83	0.74 EMPC	34.9	10.9	0
1,2,3,7,8,9-HxCDD	6	4	67	4.8	31.2	13.4	0
1,2,3,7,8-PeCDD	6	5	83	0.35 J	7.1	2.7	0
1,2,3,7,8-PeCDF	6	4	67	1.3 EMPC	29 EMPC	9.6	0
1,2,4,5,7,8-hexachloro(9H)xanthene	3	3	100	1.69 J	4.32	2.8	0
2,3,4,6,7,8-HxCDF	6	5	83	1.4 J	111	25.5	0
2,3,4,7,8-PeCDF	3	3	100	7.1	29.7	17	0
2,3,7,8-TCDD	6	5	83	2.1 EMPC	48	13.2	0
2,3,7,8-TCDF	6	4	67	0.63 EMPC	39.2	12.6	0
OCDD	6	6	100	92.5 EB	4040 EBJ$	1230	0
OCDF	6	6	100	7.3 EBJ	765 EB	203	0
Total HpCDD	6	6	100	28.1 J	1580 J	471	0
Total HpCDF	6	6	100	13.8 J	901 J	347	0
Total HxCDD	6	6	100	5.9 EMPC	341	120	0
Total HxCDF	6	6	100	11.7 EMPC	582	201	0
Total PeCDD	3	3	100	2.1 EMPC	116	43.1	0
Total PeCDF	5	5	100	5.1 EMPC	394	157	0
Total TCDD	6	6	100	6.7 EMPC	48.6 J	25	0
Total TCDF	6	6	100	5.8 EMPC	280	87.3	0
Inorganics (mg/kg)							
Aluminum	6	6	100	1880	4900	3340	0
Arsenic	6	5	83	0.89 J	6	2.7	0
Barium	6	6	100	7.6	227	95.5	0
Beryllium	6	6	100	0.15 J	1.4	0.67	0
Cadmium	6	1	17	1.6	1.6	0.3	0
Calcium	6	6	100	447	1040	736	0
Chromium	6	6	100	4.6 J	311	119	0
Cobalt	6	3	50	11.2	32.2	11.7	0
Copper	6	4	67	15.6	157	53.7	0
Iron	6	6	100	3700	15000	7650	0
Lead	6	6	100	24.4	247	117	0
Magnesium	6	6	100	573	944	710	0
Manganese	6	6	100	57.7	1490	448	0
Mercury	6	6	100	0.01 J	0.12	0.073	0
Nickel	6	3	50	12.1	37.8	13.3	0
Potassium	6	6	100	317	431	380	0

TABLE C-12

REFERENCE BANK SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.
Selenium	6	3	50	1.3 J	2.3	1.2	0
Silver	6	1	17	5.3	5.3	1.7	0
Sodium	6	4	67	26.3 J	63.5	34.6	0
Thallium	6	1	17	0.71 J	0.71 J	0.34	0
Vanadium	6	6	100	6.8	159	50.6	0
Zinc	6	5	83	37.6	266	94.8	0
Semivolatile Organic Compounds (ug/kg)							
Acenaphthene	6	2	33	390 J	480 J	820	0
Anthracene	6	3	50	790 J	1200	630	0
Benzo(a)anthracene	6	5	83	87 J	5000	1900	0
Benzo(a)pyrene	6	5	83	100 J	4000	1500	0
Benzo(b)fluoranthene	6	6	100	43 J	3300	1500	0
Benzo(g,h,i)perylene	6	5	83	59 J	2300	840	0
Benzo(k)fluoranthene	6	5	83	130 J	2700	1200	0
bis(2-Ethylhexyl)phthalate	6	5	83	51 J	3500	1000	0
Butylbenzylphthalate	6	1	17	490 J	490 J	1100	0
Carbazole	6	3	50	580 J	870	490	0
Chrysene	6	6	100	83 J	5200	2000	0
Di-n-Butylphthalate	6	1	17	40 J	40 J	1100	0
Dibenzo(a,h)anthracene	6	3	50	140 J	770 J	840	0
Dibenzofuran	6	1	17	290 J	290 J	1000	0
Fluoranthene	6	6	100	77 J	9000	3900	0
Fluorene	6	3	50	450 J	820	430	0
Indeno(1,2,3-cd)pyrene	6	5	83	99 J	2600	1100	0
Phenanthrene	6	6	100	72 J	7400	2900	0
Pyrene	6	6	100	49 J	8200	3200	0
Pesticides/PCBs (ug/kg)							
4,4'-DDD	6	1	17	7.5	7.5	2.9	0
4,4'-DDT	6	2	33	5.3	53	11	0
alpha-Chlordane	6	3	50	3.8	12	4.5	0
Aroclor, Total	6	4	67	64	450	190	0
Aroclor-1221	6	1	17	26 J	26 J	36	0
Aroclor-1254	6	4	67	64	450	180	0
gamma-Chlordane	6	3	50	2.4	10	3.9	0

TABLE C-13

REFERENCE FLOODPLAIN SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.
Dioxins (ng/kg)									
1,2,3,4,6,7,8-HpCDD	3	3	100.0	78.6		1470		664	0
1,2,3,4,6,7,8-HpCDF	3	3	100.0	17.1		533		247	0
1,2,3,6,7,8-HxCDF	3	2	66.7	17		50.3		22.7	0
1,2,3,7,8,9-HxCDD	3	2	66.7	24.9		68.7		31.9	0
1,2,3,7,8,9-HxCDF	3	1	33.3	1.4	EMPC	1.4	EMPC	1.1	0
1,2,3,7,8-PeCDD	3	2	66.7	3.5	EMPC	13.1		5.7	0
1,2,3,7,8-PeCDF	3	1	33.3	15.4		15.4		6.1	0
1,2,4,5,7,8-hexachloro(9H)xanthene	2	2	100.0	4.77	J	14.5	J	9.6	0
2,3,4,6,7,8-HxCDF	3	2	66.7	19		61.9		27.3	0
2,3,4,7,8-PeCDF	3	2	66.7	9.5		26.9		12.3	0
1,2,3,4,7,8,9-HpCDF	3	3	100.0	1.2	EMPC	26.7		12.9	0
1,2,3,4,7,8-HxCDD	3	2	66.7	7.1		25.3		11.1	0
1,2,3,4,7,8-HxCDF	3	2	66.7	25.7		73.9		33.7	0
1,2,3,6,7,8-HxCDD	3	3	100.0	4.1	J	85.3		37.6	0
2,3,7,8-TCDD	3	3	100.0	0.76	J	86.6		30.1	0
2,3,7,8-TCDF	3	3	100.0	2.3		69.3		29.7	0
OCDD	3	3	100.0	637	JEB	10920	J$EB	5010	0
OCDF	3	3	100.0	35.5		611		330	0
Total HpCDD	3	3	100.0	157	J	2940	J	1330	0
Total HpCDF	3	3	100.0	35.9	J	1300	J	583	0
Total HxCDD	3	3	100.0	32.5	EMPC	655	J	294	0
Total HxCDF	3	3	100.0	28	EMPC	1020	J	443	0
Total PeCDD	3	2	66.7	8.1	EMPC	99.1	J	37.4	0
Total PeCDF	3	3	100.0	16.3	EMPC	557	J	257	0
Total TCDD	3	3	100.0	1.4	J	147	J	58.5	0
Total TCDF	3	3	100.0	7.3	J	636	J	270	0
Inorganics (mg/kg)									
Aluminum	3	3	100.0	8990		16100		12100	0
Antimony	3	2	66.7	2.3	J	4.3	J	2.3	0
Arsenic	3	3	100.0	3.4		13.5		7.7	0
Barium	3	3	100.0	102		245		182	0
Beryllium	3	3	100.0	1.8		4.1		2.7	0
Cadmium	3	2	66.7	0.21	J	1.1	J	0.46	0
Calcium	3	3	100.0	1710	J	2660	J	2080	0
Chromium	3	3	100.0	14.1		271		143	0
Cobalt	3	3	100.0	7.9	J	10.4	J	9.1	0
Copper	3	3	100.0	13.5		436		187	0
Iron	3	3	100.0	20700		23800		22400	0
Lead	3	3	100.0	37.4		570		278	0
Magnesium	3	3	100.0	1420	J	2360	J	1930	0
Manganese	3	3	100.0	503		1990		1360	0

TABLE C-13

REFERENCE FLOODPLAIN SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.
Mercury	3	2	66.7	0.3	J	0.53	J	0.28	0
Nickel	3	3	100.0	9.9		261		99	0
Potassium	3	3	100.0	836		1580		1220	0
Selenium	3	3	100.0	2.2	J	3.6	J	2.8	0
Silver	3	3	100.0	6.5		9.2		7.7	0
Sodium	3	1	33.3	254		254		123	0
Vanadium	3	3	100.0	20.9		129		65.7	0
Zinc	3	3	100.0	85.9	J	376	J	255	0
Semivolatile Organic Compounds (ug/kg)									
Acenaphthene	3	1	33.3	260	J	260	J	1800	0
Anthracene	3	1	33.3	750	J	750	J	2000	0
Benzo(a)anthracene	3	3	100.0	270	J	3500		1700	0
Benzo(a)pyrene	3	3	100.0	320	J	3100		1600	0
Benzo(b)fluoranthene	3	3	100.0	390	J	3100		1700	0
Benzo(g,h,i)perylene	3	3	100.0	280	J	1600	J	1000	0
Benzo(k)fluoranthene	3	3	100.0	310	J	3600		1800	0
Butylbenzylphthalate	3	1	33.3	540	J	540	J	1900	0
Carbazole	3	1	33.3	520	J	520	J	1900	0
Chrysene	3	3	100.0	430	J	4100		2100	0
Di-n-Butylphthalate	3	2	66.7	63	JEB	470	JEB	1800	0
Dibenzo(a,h)anthracene	3	1	33.3	100	J	100	J	2100	0
Fluoranthene	3	3	100.0	840		7000		3400	0
Fluorene	3	1	33.3	400	J	400	J	1900	0
Indeno(1,2,3-cd)pyrene	3	3	100.0	270	J	1700	J	1100	0
Phenanthrene	3	3	100.0	300	J	4500		2000	0
Pyrene	3	3	100.0	590	J	6500		3200	0
Pesticides/PCBs (ug/kg)									
4,4'-DDT	3	1	33.3	5.6		5.6		3.5	0
alpha-Chlordane	3	2	66.7	3.2		4.9		3.1	0
Aroclor, Total	3	3	100.0	27		480		210	0
Aroclor-1254	3	3	100.0	27	J	380		180	0
Aroclor-1260	3	1	33.3	100		100		50	0
gamma-Chlordane	3	2	66.7	2.9		7.8		4	0
Miscellaneous Parameters (mg/kg)									
Total Organic Carbon	3	3	100.0	37000		109000		73000	0

TABLE C-14

REFERENCE SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.
Dioxins (ng/kg)									
1,2,3,4,6,7,8-HpCDD	4	4	100.0	7.7		992		321	0
1,2,3,4,6,7,8-HpCDF	4	3	75.0	40.6		383		118	0
1,2,3,4,7,8,9-HpCDF	4	3	75.0	1.4	EMPC	22.1		6.9	0
1,2,3,4,7,8-HxCDD	4	2	50.0	4.2	J	18.9		5.9	0
1,2,3,4,7,8-HxCDF	4	1	25.0	60.5		60.5		16	0
1,2,3,6,7,8-HxCDD	4	2	50.0	10.9		62.8		18.8	0
1,2,3,6,7,8-HxCDF	4	1	25.0	39.4		39.4		10.5	0
1,2,3,7,8,9-HxCDD	4	2	50.0	10.7		55.5		17	0
1,2,3,7,8,9-HxCDF	4	1	25.0	0.37	EMPC	0.37	EMPC	0.46	0
1,2,3,7,8-PeCDD	4	2	50.0	0.62	EMPC	10.3		3	0
1,2,3,7,8-PeCDF	4	2	50.0	0.55	EMPC	11.6		3.2	0
1,2,4,5,7,8-hexachloro(9H)xanthene	1	1	100.0	7.46		7.46		7.5	0
2,3,4,6,7,8-HxCDF	4	1	25.0	49		49		13.1	0
2,3,4,7,8-PeCDF	4	2	50.0	1.3	EMPC	24.5		6.6	0
2,3,7,8-TCDD	4	4	100.0	0.43	J	6.5		3	0
2,3,7,8-TCDF	4	3	75.0	1.2		58.9		15.9	0
OCDD	4	4	100.0	55.6	JEB	4890		1720	0
OCDF	4	3	75.0	38.7		441		152	0
Total HpCDD	4	3	75.0	90.5	J	1950		621	0
Total HpCDF	4	3	75.0	76.3	J	877		271	0
Total HxCDD	4	3	75.0	2.8	EMPC	510		149	0
Total HxCDF	4	4	100.0	2.1	EMPC	724		207	0
Total PeCDD	4	1	25.0	81.9		81.9		22.2	0
Total PeCDF	4	3	75.0	1.3	EMPC	457		122	0
Total TCDD	4	4	100.0	1.9	J	54.6		16.4	0
Total TCDF	4	3	75.0	4.2	J	551		145	0
Inorganics (mg/kg)									
Aluminum	4	4	100.0	2800		14100		7160	0
Antimony	4	2	50.0	0.92	J	4.6		1.6	0
Arsenic	4	4	100.0	0.93	J	9.6		3.8	0
Barium	4	4	100.0	29		202		89.6	0
Beryllium	4	4	100.0	0.3	J	3.5		1.7	0
Cadmium	4	1	25.0	2.5		2.5		0.67	0
Calcium	4	4	100.0	1480	J	4290		2470	0
Chromium	4	4	100.0	7.1		360		104	0
Cobalt	4	4	100.0	2.4	J	19.6		7.6	0
Copper	4	4	100.0	9.7		296		87.3	0
Iron	4	4	100.0	6100		21800		12400	0
Lead	4	4	100.0	24.3		380		121	0
Magnesium	4	4	100.0	579	J	2370		1340	0
Manganese	4	4	100.0	81.8		707		430	0
Mercury	4	2	50.0	0.05	J	0.29		0.096	0

TABLE C-14

REFERENCE SEDIMENT SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.		Maximum Conc.		Average Conc.	Average Bkg. Conc.
Nickel	4	4	100.0	3.9	J	141		38.9	0
Potassium	4	4	100.0	370		1440		848	0
Selenium	4	2	50.0	1.2	J	3.2		1.3	0
Silver	4	4	100.0	1.8	J	7.1		3.2	0
Sodium	4	1	25.0	349		349		116	0
Vanadium	4	4	100.0	9.5		93.3		31.4	0
Zinc	4	4	100.0	49.2	J	856		268	0
Semivolatile Organic Compounds (ug/kg)									
Anthracene	4	1	25.0	820	J	820	J	970	0
Benzo(a)anthracene	4	4	100.0	150	J	3200	J	1300	0
Benzo(a)pyrene	4	4	100.0	140	J	3300	J	1300	0
Benzo(b)fluoranthene	4	4	100.0	160	J	3400	J	1300	0
Benzo(g,h,i)perylene	4	4	100.0	56	J	1400	J	690	0
Benzo(k)fluoranthene	4	4	100.0	150	J	3400	J	1400	0
bis(2-Ethylhexyl)phthalate	4	1	25.0	550		550		1500	0
Carbazole	4	2	50.0	89	J	880	J	920	0
Chrysene	4	4	100.0	170	J	4200	J	1700	0
Di-n-Butylphthalate	4	2	50.0	80	JEB	88	JEB	1300	0
Dibenzo(a,h)anthracene	4	1	25.0	120	J	120	J	1300	0
Fluoranthene	4	4	100.0	320	J	8600		3200	0
Indeno(1,2,3-cd)pyrene	4	4	100.0	63	J	1500	J	710	0
Phenanthrene	4	4	100.0	190	J	5400		1900	0
Pyrene	4	4	100.0	250	J	5800		2300	0
Pesticides/PCBs (ug/kg)									
alpha-Chlordane	4	1	25.0	12		12		4.1	0
Aroclor, Total	4	2	50.0	23		210		89	0
Aroclor-1254	4	2	50.0	23	J	210		74	0
Endosulfan II	4	1	25.0	13		13		5.4	0
gamma-Chlordane	4	1	25.0	12		12		4.1	0
Miscellaneous Parameters (mg/kg)									
Total Organic Carbon	4	4	100.0	21600		81600		39000	0

TABLE C-15

REFERENCE SURFACE WATER SAMPLES
EE/CA ECOLOGICAL RISK SCREENING
CENTREDALE MANOR SITE

Parameter	Number Analyzed	Number of Detects	Freq. of Detect. (percent)	Minimum Conc.	Maximum Conc.	Average Conc.	Average Bkg. Conc.
Dioxins (pg/L)							
1,2,3,4,6,7,8-HpCDD	4	1	25	12.4 J	12.4 J	5.8	0
Total HpCDD	4	1	25	24.6 J	24.6 J	8.8	0
Inorganics (unfiltered) (ug/L)							
Aluminum	4	3	75	166	583	256	0
Barium	4	4	100	22.6	35.7	27.6	0
Calcium	4	4	100	8650	38100	16200	0
Chromium	4	2	50	2.5	8.3	3	0
Copper	4	4	100	3.5	25.8	11.9	0
Iron	4	4	100	657	1590	1050	0
Lead	4	2	50	6.8	21.4	7.6	0
Magnesium	4	4	100	1430 J	6780	2830	0
Manganese	4	4	100	126	531	242	0
Nickel	4	3	75	2.1 J	6.3	3.2	0
Potassium	4	4	100	1540	5210	2640	0
Sodium	4	4	100	16800	21600	19600	0
Vanadium	4	2	50	2.2	4.2	2.1	0
Zinc	4	4	100	16.1	76	51.7	0
Inorganics (filtered) (ug/L)							
Cadmium	4	1	25	4	4	1.4	0
Calcium	4	4	100	7210	38300	15400	0
Copper	4	3	75	3.1	5.5	3.1	0
Iron	4	4	100	173	496	282	0
Magnesium	4	4	100	1220	6820	2720	0
Manganese	4	4	100	45.7	451	184	0
Nickel	4	2	50	3.6 J	23.2	7.2	0
Potassium	4	4	100	1530	5270	2570	0
Sodium	4	2	50	20600	21200	14900	0
Zinc	4	4	100	16.7	34.3	24.9	0
Semivolatile Organic Compounds (ug/L)							
bis(2-Ethylhexyl)phthalate	4	1	25	1 J	1 J	4	0

ATTACHMENT 1

For

Centredale Manor Restoration Project Site

Streamlined Ecological Risk Evaluation

Habitat Map

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 8461
FIGURE 1, HABITAT MAP, CENTREDALE
MANOR SITE STUDY AREA

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

ATTACHMENT 2

For

Centredale Manor Restoration Project Site

Streamlined Ecological Risk Evaluation

Information Provided for Wildlife Survey

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DIVISION OF FISH AND WILDLIFE
Field Headquarters
P.O. Box 218
West Kingston, RI 02892

401 789-0281
401 222-1267
FAX 401 783-7490
TDD 401 831-5508

APR 26 2000

April 21, 2000

Kevin O'Neill
Tetra Tech NUS
55 Jonspin Road
Wilmington, MA 01887

RE: Woonasquatucket River, North Providence and Johnston, Rhode Island

Dear Kevin:

On April 13, 2000 I conducted an informal survey of the Woonasquatucket River in North Providence and Johnston, Rhode Island from Route 44 to the pond above the Lymonsville Dam. The survey consisted of walking within the river where possible and along the both shorelines to look for signs of aquatic furbearer activity (i.e. tracks, scat).

In that section of river between Route 44 and the Allendale Dam I noted muskrat scat on exposed rocks and logs and a number of locations, all on the Johnston side of the river. I did not survey the pond and wetland area directly above the Allendale dam but the habitat appears appropriate for muskrats. The lack of activity noted along the North Providence side of the river at the Centerdale Manor is probably due to the nature of the recently armored shoreline and the lack of any vegetative cover as well as the high level of flow in this stretch.

Below the Allendale Dam to the pond above the Lymonsville Dam there is more vegetative cover along the river as well as adjacent wetlands and a wooded area on the Johnston side of the river. At a number of locations along this stretch and particularly on the Johnston side I noted evidence of furbearers utilizing the river. I noted a latrine and tracks of raccoon, several locations where muskrat had deposited scat on exposed objects and the riverbank, and also two otter latrines. An otter latrine or haul-out site is an area that is used by otters for deposition of scat and scent marking and conveys territoriality and other messages between individual otters. These areas can often be identified by the presence of food remains, mounds of soil, leaves or grass scratched together, areas of exposed soil and musk deposits. One such area is located directly opposite the Little League concession stand on the elevated landform that separates the river from a small pond. Food remains noted were various types of fish scales and bones and crayfish parts.

Although I did not find any evidence of mink at the time, I would not doubt that they are present in some portions of this river system.

Among other things that I noted was fox scat on the same landform as the otter latrine, a spotted turtle in the small pond as well as green frogs and bullfrogs in the same pond.

As stated earlier, this was just an informal survey of the river shoreline to check for the presence of obvious aquatic furbearer sign. If you have any questions please feel free to contact me at (401)-789-0281.

Sincerely,

Charles Brown
Wildlife Biologist

Fish Survey Rpt
Woonasquatucket River
Watershed
rec'd 2/00
FROM A. Libby
(FWS)

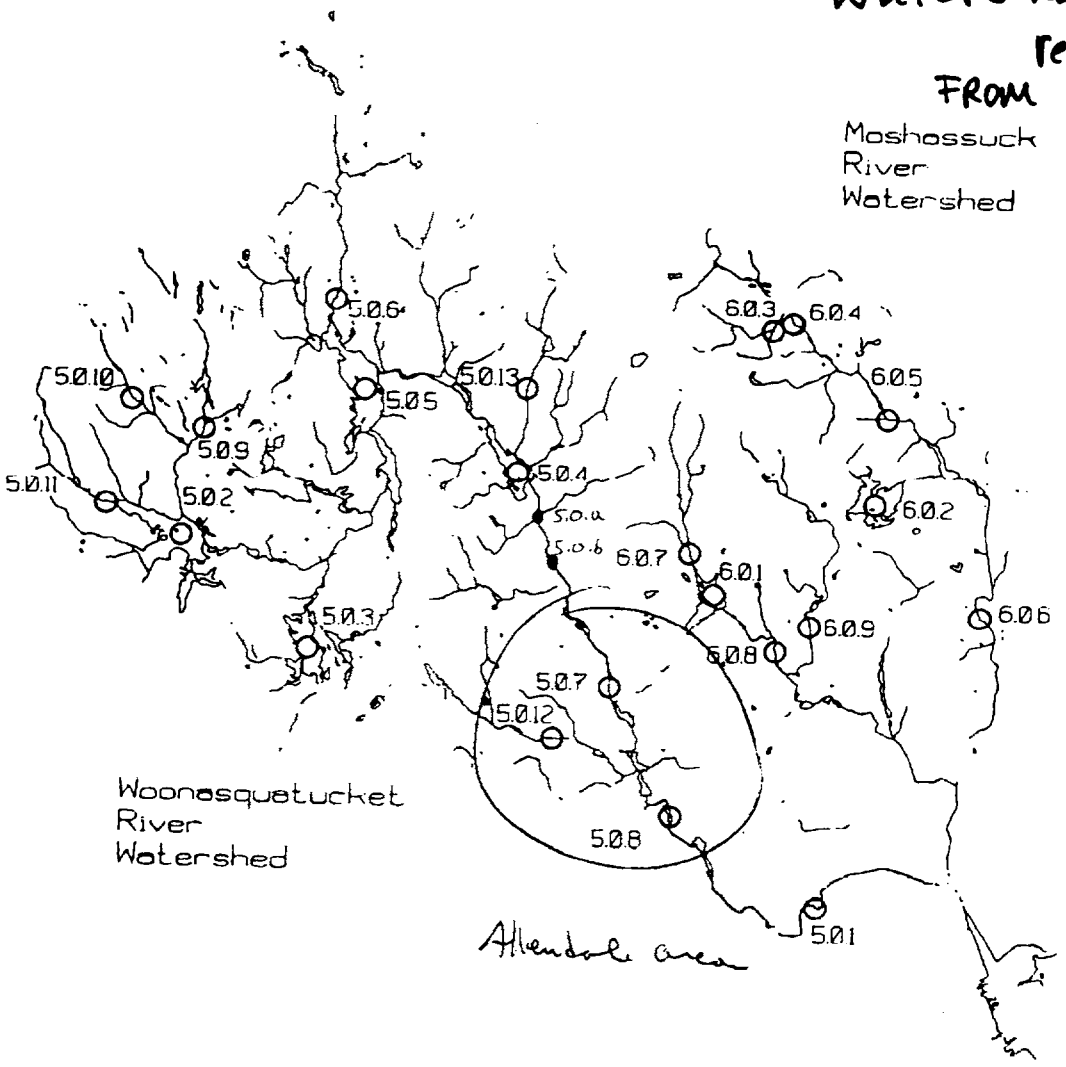

Figure 37. - Sampling station locations in the Woonasquatucket River and Moshassuck River watersheds.

Table 8. - The relative abundance (number-per-hour) of fish species collected from ponds in the Woonasquatucket River and the Moshassuck River watersheds by electrofishing in 1995.

Pond/Station No.	Number-per-Hour																					
	BG	YP	PS	WP	LMB	EL	CP	BK	BBL	GS	BC	YB	TD	NP	WS	CRP	BRW	BRK	RNB	WC	RB	SMB	BND
Woonasquatucket																							
Waterman Res./5.0.2	90	131	24	90	14	2	1	0	3	1	2	0	1-	1	0	0	0	0	0	0	0	0	0
Slack Res./5.0.3	69	98	57-	29	16	11-	9	11-	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Georgiaville Pond/5.0.4	90	34	20	4	33	7-	2	1-	1	2-	1	1-	0	0	1	0+	0	0	0	0+	0	0	0
Woonasquatucket Res./5.0.5	107	41	46	6	53	12-	3	0	1	0+	0	1-	0	0*	0	0	0	0	0	0	0	0	0
TOTAL	356	304	147	129	116	32	15	12	9	4	3	2	1	1	1	0	0	0	0	0	0	0	0
Moshassuck																							
Wenscott Res./6.0.1	74	26	45	0+	48	5	24	1	0+	3	3	3-	0	0	0+	2	0	0	0	0+	0	0	0
Olney Pond/6.0.2	67	66	50	14	50	4-	5	0	0	0+	1	1-	0	0	0	8-	1*	2*	1*	0	0+	0+	0+
TOTAL	141	92	95	14	98	9	29	1	0	3	4	4	0	0	0	10	1	2	1	0	0	0	0

\+ Species found in Guthrie and Stolgitis (1977) but not in the present survey.

\- Species found in the present survey but not in Guthrie and Stolgitis (1977).

* Stocked

Species Code:

BBL	Brown Bullhead	EL	American Eel	SMB	Smallmouth Bass
BC	Black Crappie	GS	Golden Shiner	WC	White Catfish
BG	Bluegill	LMB	Largemouth bass	WP	White Perch WC
BK	Banded Killifish	NP	Northern Pike	WS	White Sucker
BND	Blacknose Dace	PS	Pumpkinseed	YB	Yellow Bullhead
BRK	Brook Trout	RB	Redbreast Sunfish	YP	Yellow Perch
BRN	Brown Trout	RNB	Rairbow Trout		
CRP	Common Carp	TD	Tessellated Darter		

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Table 9. - The relative abundance (number-per-hour) of fish species collected from streams in the Woonasquatucket River and the Moshassuck River watersheds by electrofishing in 1995.

Stream/Station No.	Number-per-Hour																		
	BND	BG	WS	TD	PS	LMB	EL	GS	BBL	FF	RFP	CCS	CP	SD	RNB	YP	YB	LND	BRK
Woonasquatucket																			
Woonasquatucket R./5.0.1	0	0	113	45	0	0	P	11	0	0	0	0	0	0	0	0	0	0	0
Woonasquatucket R./5.0.6	0	10	0	30	0	10	60	0	0	0	10	50	0	0	10	0	0	0	0
Woonasquatucket R./5.0.7	0	0	78	34	4	0	28	0	0	55	0	0	4	0	0	0	2	0	0
Woonasquatucket R./5.0.8	0	18	0	36	143	54	0	125	0	0	0	0	0	0	0	0	0	0	0
Nine Foot Bk./5.0.9	0	197	0	0	88	51	7	7	80	0	44	0	0	0	0	7	0	0	0
Shincsott Bk./5.0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cutler Bk./5.0.11	0	329	588	173	0	52	0	0	0	0	0	0	17	17	0	0	0	0	0
Assumpset Bk./5.0.12	942	222	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0
Harris Bk./5.0.13	0	50	34	0	0	17	34	0	17	0	0	0	17	0	0	0	0	0	0
Wwm /5.0.14	0	0	0	P	P	P	P	0	0	P	0	0	0	0	0	0	0	0	0
Wwm /5.0.15	0	0	0	P	0	0	P	0	0	P	0	0	0	0	0	0	0	0	0
TOTAL	942	826	813	318	235	184	157	143	97	55	54	50	38	17	10	7	2	0	0
Moshassuck																			
Moshassuck R./6.0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	288
Moshassuck R./6.0.4	0	0	29	0	0	7	22	0	0	0	81	0	0	0	0	0	0	191	15
Moshassuck R./6.0.5	0	0	12	50	0	0	95	17	0	0	4	4	4	0	0	0	0	178	0
Moshassuck R./6.0.6	0	0	262	262	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0
West R./6.0.7	0	58	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0
West R./6.0.8	316	35	152	47	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0
Tributary-West R./6.0.9	0	14	0	0	28	28	14	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	316	107	455	359	28	82	155	17	0	0	200	4	4	0	0	0	0	778	303

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Table 9. - Continued.

P Present

Species Code:

BBL	Brown Bullhead	GS	Golden Shiner	WS	White Sucker
BG	Bluegill	LMB	Largemouth Bass	YB	Yellow Bullhead
BND	Blacknose Dace	LND	Longnose Dace	YP	Yellow Perch
BRK	Brook Trout	PS	Pumpkinseed		
CCS	Creek Chubsucker	RFP	Redfin Pickerel		
CP	Chain Pickerel	RNB	Rainbow Trout		
EL	American Eel	SD	Swamp Darter		
FF	Fallfish	TD	Tessellated Darter		

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ATTACHMENT 3

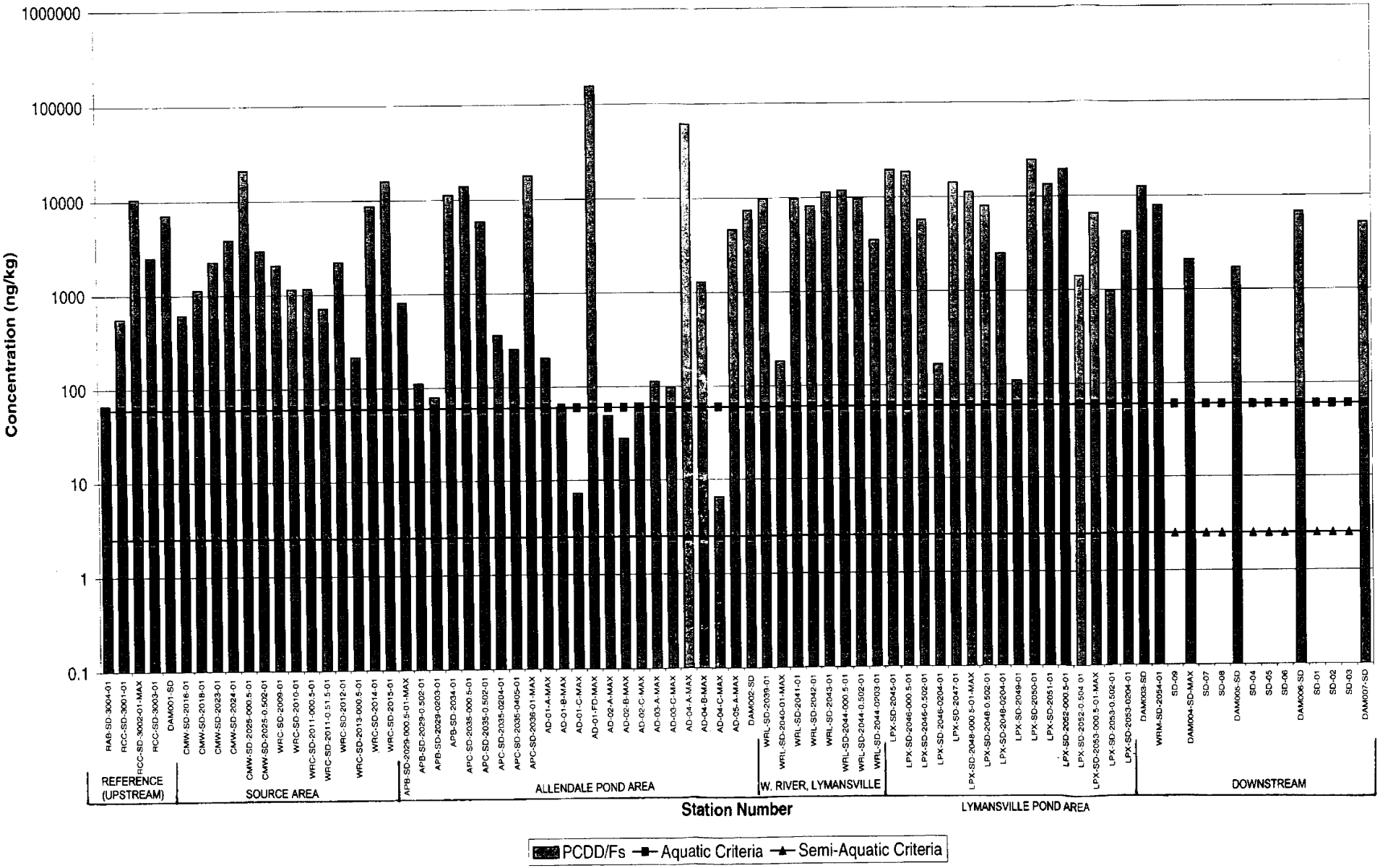
For

Centredale Manor Restoration Project Site

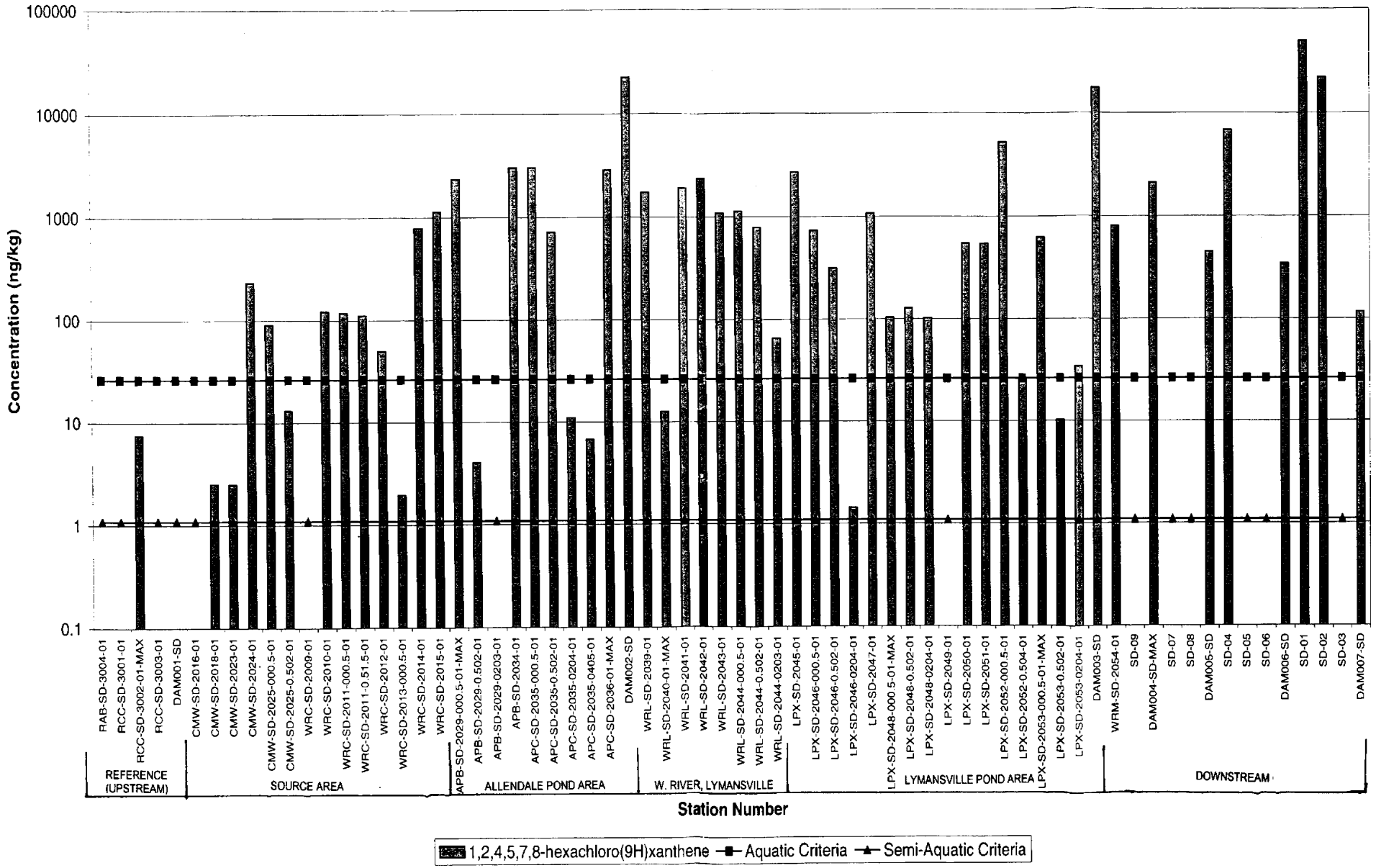
Streamlined Ecological Risk Evaluation

Hazard Quotient Graphs

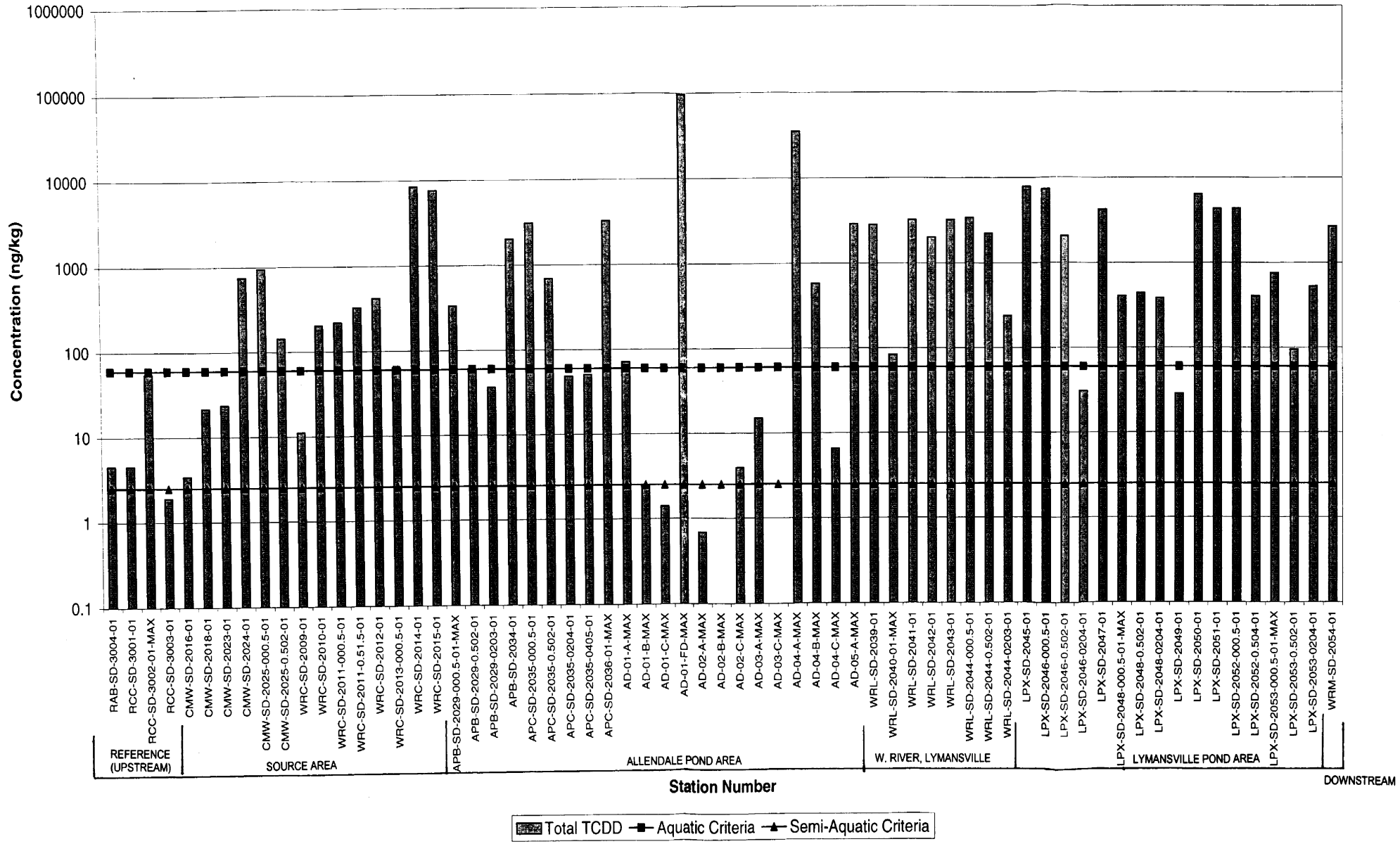
Total PCDD/F Detections in Sediment Samples



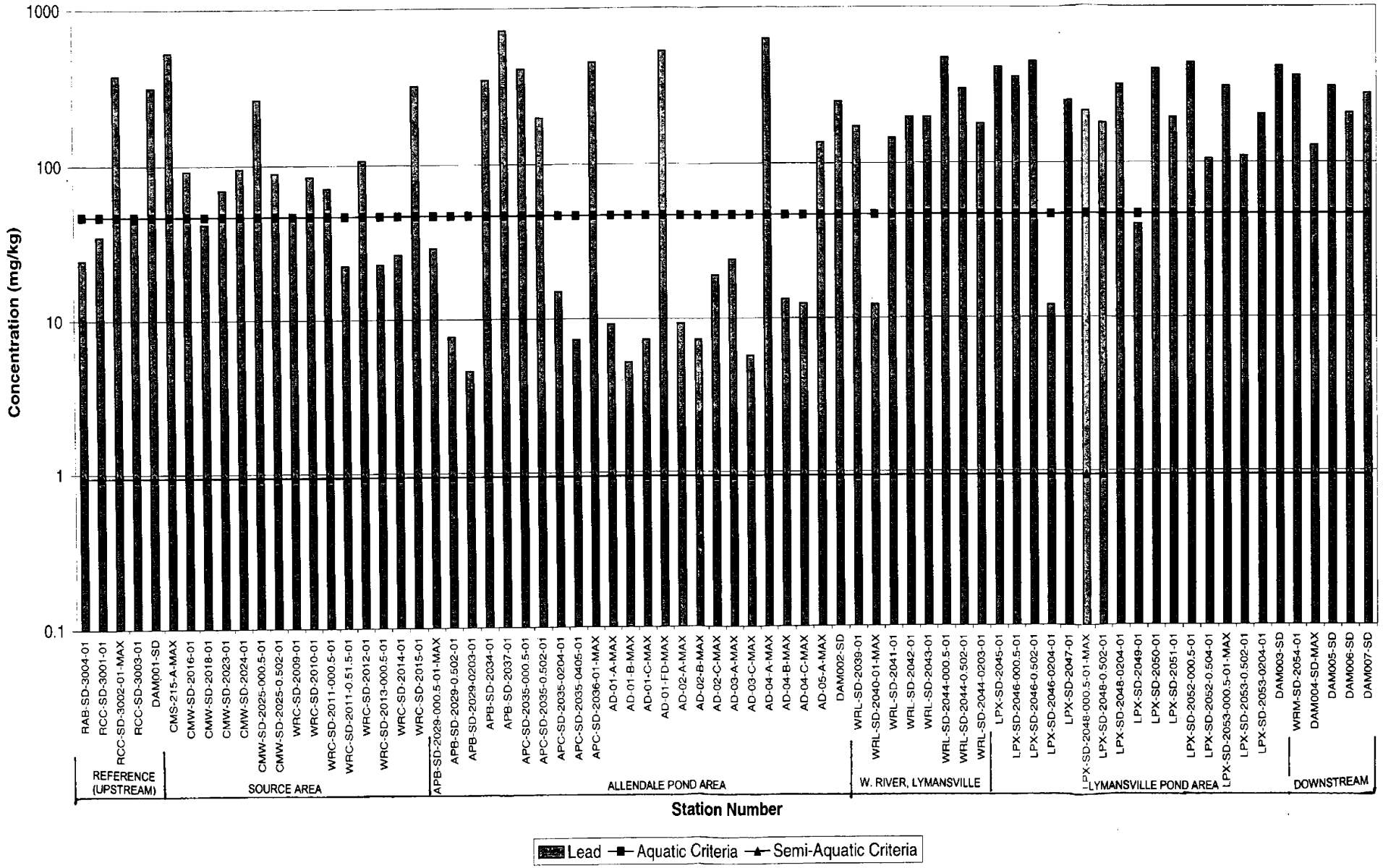
1,2,4,5,7,8-hexachloro(9H)xanthene Detections in Sediment Samples



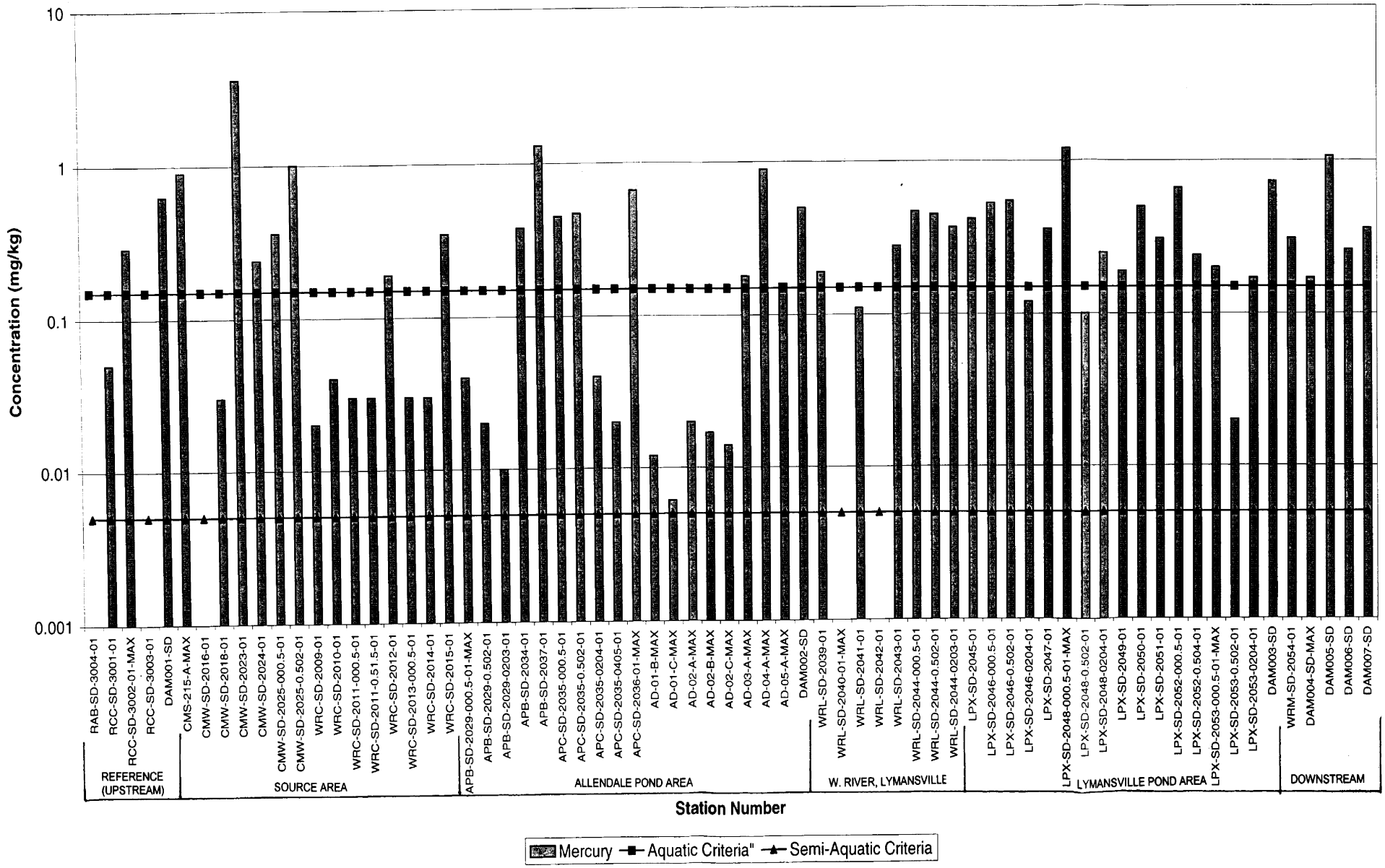
Total TCDD Detections in Sediment Samples



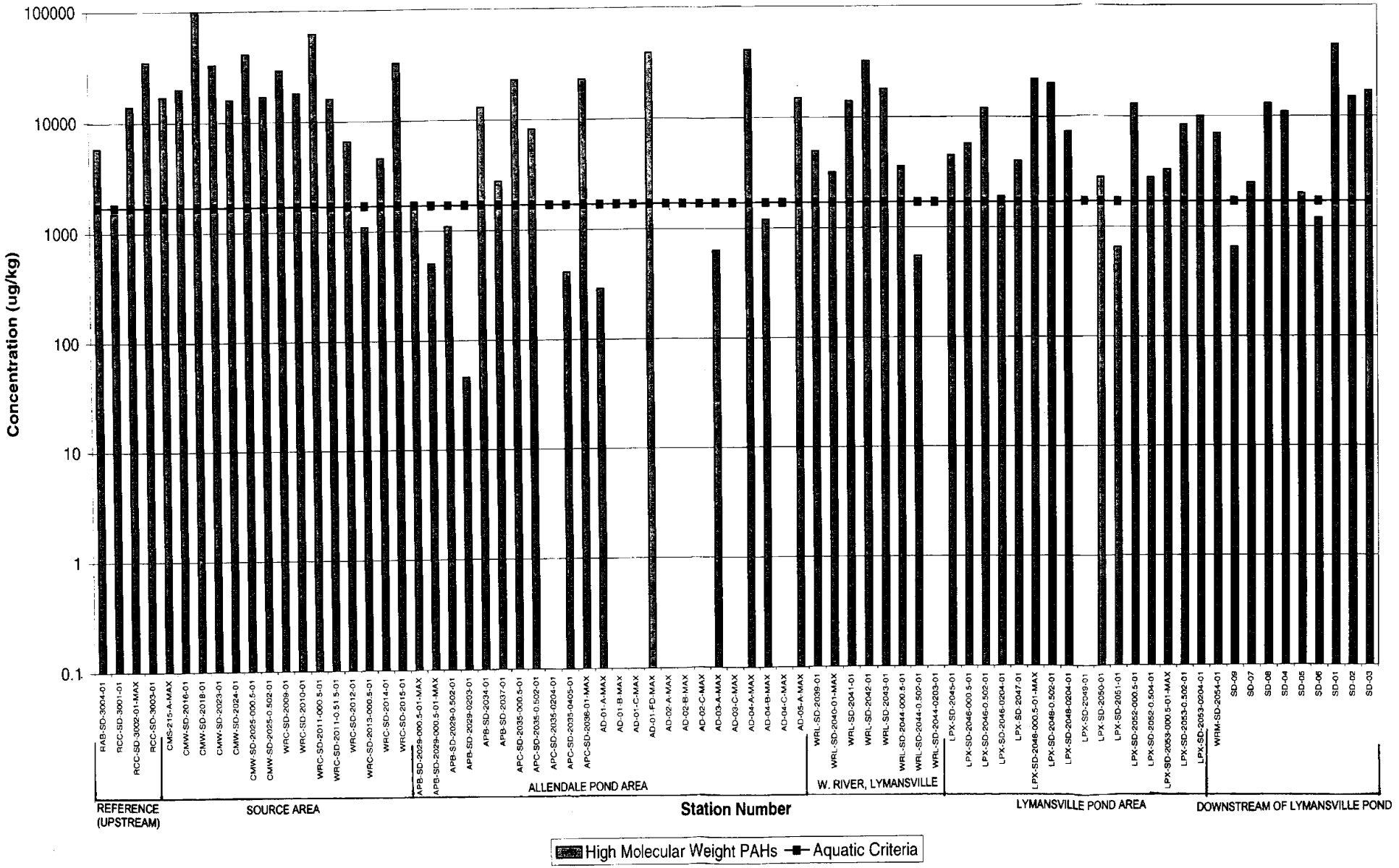
Lead Detections in Sediment Samples



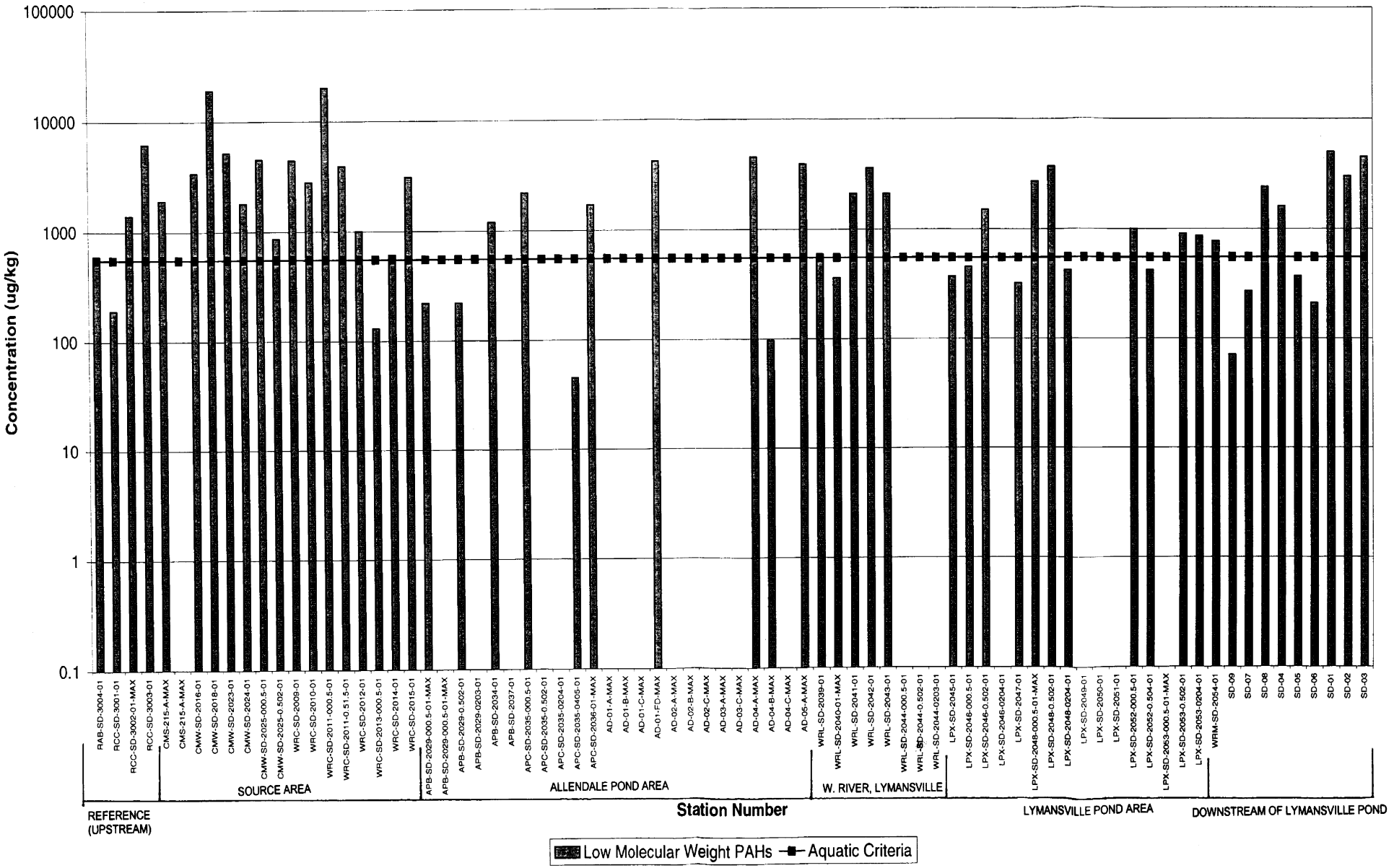
Mercury Detections in Sediment Samples



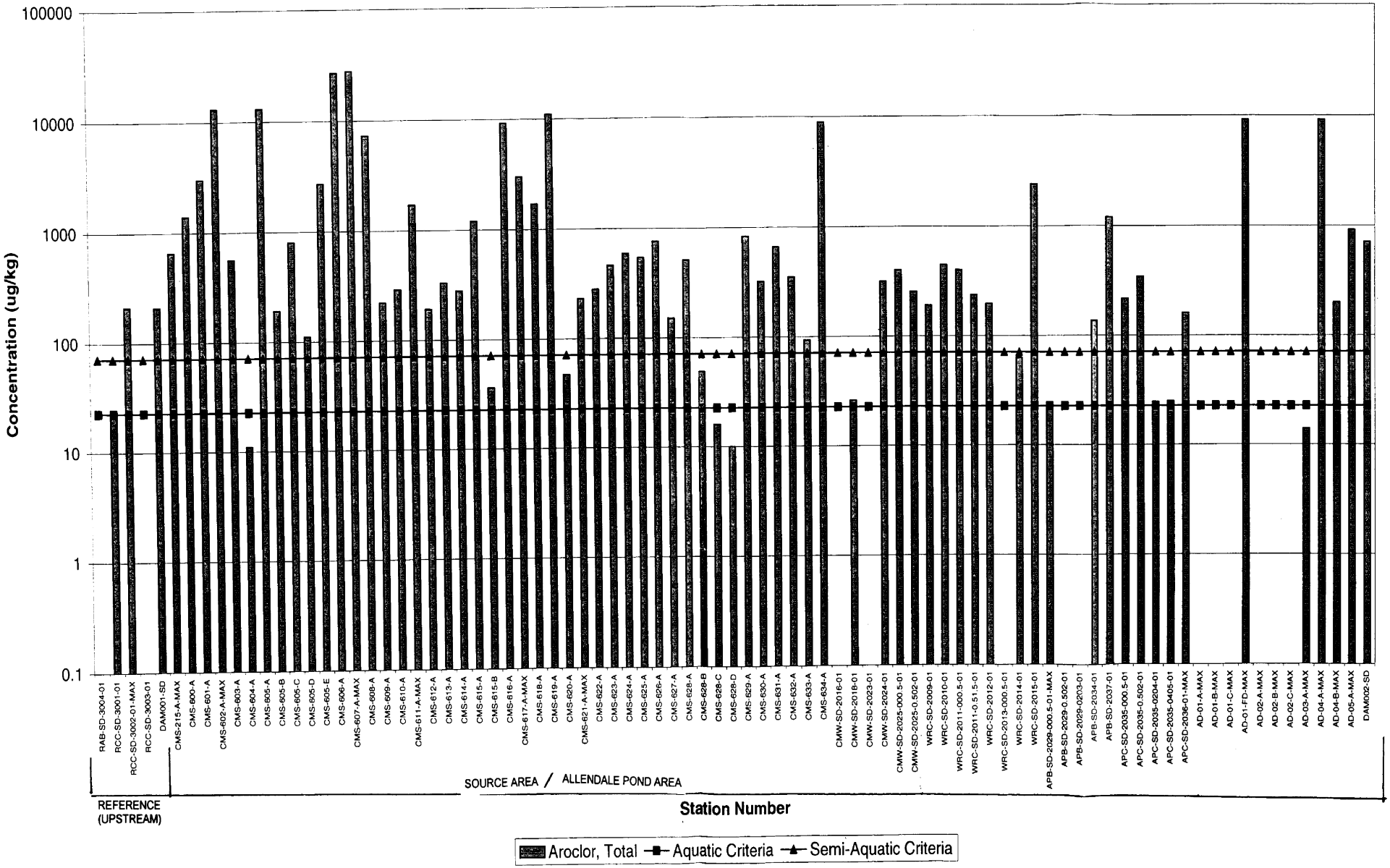
High Molecular Weight PAH Detections in Sediment Samples



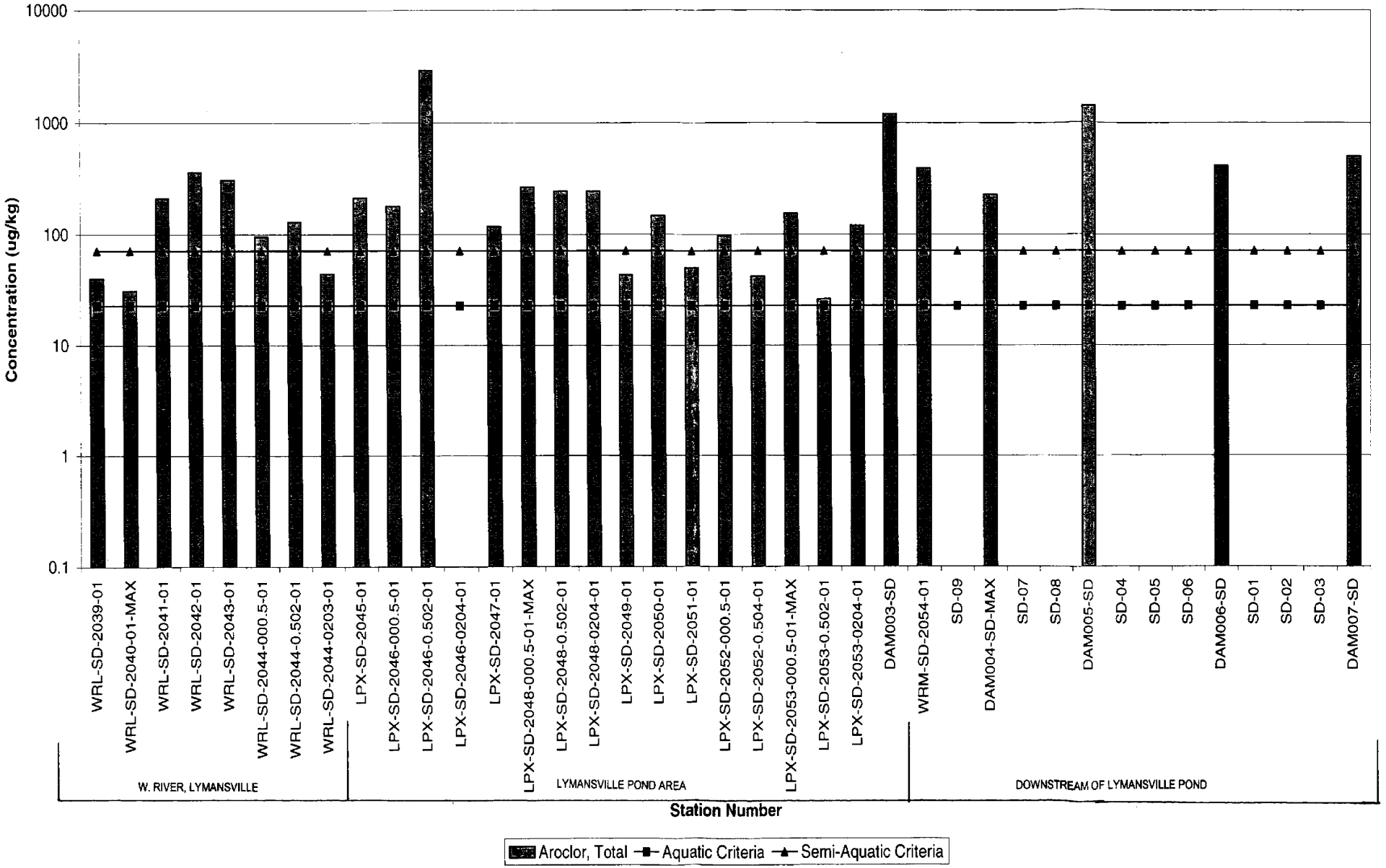
Low Molecular Weight PAH Detections in Sediment Samples



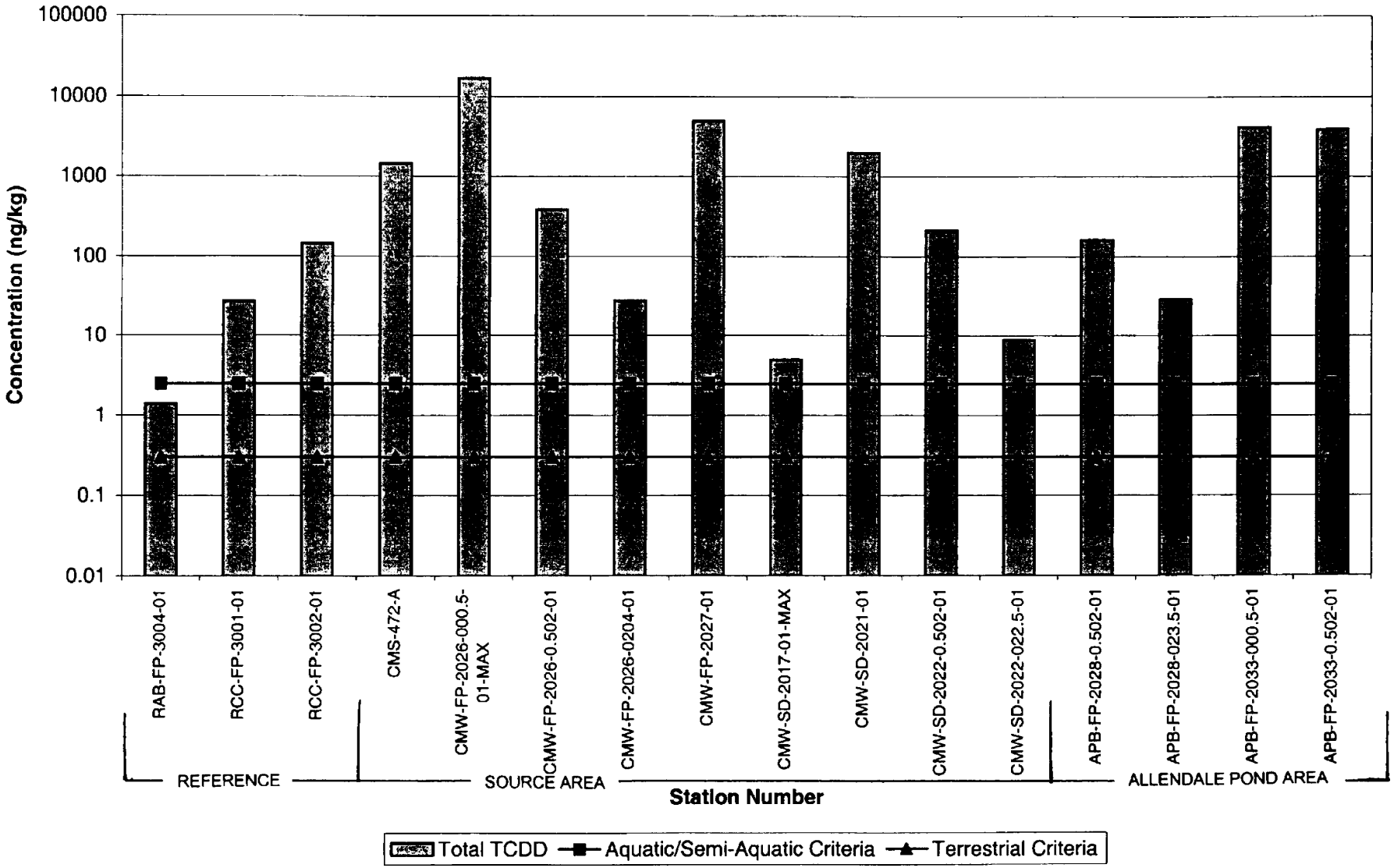
Total PCB Detections in Upstream Sediment Samples



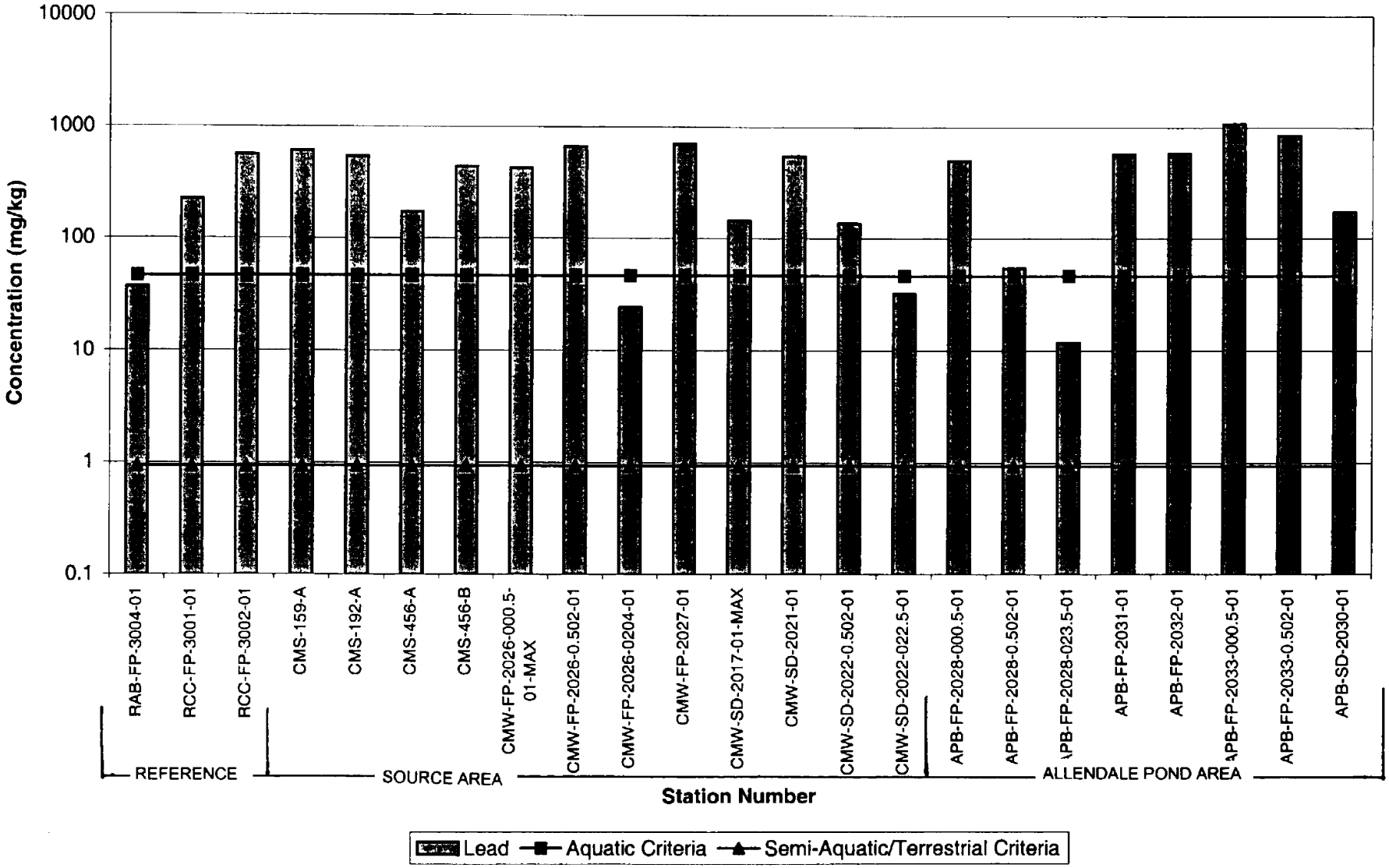
Total PCB Detections in Downstream Sediment Samples



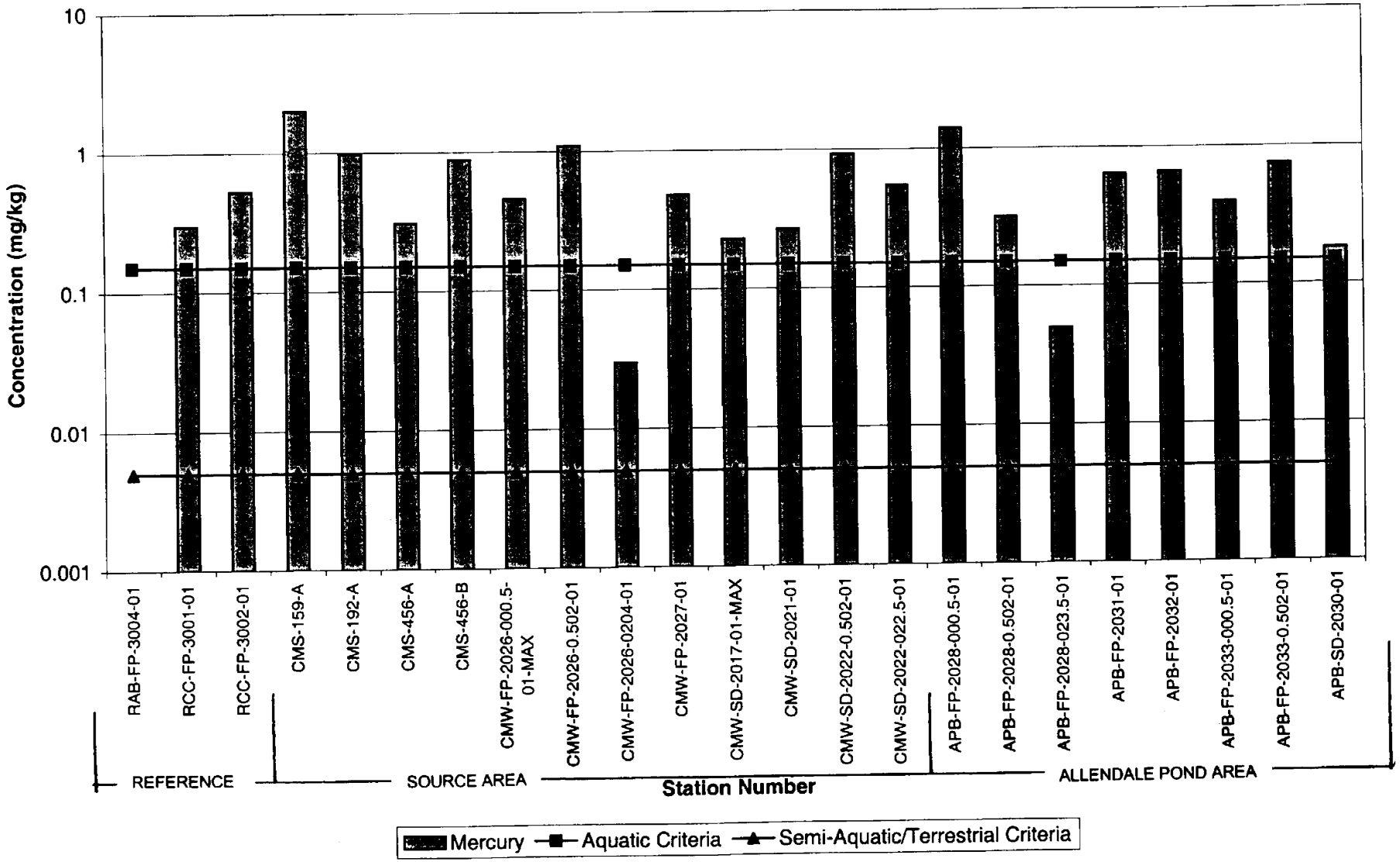
TCDD Detections in Floodplain Samples



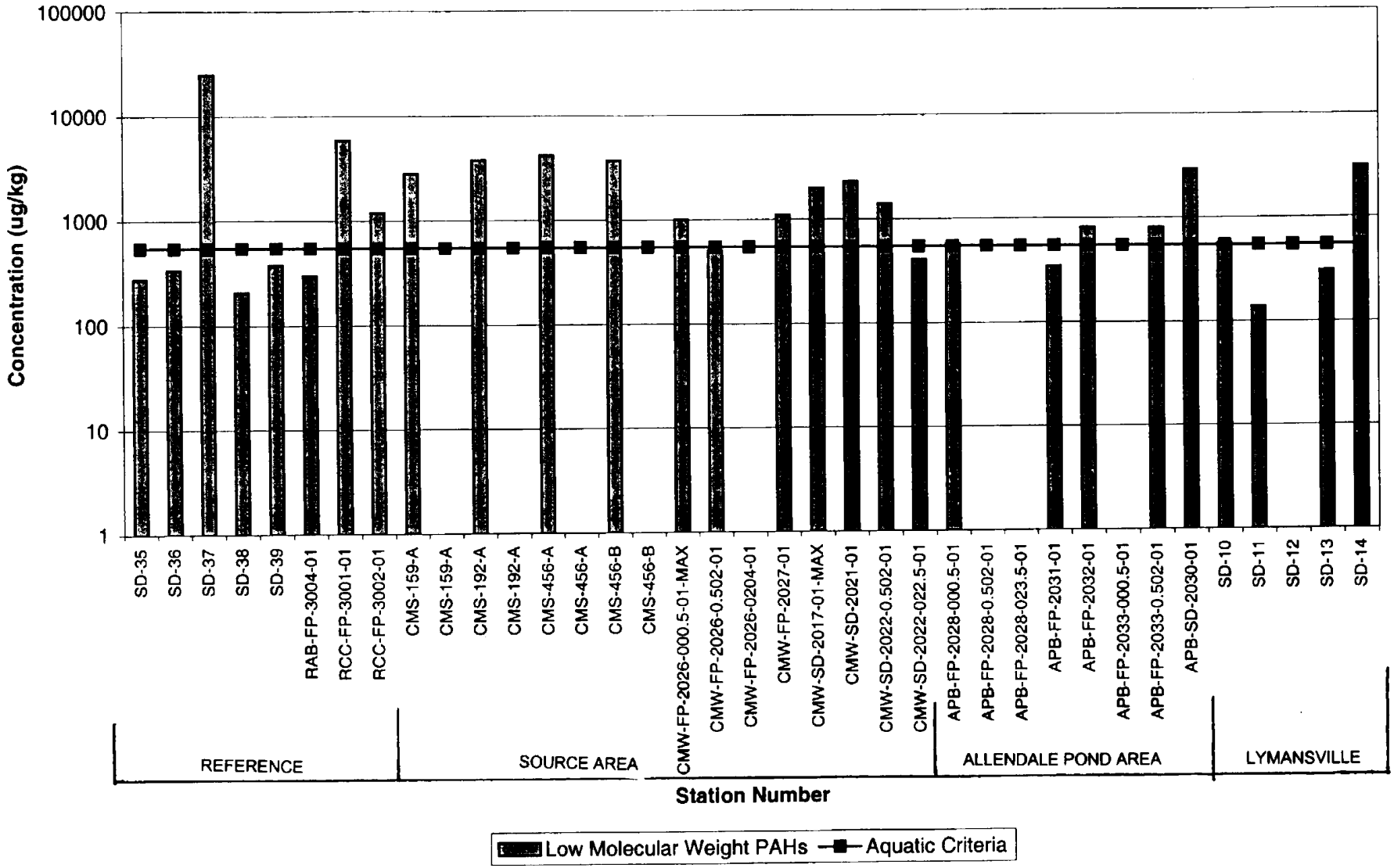
Lead Detections in Floodplain Samples



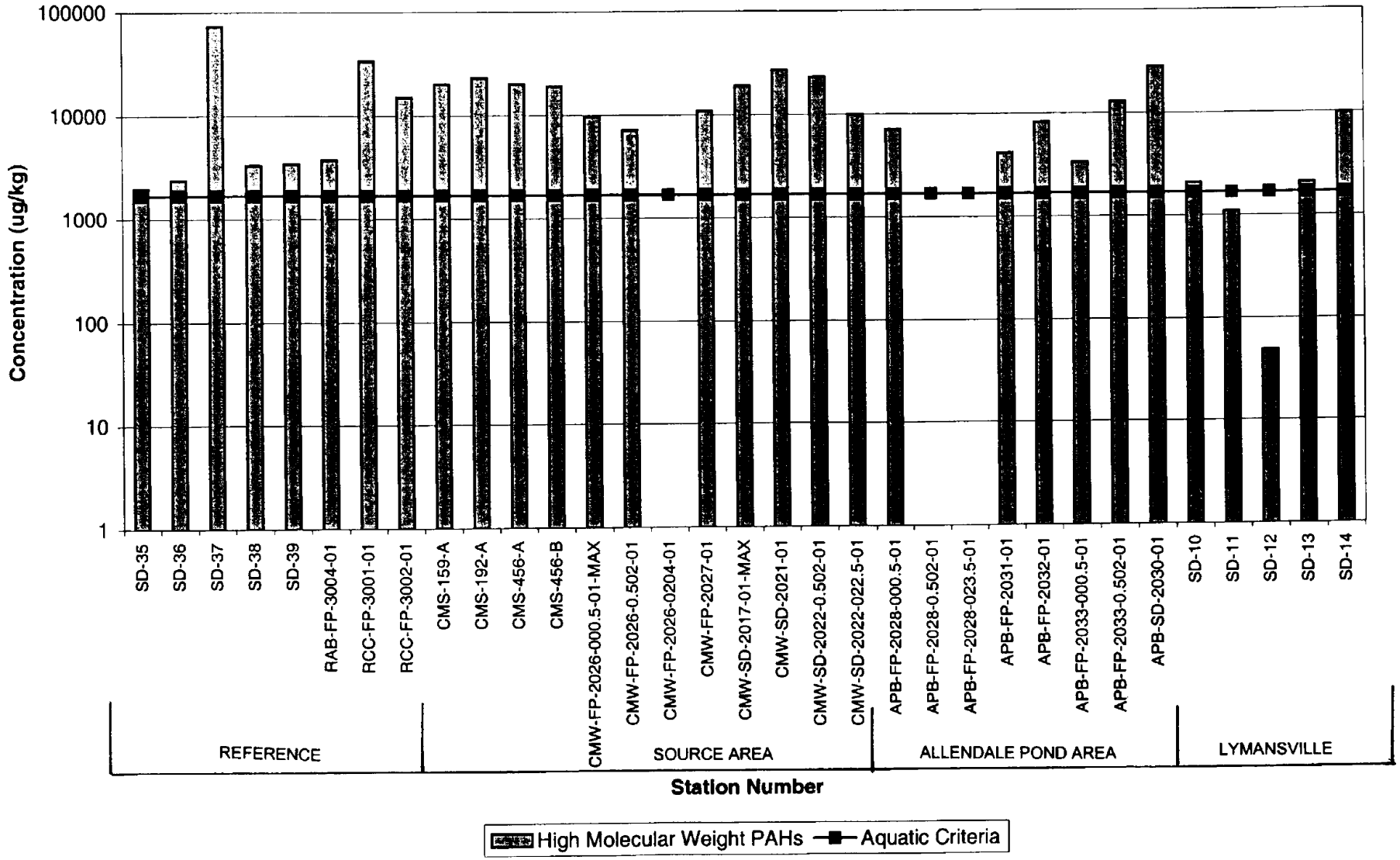
Mercury Detections in Floodplain Samples



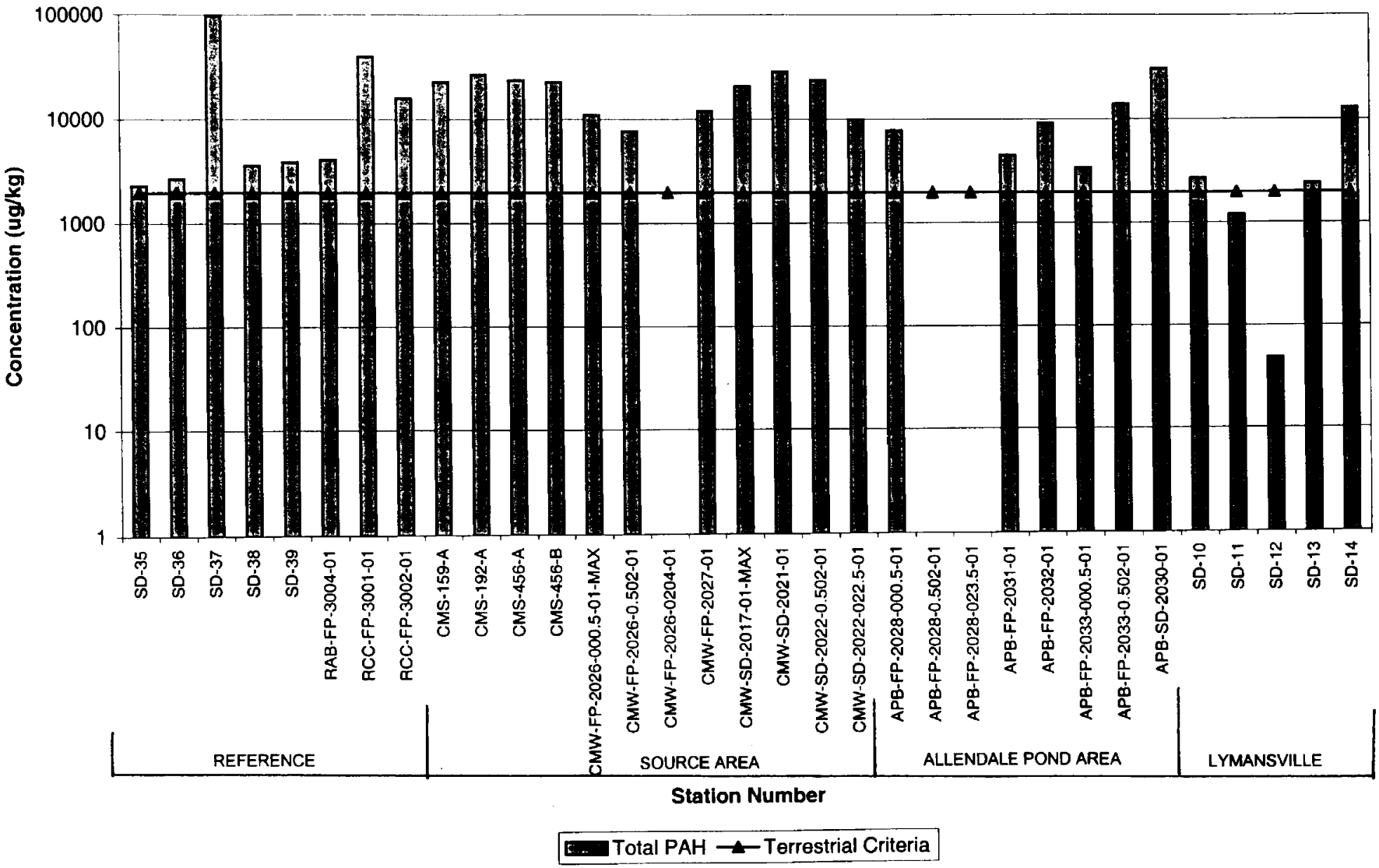
Low Molecular Weight PAH Detections in Floodplain Samples



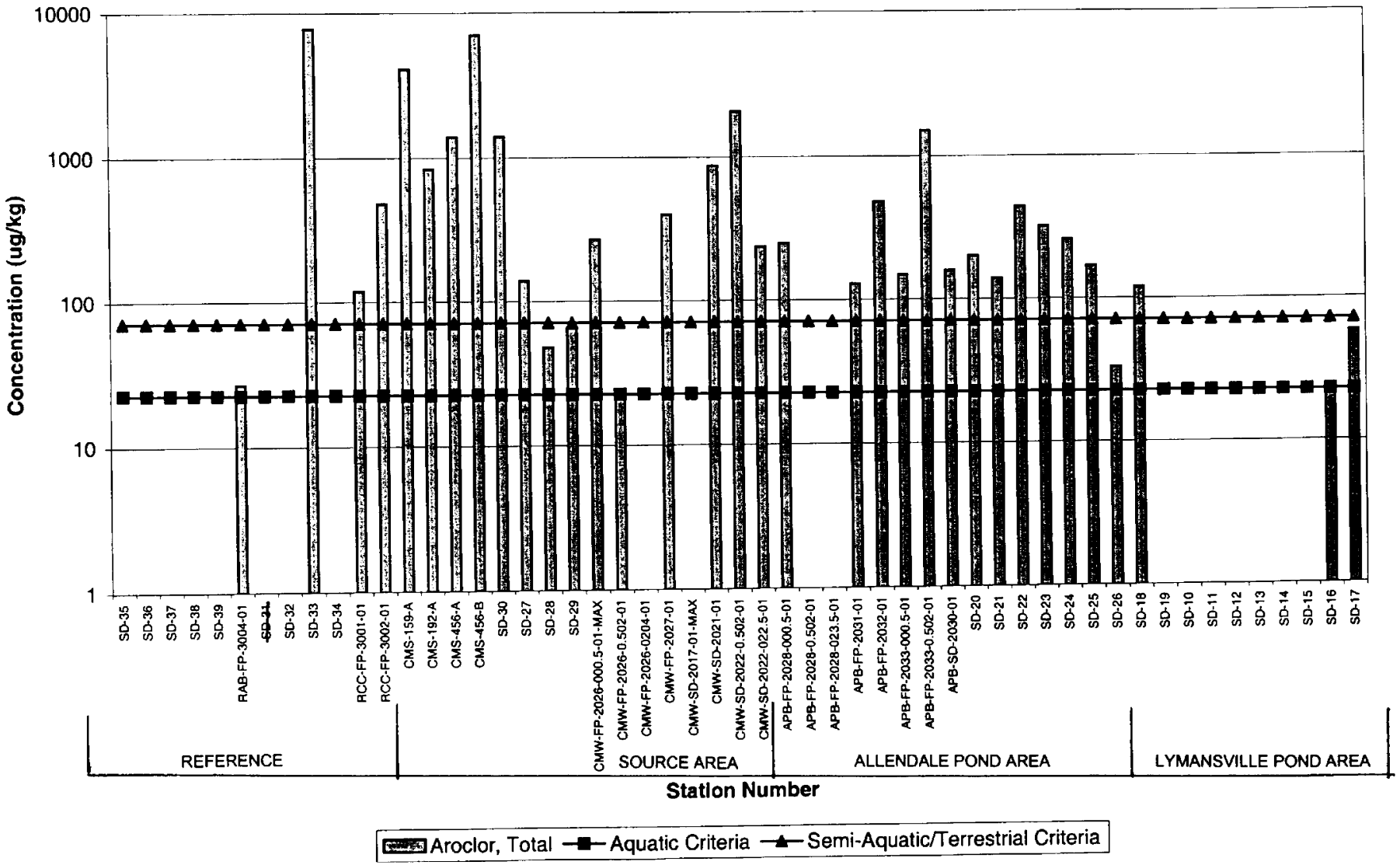
High Molecular Weight PAH Detections in Floodplain Samples



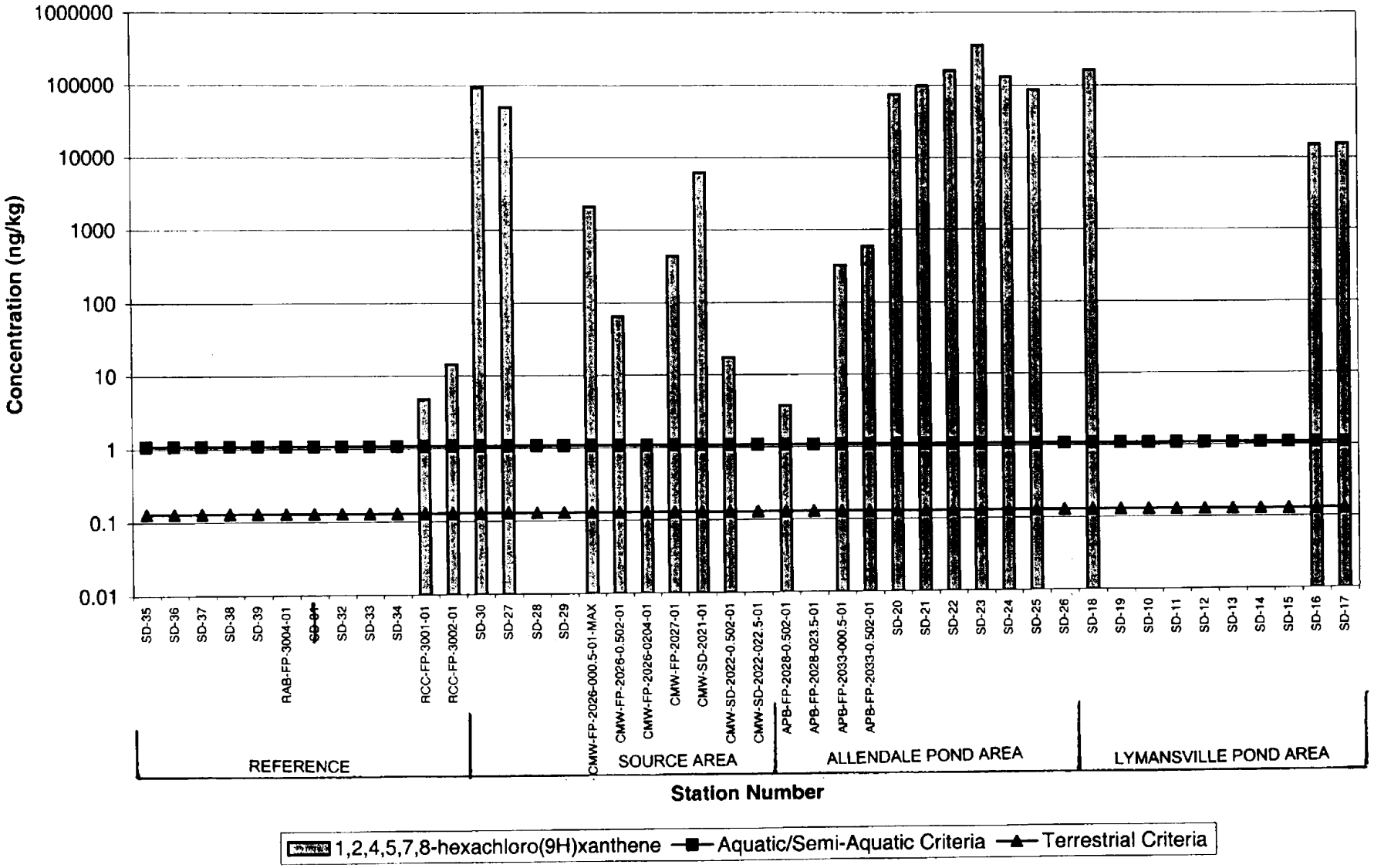
Total PAH Detections in Floodplain Samples



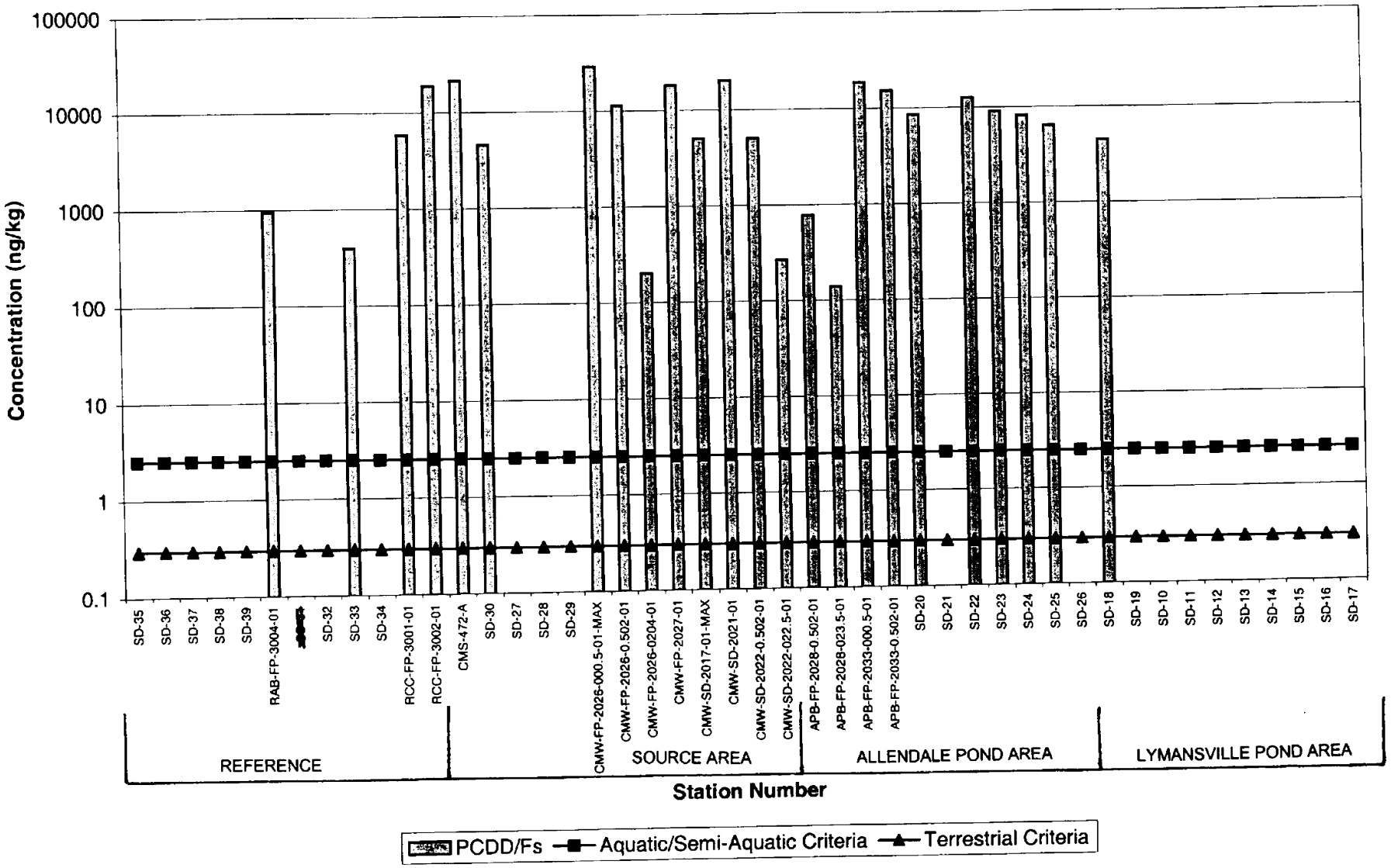
Total PCB Detections in Floodplain Samples



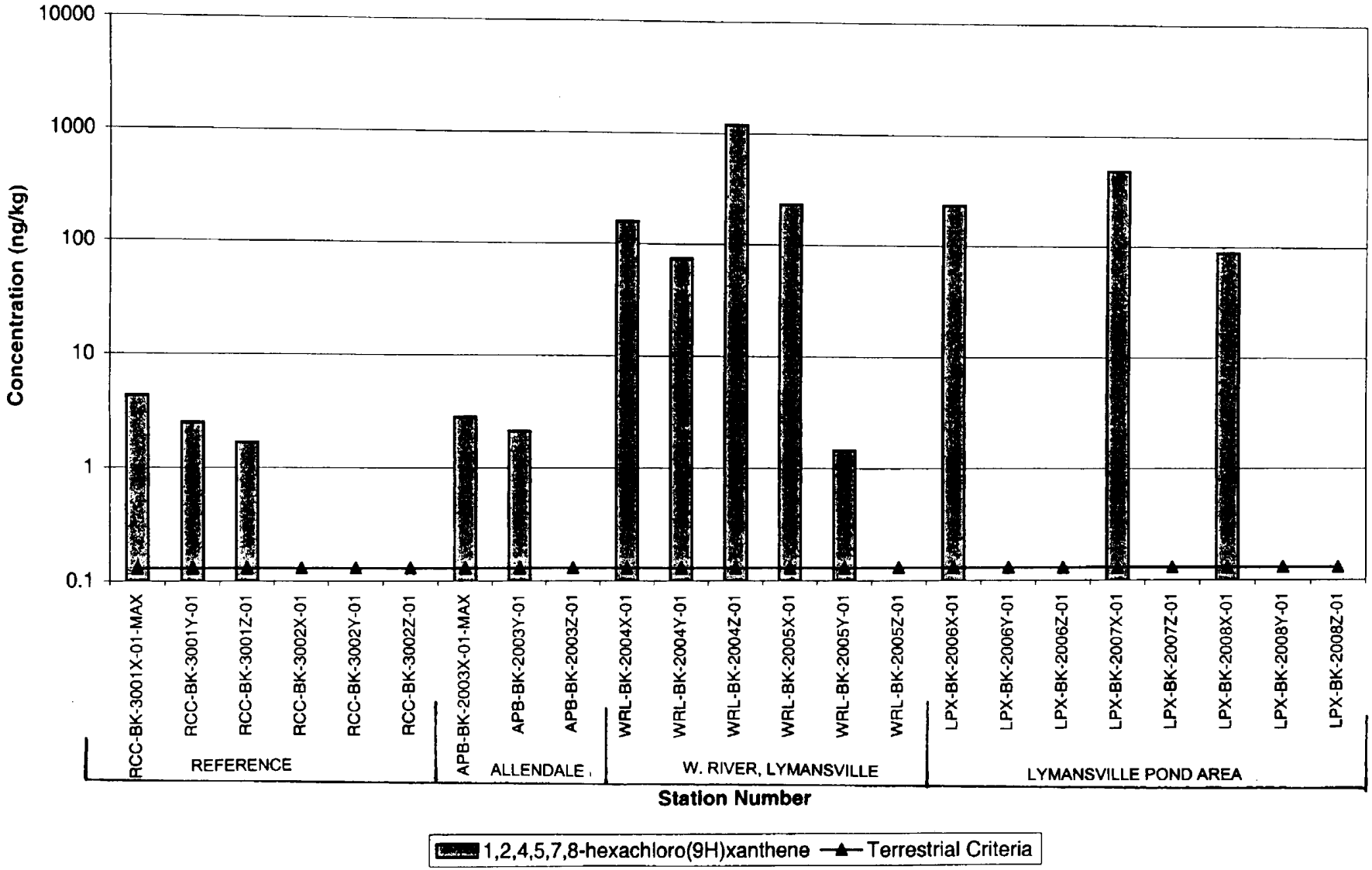
1,2,4,5,7,8-hexachloro(9H)xanthene Detections in Floodplain Samples



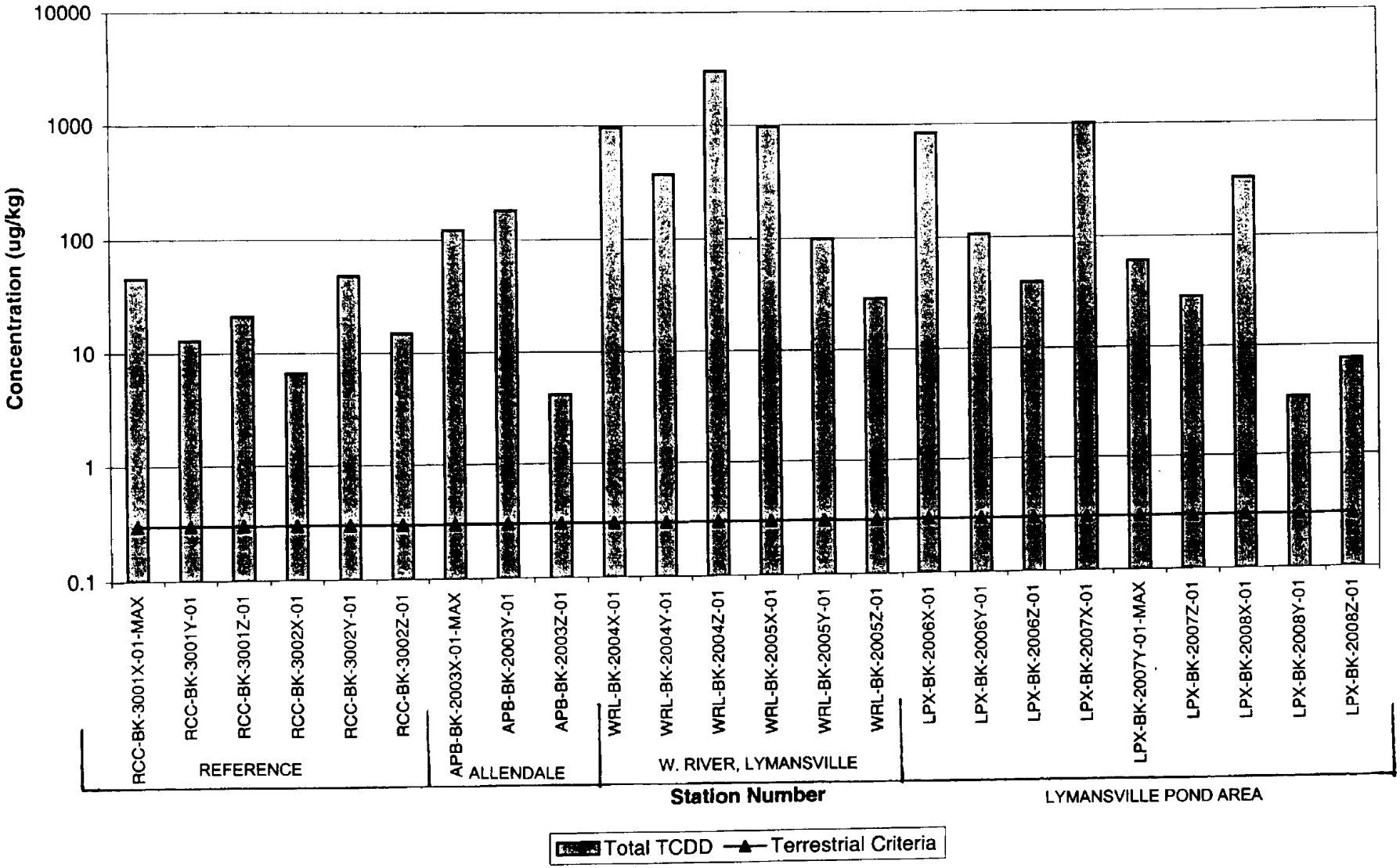
Total PCDD/F Detections in Floodplain Samples



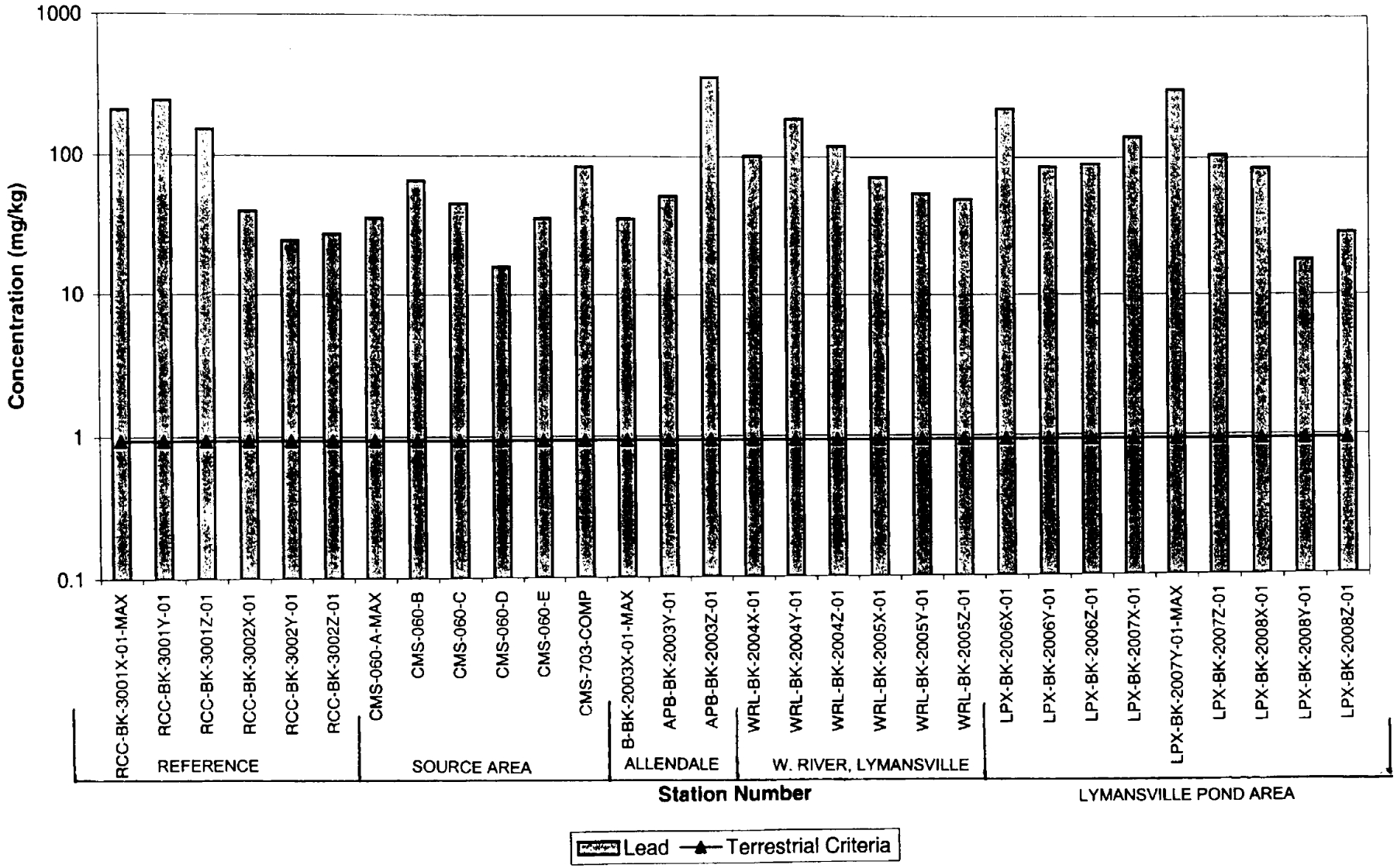
1,2,4,5,7,8-hexachloro(9H)xanthene Detections in Bank Samples



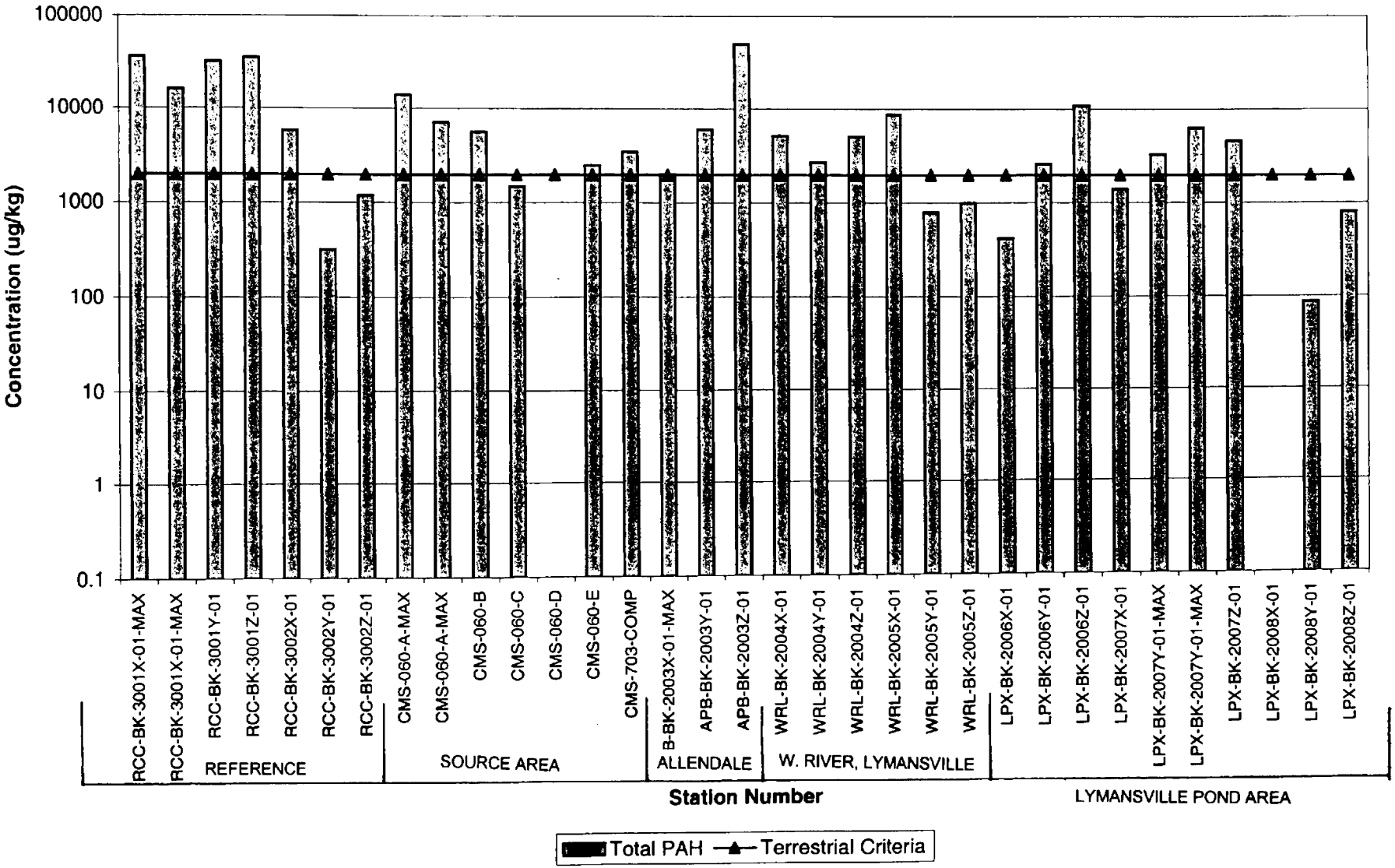
Total TCDD Detections in Bank Samples



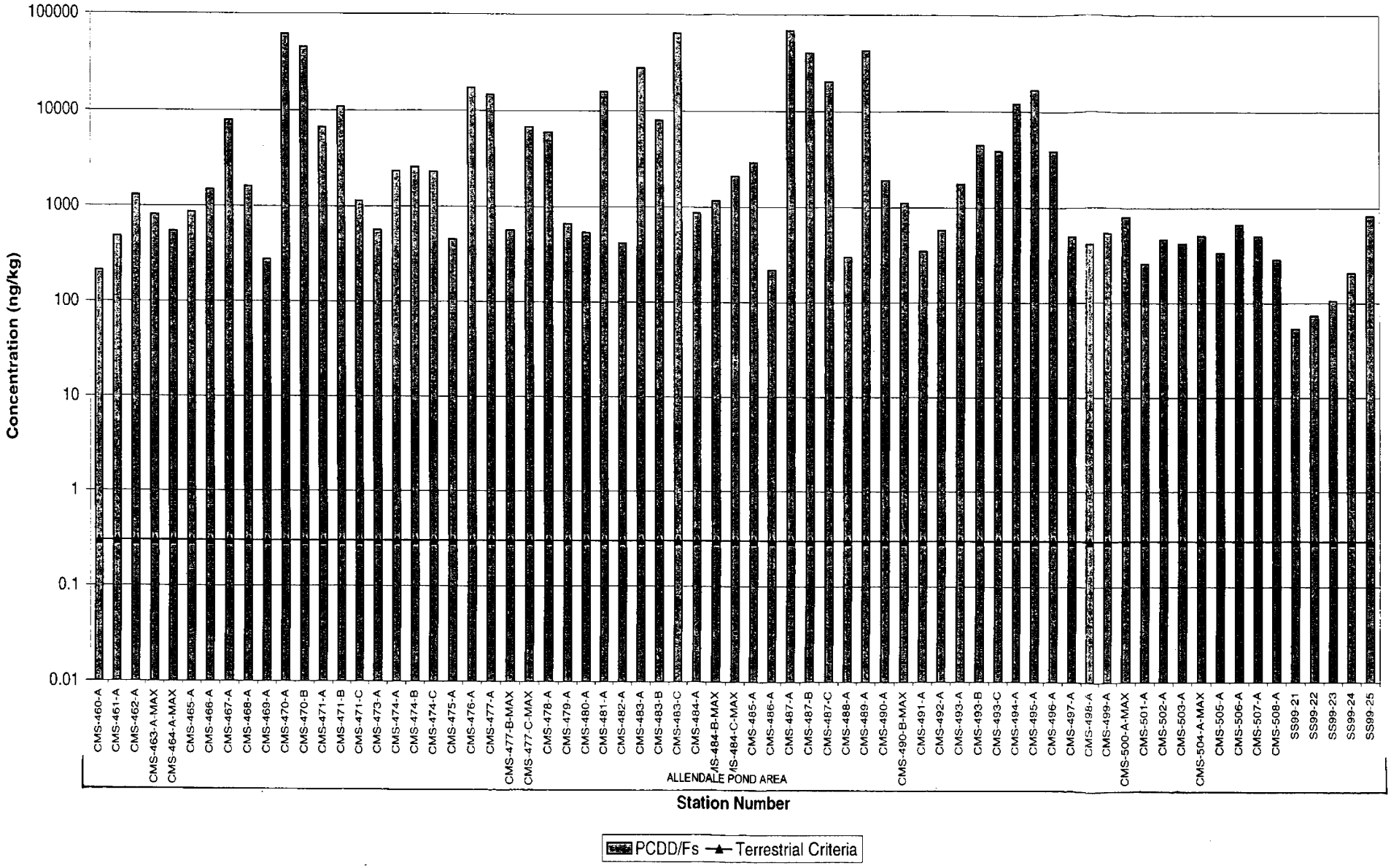
Lead Detections in Bank Samples



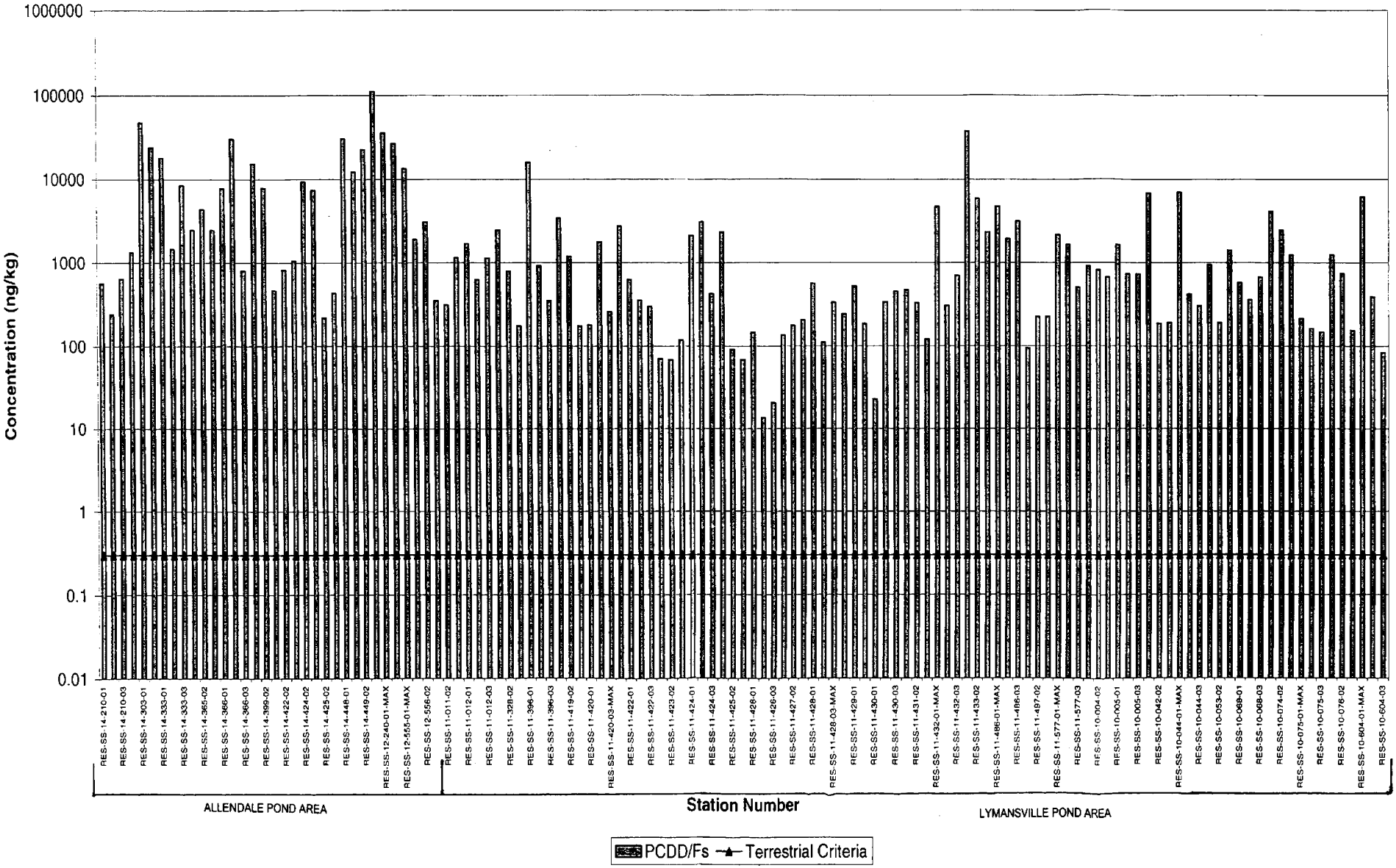
Total PAH Detections in Bank Samples



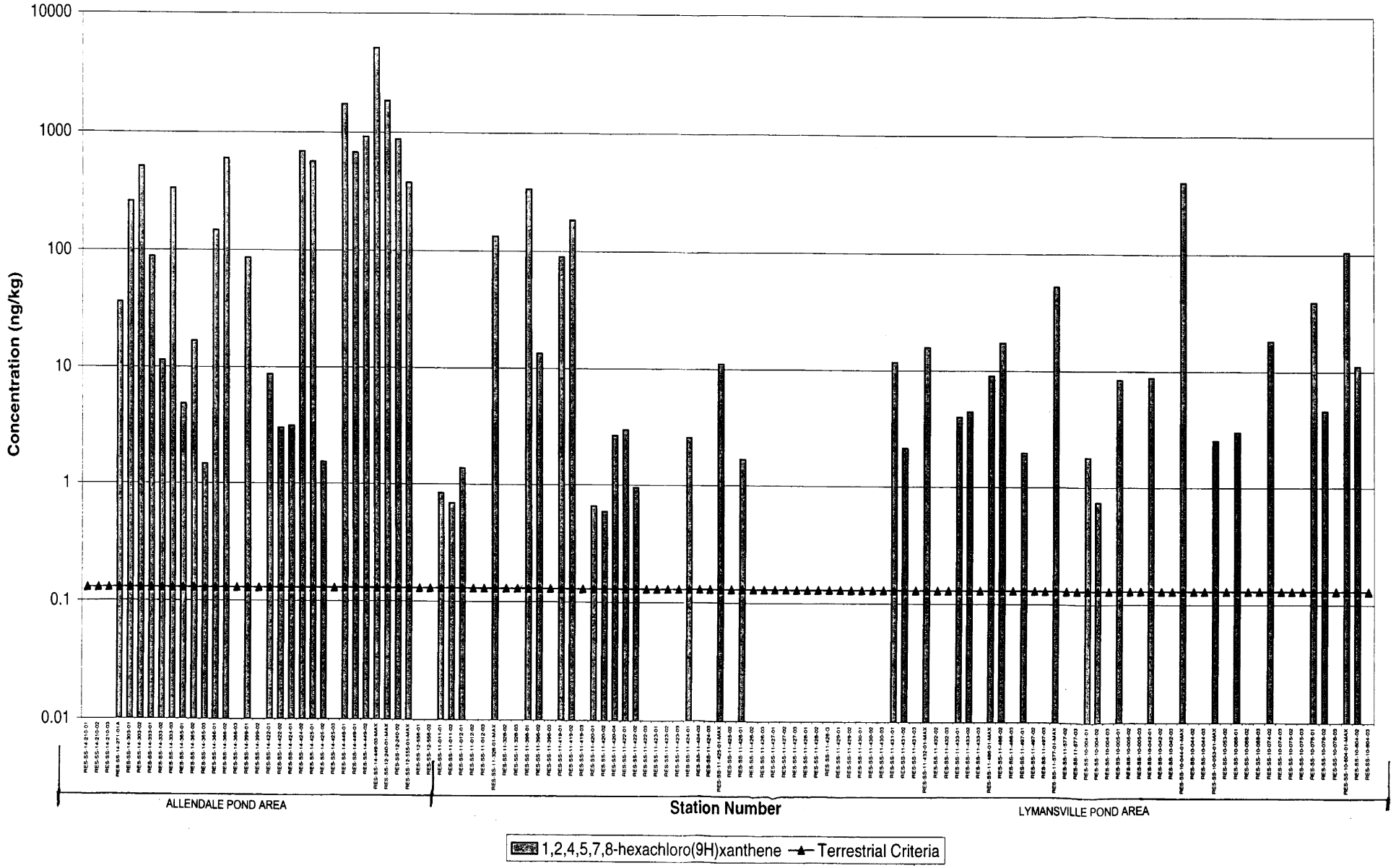
Total PCDD/F Detections in Upstream Residential Samples



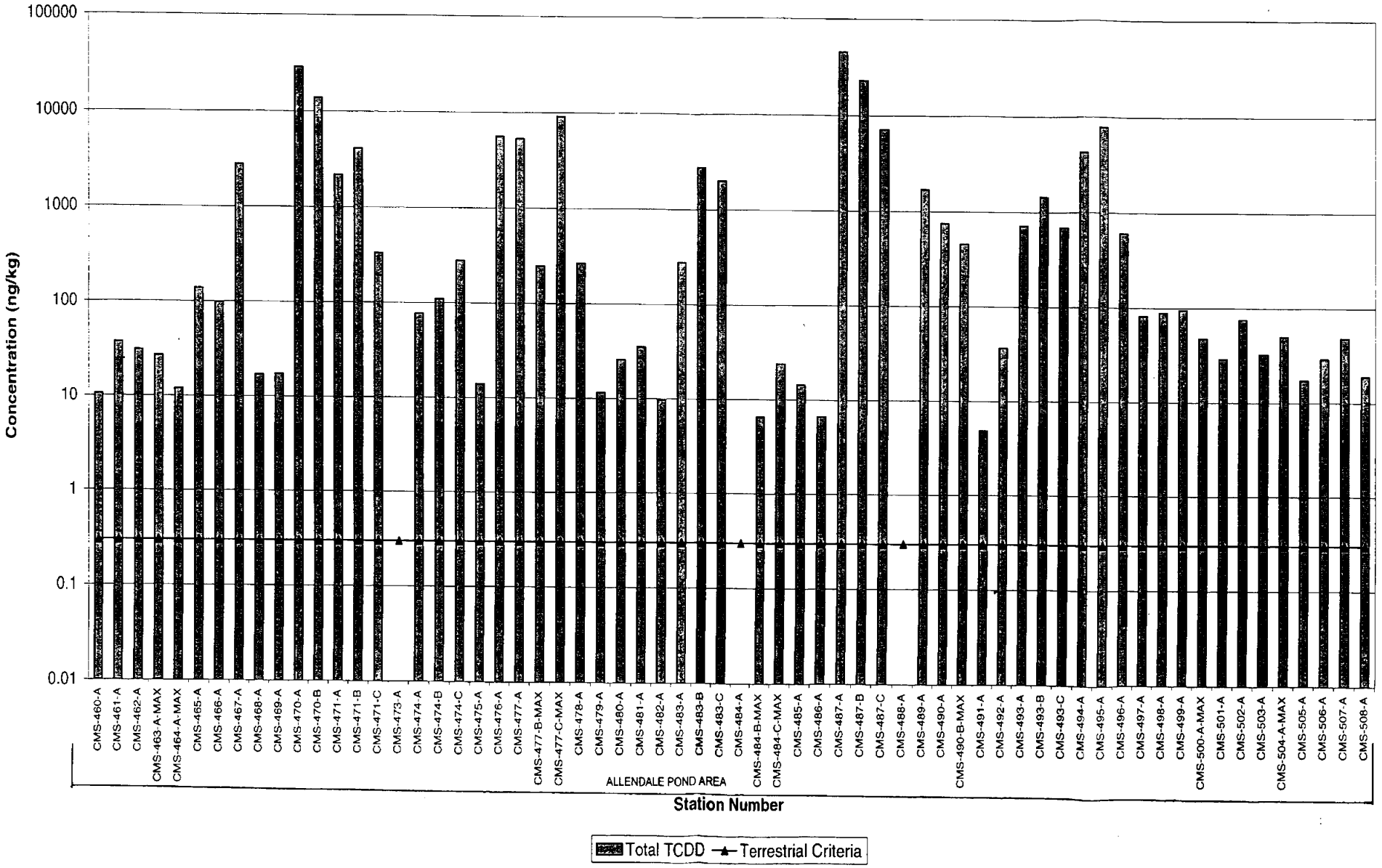
Total PCDD/F Detections in Downstream Residential Samples



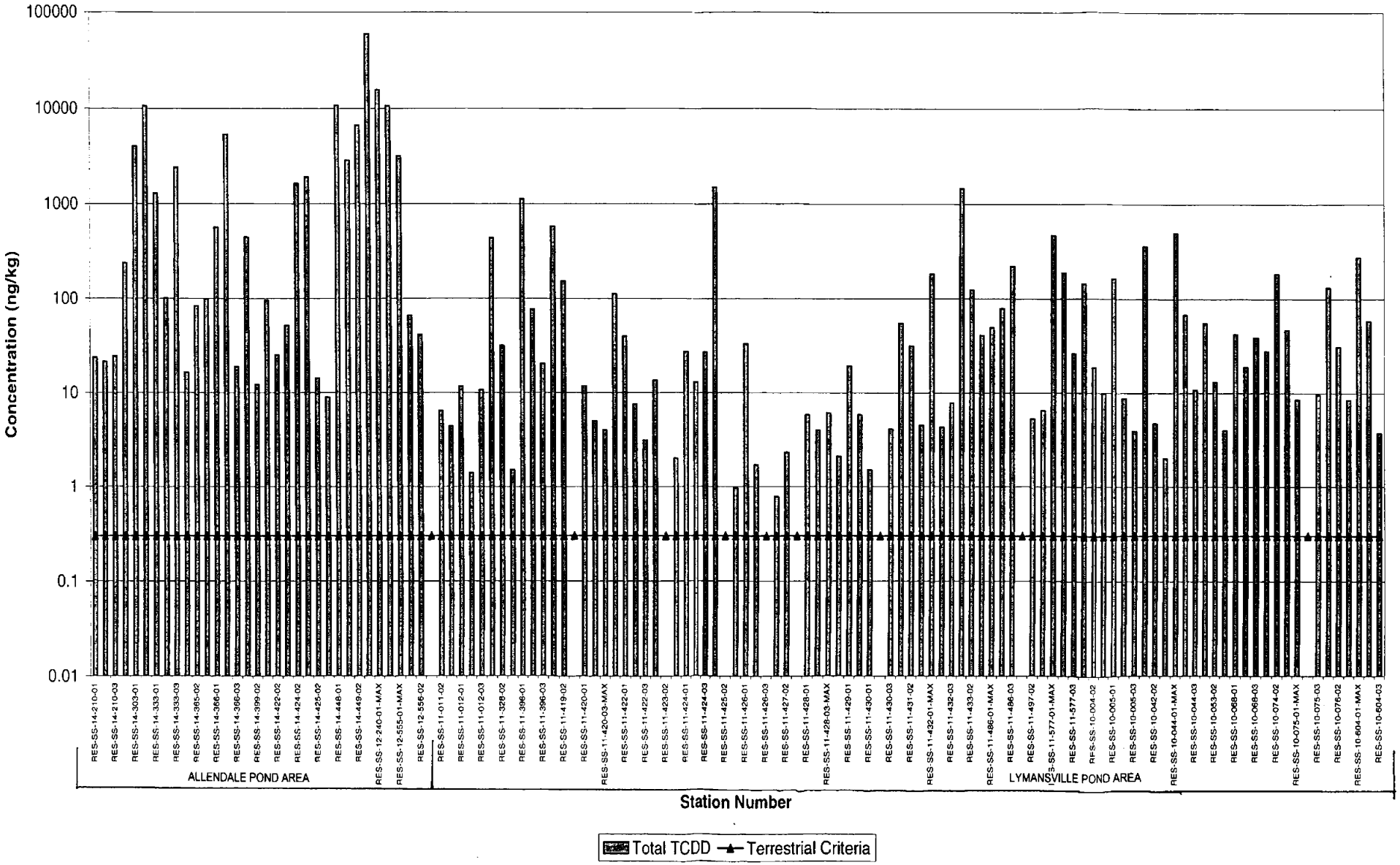
1,2,4,5,7,8-hexachloro(9H)xanthene Detections in Residential Samples



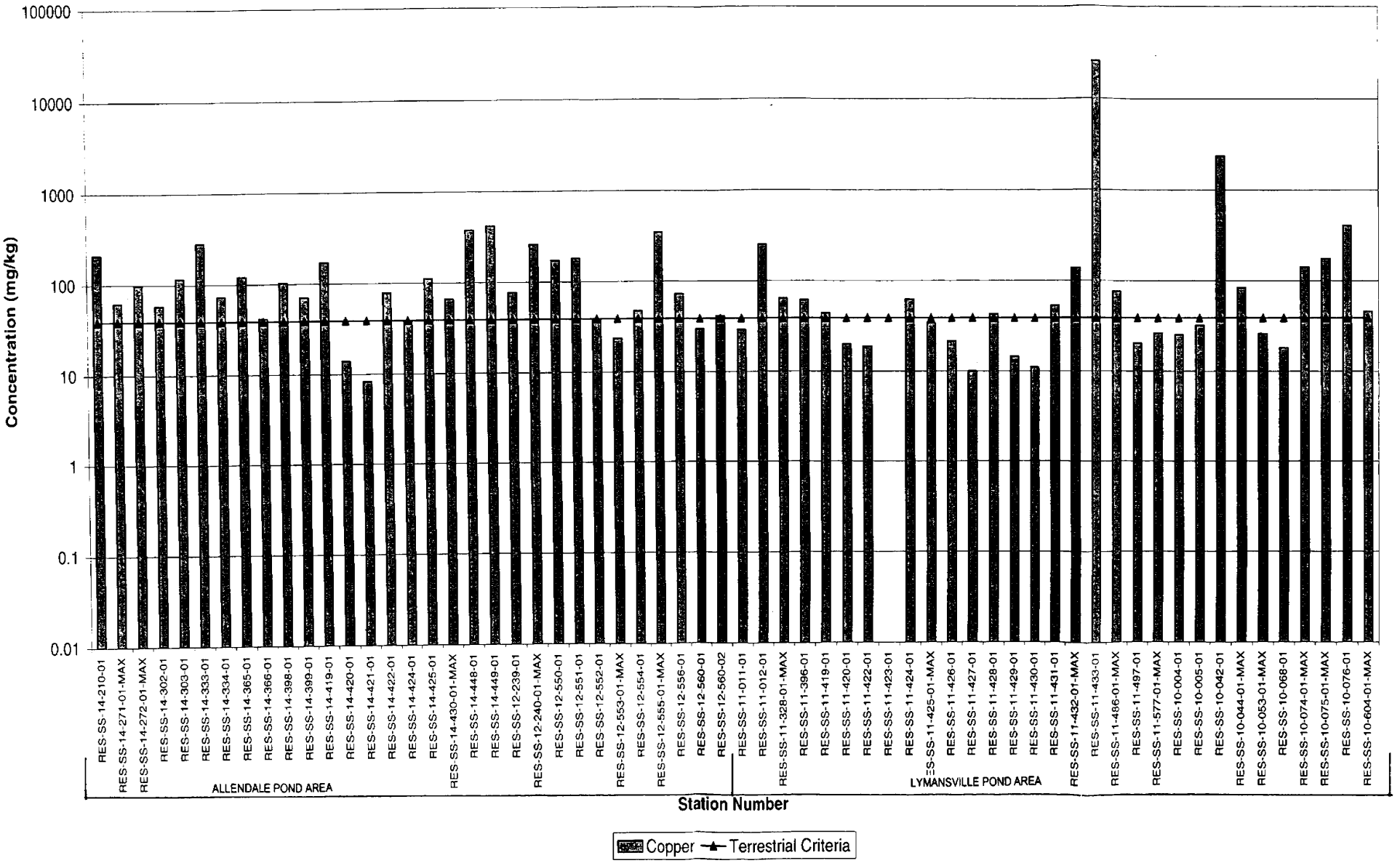
Total TCDD Detections in Upstream Residential Samples



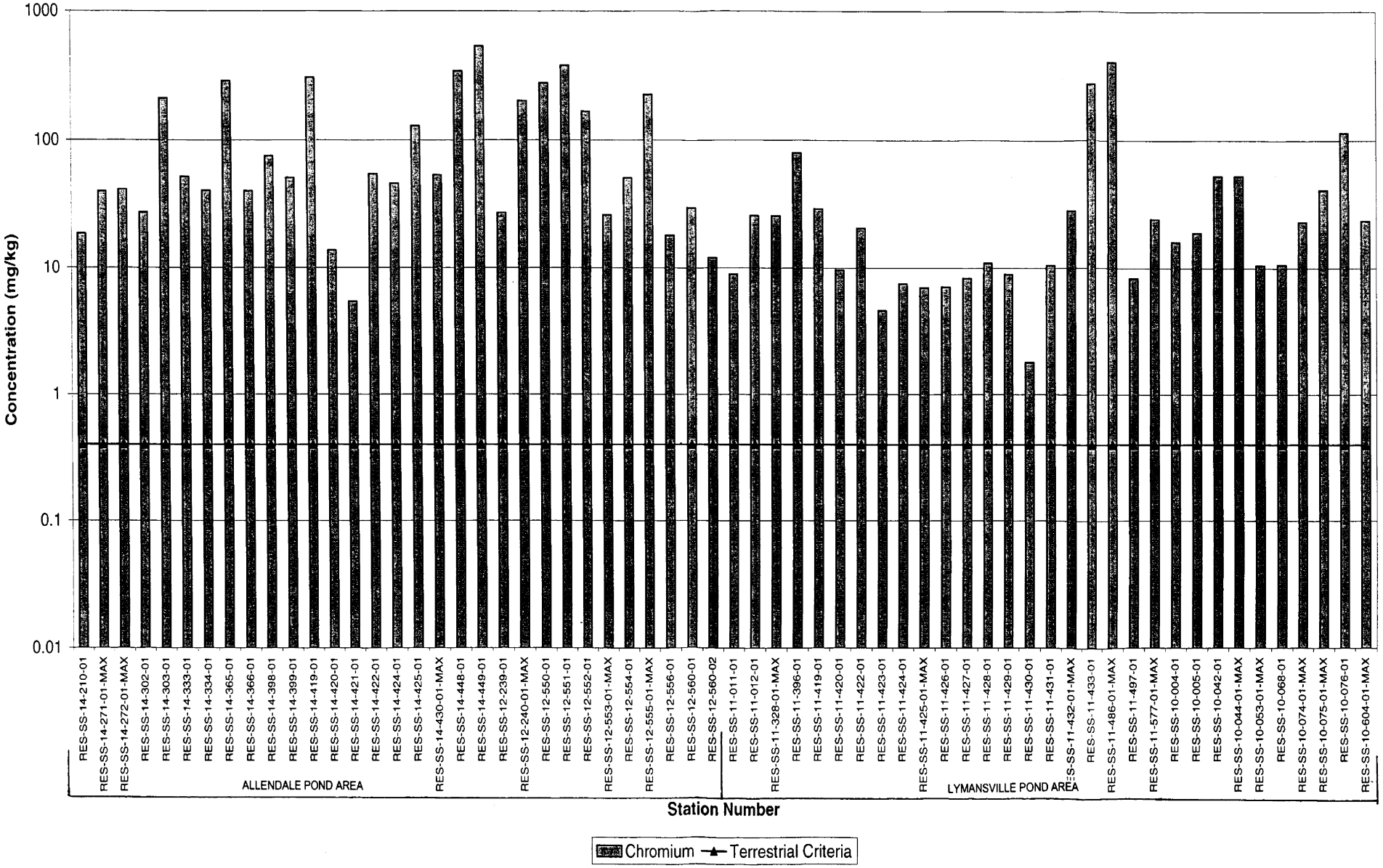
Total TCDD Detections in Downstream Residential Samples



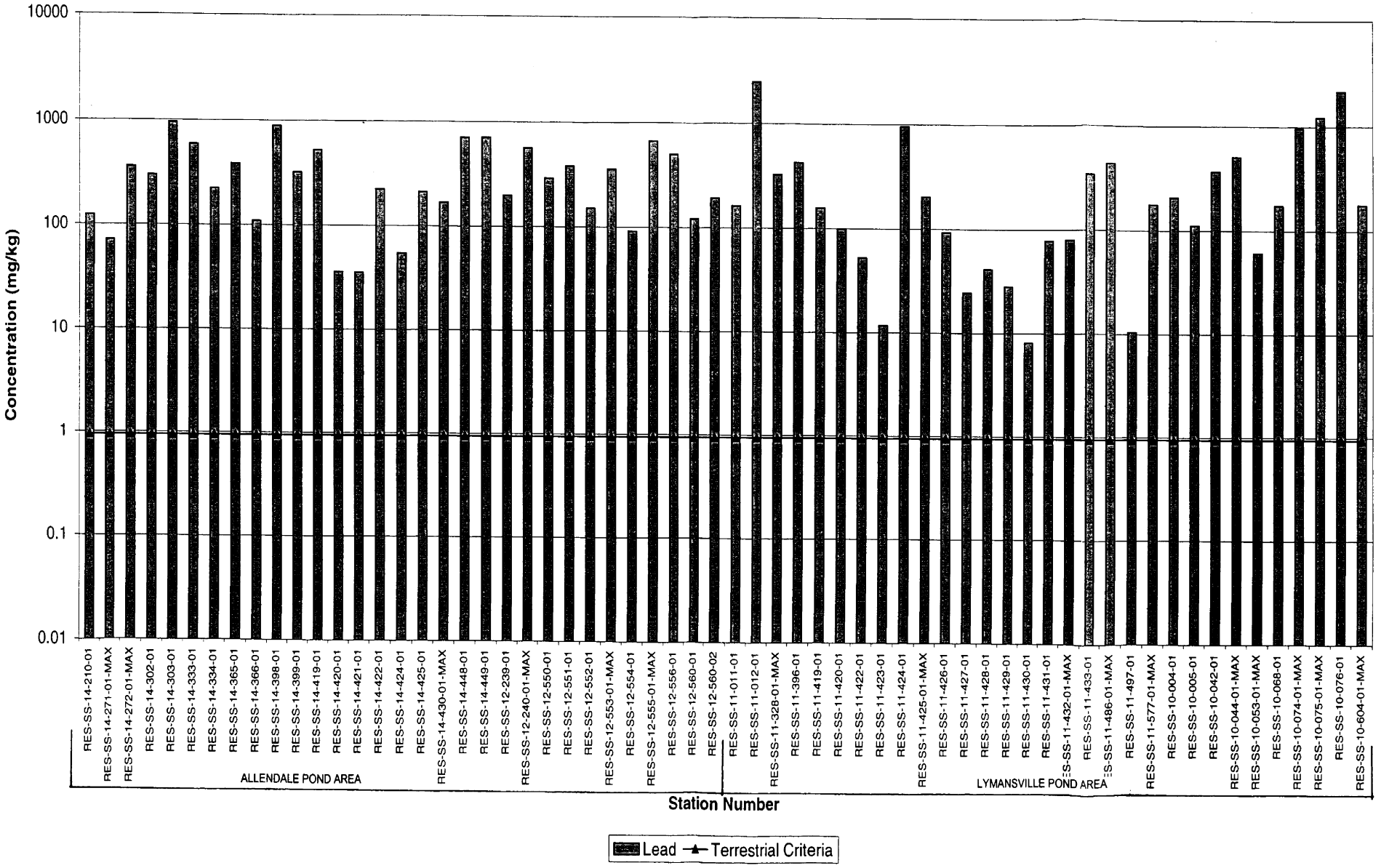
Copper Detections in Residential Samples



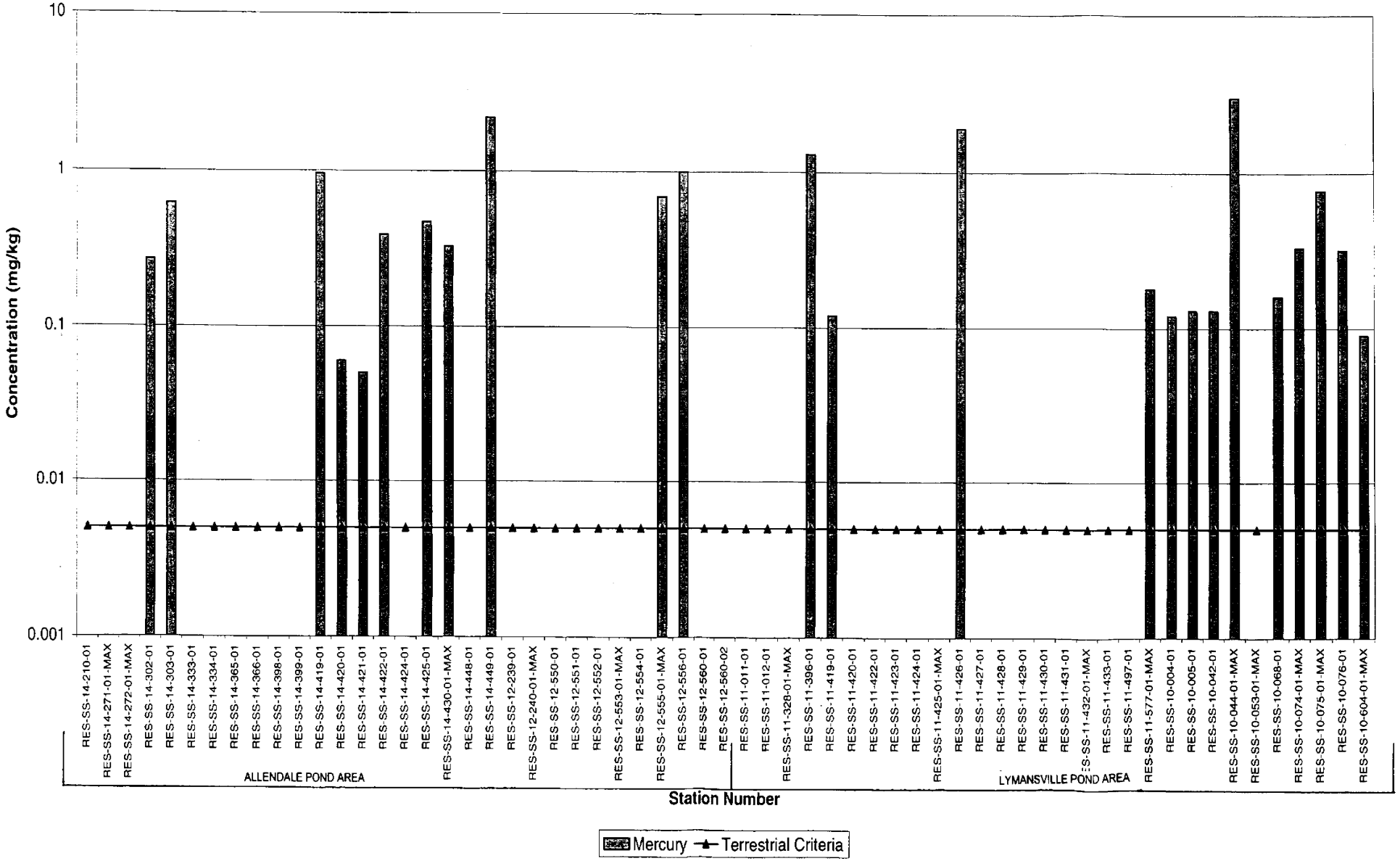
Chromium Detections in Residential Samples



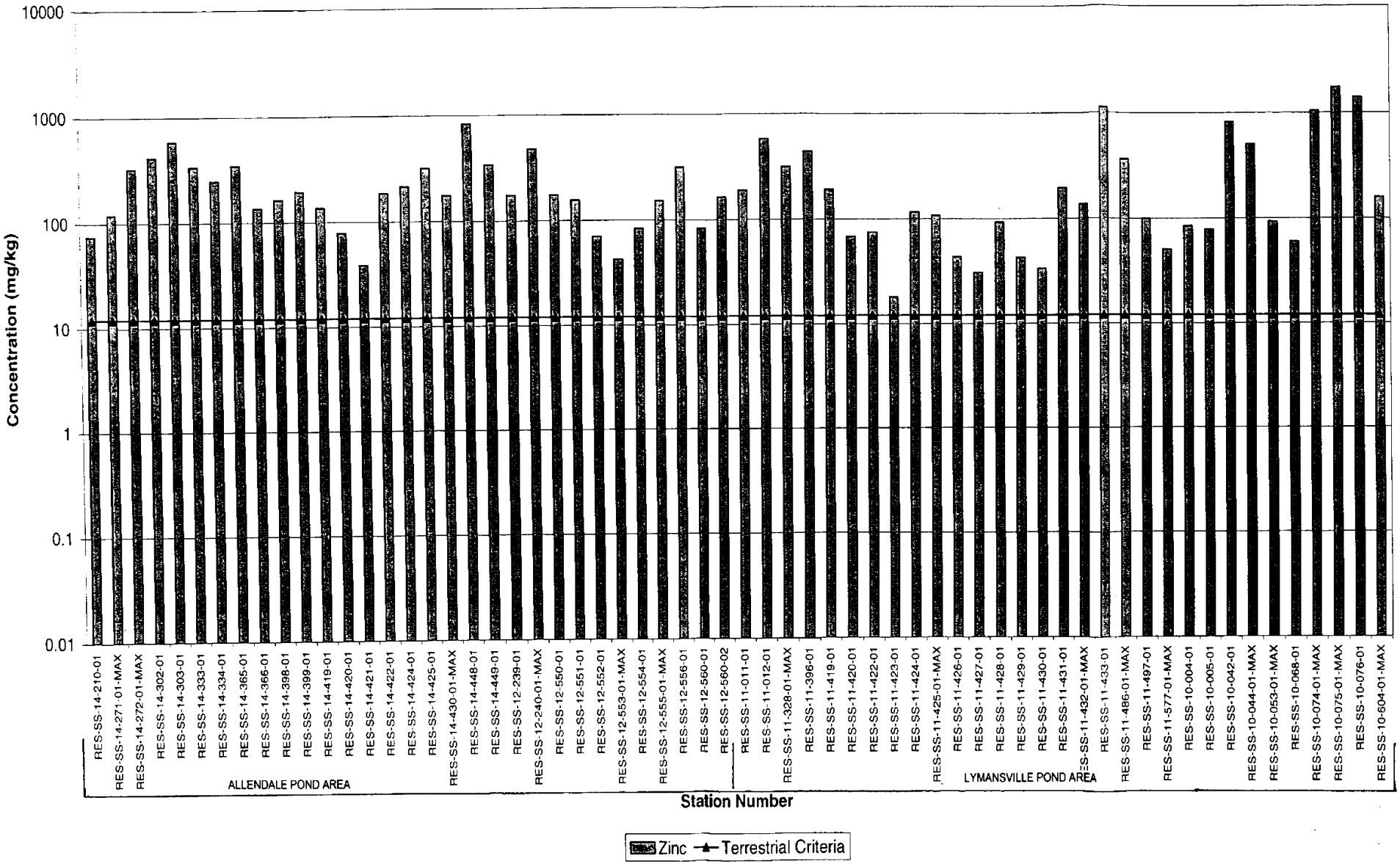
Lead Detections in Residential Samples



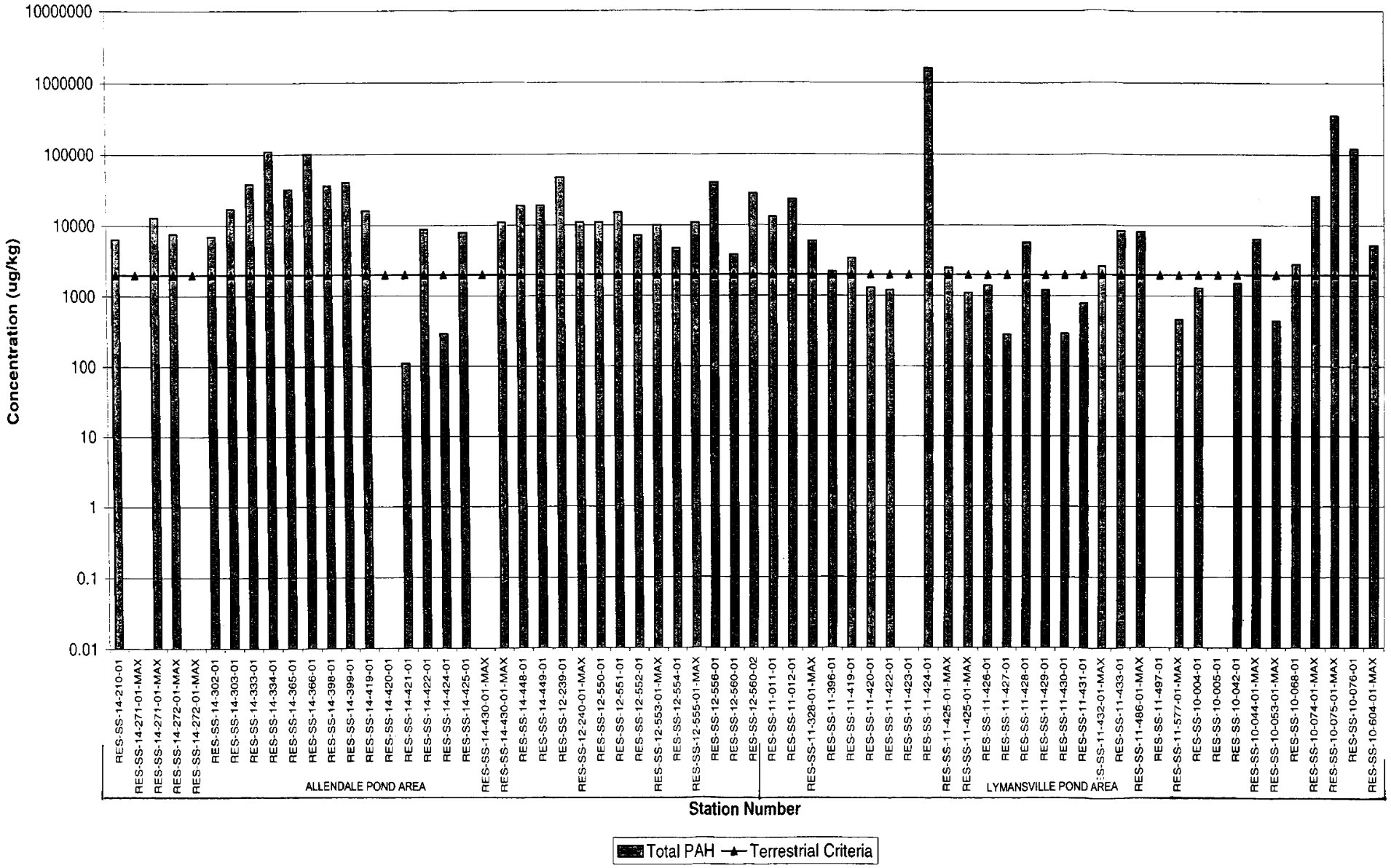
Mercury Detections in Residential Samples



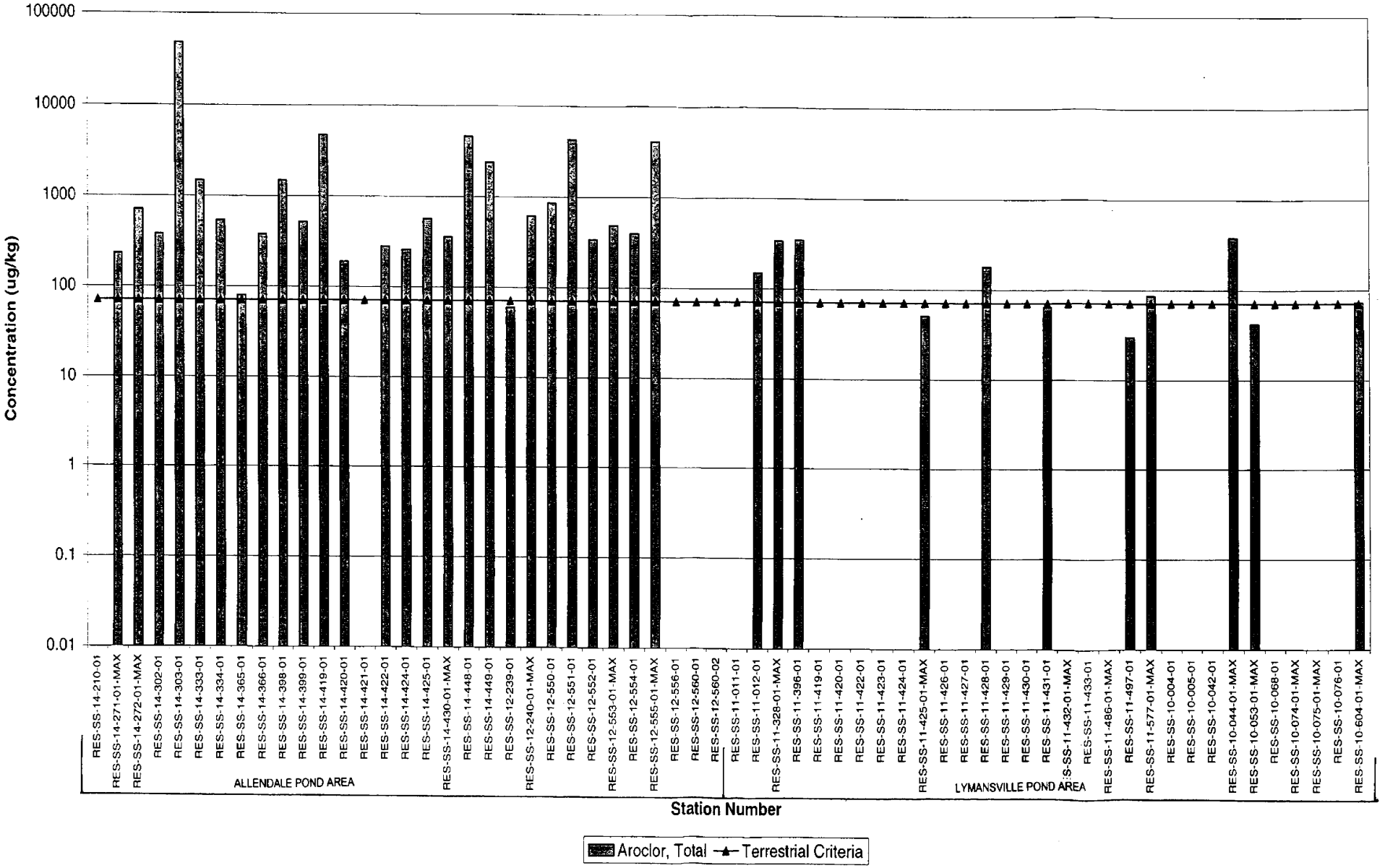
Zinc Detections in Residential Samples



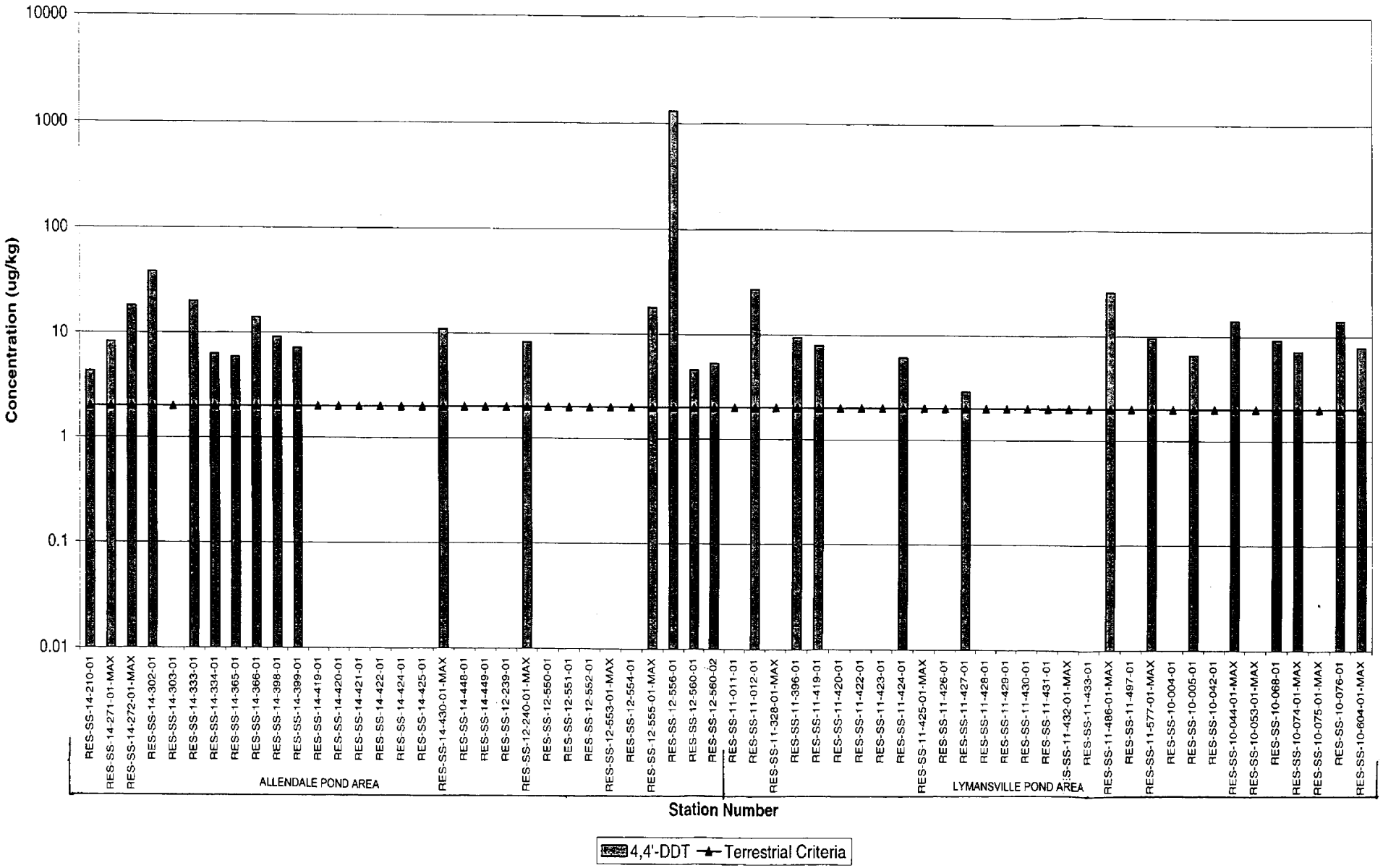
Total PAH Detections in Residential Samples



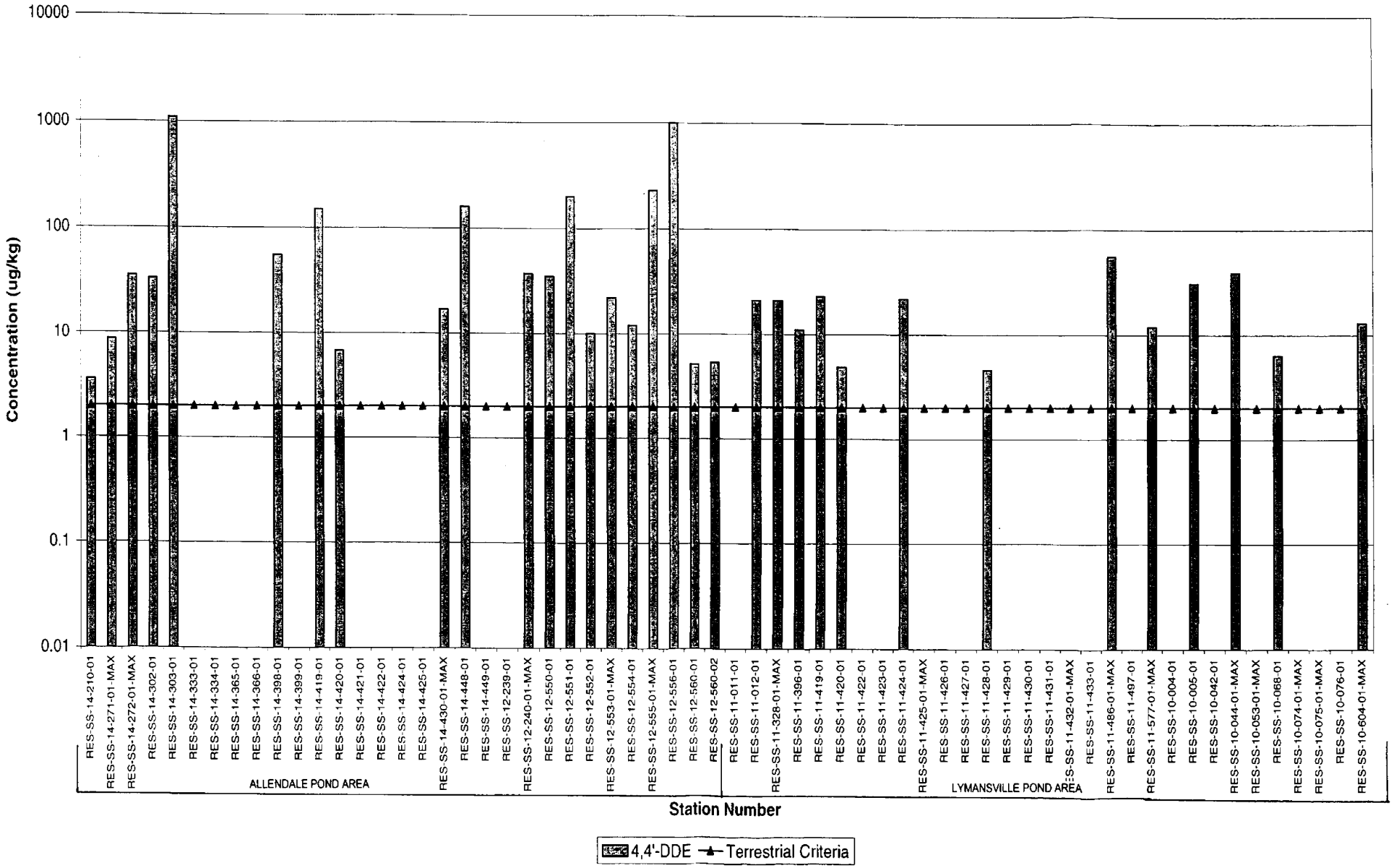
Total PCB Detections in Residential Samples



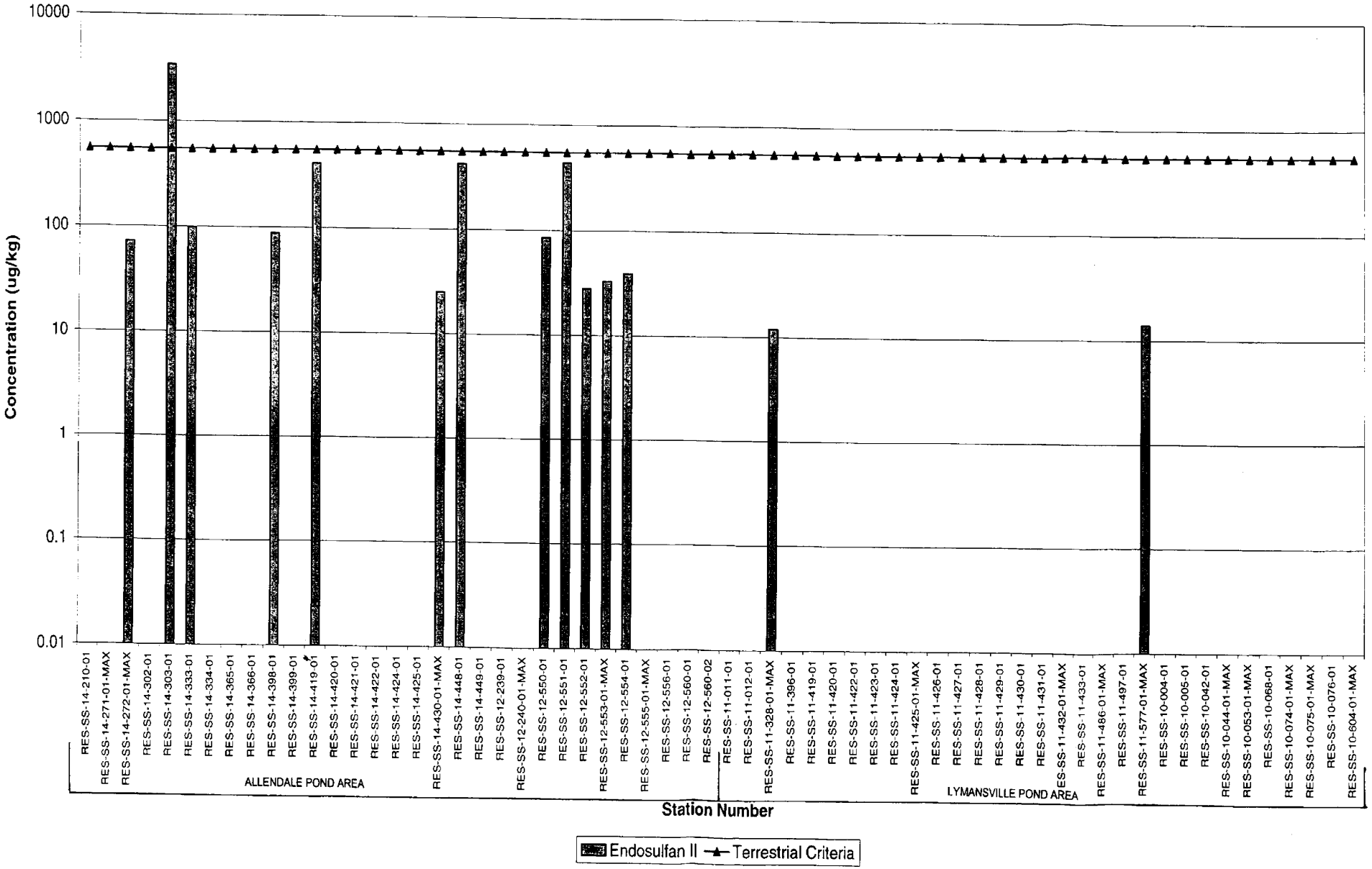
4,4'-DDT Detections in Residential Samples



4,4'-DDE Detections in Residential Samples



Endosulfan II Detections in Residential Samples



APPENDIX D

ARAR TABLES

TABLE D-1
CHEMICAL-SPECIFIC ARARs
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE EE/CA
Federal Regulatory Requirements	OSWER Directive 9200.4-26, Approaches for Addressing Dioxins in Soil at CERCLA and RCRA Sites (Apr. 13, 1998)	To Be Considered	This Directive provides guidance in establishing cleanup levels for dioxins. A 1 µg/kg (ppb) concentration of dioxins (as 2,3,7,8-TCDD TE) has been established for surficial soils involving residential exposure scenarios. A cleanup range of 5 to 20 µg/kg of dioxin (as 2,3,7,8-TCDD TE) has been established for commercial and industrial exposure scenarios.	This OSWER policy aided in the establishment of dioxin PRGs for soil and sediment to be used in the removal action.
	EPA Region IX Risk-Based Concentrations (Oct 1997)	To Be Considered	Risk Based Concentrations (RBCs) are human-health-based allowable exposure guidance levels developed for carcinogenic and non-carcinogenic compounds, using reference doses and carcinogenic potency slopes obtained from EPA's Integrated Risk Information System (IRIS) database, EPA's Health Effects Assessment Summary Tables (HEAST), and standard exposure scenarios. RBCs are chemical concentrations corresponding to a fixed level of risk in various media.	RBCs were used in the EE/CA's human health risk evaluation to identify and select potential contaminants of concern.

TABLE D-2
LOCATION-SPECIFIC ARARs
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE EE/CA
Federal Regulatory Requirements	Protection of Wetlands (Executive Order 11990), 40 CFR 6.302(a) and Statement of procedures on Floodplain Management and Wetlands Protection (40 CFR 6, App. A)	Applicable, Alternatives 1-4	Federal agencies are required to avoid undertaking or providing assistance for new construction located in wetlands unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use.	Each alternative includes work in wetlands as defined in Section 4 of Appendix A. Each alternative will include all practicable measures to minimize harm to wetlands. Alternative 3 is the least disruptive to wetlands.
	Floodplain Management (Executive Order 11988-40 CFR 6.302(b) and Statement of procedures on Floodplain Management and Wetlands Protection (40 CFR 6, App. A)	Applicable, Alternatives 1-4	Federal agencies are required to avoid impacts associated with the occupancy and modification of a floodplain and avoid support of floodplain development wherever there is a practicable alternative.	The expected impacts of each alternative will be evaluated, in terms of the intent of this provision, and considered during the preferred alternative selection process. Adverse impacts may be mitigated where feasible or necessary. Alternative 3 is least disruptive to floodplains
	Rivers and Harbors Act (33 U.S.C. Section 403); Section 10	Applicable, Alternatives 1-3	These regulations set forth criteria from the Army Corps of Engineers (ACOE) for placing dams/structures in navigable waters of the United States.	Where an alternative involves a cap (Alternative 1 and 2) or dam (Alternatives 1 and 3) in the Woonasquatucket River, the substantive requirements of these regulations will be met.
	Resource Conservation and Recovery Act (42 U.S.C. Section 6901 et. seq.); Location Standards (40 CFR Section 264.18(b)	Applicable, Alternatives 1 and 2, and Alternatives 1, 3, and 4 with Disposal Option 1.	A hazardous waste facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	Alternatives that involve locating a hazardous waste facility at the Site will comply with this regulation, to the extent practicable.
	Clean Water Act - Section 404(b)(1) Guidelines for specification of disposal sites for dredged or fill material (40 CFR Part 230)	Applicable, Alternatives 1-4	These guidelines outline requirements for the discharge of dredged or fill materials into surface waters, including wetlands. Under these requirements, no activity that adversely impacts a wetland shall be permitted if a practicable alternative that would have less adverse impact exists. If there is no other practicable alternative, impacts must be mitigated.	Alternatives 1 and 2 involve filling wetland areas via caps. Alternatives 3 and 4 involve dredging wetlands (excavation). Filling or dredging activity will only occur where there is no other practicable alternative and any adverse impacts will be mitigated. Alternative 3 is least disruptive to wetlands.

TABLE D-2
LOCATION-SPECIFIC ARARs
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE EE/CA
Federal Regulatory Requirements (continued)	Fish and Wildlife Coordination Act (16 U.S.C. 661), Fish and Wildlife protection (40 CFR Section 6.302(g))	Applicable, Alternatives 1-4	This regulation requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service, and other related state agencies. That federal agency must consult with the appropriate government entity and also take action to prevent, mitigate, or compensate for project-related losses of fish and wildlife resources.	Each alternative modifies potential fish and wildlife habitats (at Allendale Pond). EPA will consult with all appropriate state and federal agencies, such as the USFWS, and ensure that losses of these resources will be prevented, mitigated, or compensated.
State Regulatory Requirements	Hazardous Waste Management Act (RI General Laws 23-19.1-6, 23-19.1-7, and 23-19.1-10); Section 10, Land disposal activities	Applicable, 1,3,4 w/disposal option 1 (because of cap) 1,2 (because of cap) Relevant and appropriate alternatives 1 + 3 (because of dam)	Rhode Island is delegated to administer the federal RCRA statute through its state regulations. The standards of 40 CFR 264 (including 264.18) are incorporated by reference.	Disposal option 1 includes consolidation of contaminated material excavated from the site under a cap on site. This cap will meet these state requirements to the extent practicable. Caps next to the Woonasquatucket River/Allendale Pond which are on land also must meet these state requirements. These caps also will meet these state requirements to the extent practicable. The dam must meet the surface impoundment portion of these state requirements. Again, they will be met to the extent practicable.
Criteria, Advisories, Guidance	Freshwater Wetlands Act (RI Gen. Laws 2-1-18 through 2-1-24); Rule # 10, Protection of Wetlands Functions and Values.	Applicable, Alternatives 1-4	Any activity which alters a wetland must avoid all probable impact to freshwater wetlands to the maximum extent possible. If impacts cannot be avoided, they must be reduced to the maximum extent possible.	Each alternative includes work in wetlands. Each alternative will avoid impacts to wetlands to the maximum extent possible. Where impacts cannot be avoided, they will be reduced to the maximum extent possible.

TABLE D-3
ACTION-SPECIFIC ARARs
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE EE/CA
Federal Regulatory Requirements	Clean Water Act, Section 402; EPA administered permit programs: the NPDES (40 CFR Part 122), criteria and standards for the NPDES (40 CFR Part 125), Water quality standards (40 CFR Part 131)	Applicable, alternatives 1-4	Contains discharge limitations, monitoring requirements, and best management practices. Substantive requirements under NPDES are written such that state and federal ambient water quality criteria (AWQC) are met. Permits are required for off-site discharges	All of the alternatives involve substantial activities in the Woonasquatucket River/Allendale Pond, including dewatering sediment, reconstructing the Allendale Dam, rerouting the river to conduct excavations and capping activities which may disturb sediments. These regulations will be complied with to the extent practicable.
State Regulatory Requirements	Hazardous Waste Management Act (RI General Laws 23-19.1-6, 23-19.1-7, and 23-19.1-10); Section 5, Generators	Applicable, Alternatives 1, 2, 3 and 4	These regulations apply to all generators of hazardous waste. They include requirements for identification, storage, shipment and labelling of waste	Alternatives 1, 2, 3 and 4 involve the generation of hazardous waste via excavation. Excavation and related activities will comply with this regulation.
	Hazardous Waste Management Act (RI General Laws 23-19.1-6, 23-19.1-7, and 23-19.1-10); Section 9. Operational requirements for treatment, storage, and disposal facilities.	Applicable, 1,3,4 w/disposal option 1 (because of cap) 1,2 (because of cap) Relevant and appropriate alternatives 1 + 3 (because of dam)	The standards of 40 CFR 264 are incorporated by reference. This regulation governs facilities which treat, store, or dispose of hazardous wastes - including the placement of hazardous waste into or on any land or water. It includes monitoring, closure, post-closure and operation and maintenance requirements.	Under disposal option 1, wastes will be disposed of on site. Under alternatives 1 and 2, a cap will be placed over hazardous wastes in sediments and soils. Under alternative 1 and 3, a dam will be built on-site. Under each of the scenarios, the substantive requirements of Section 10 will be met.

TABLE D-3
ACTION-SPECIFIC ARARs
FINAL ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SITE
NORTH PROVIDENCE, RHODE ISLAND

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE EE/CA
State Regulatory Requirements (con't)	Waters and Navigation (RI Gen. Laws 46-12 and 46-13.1), Health and Safety (RI Gen Laws 23-19.1, 23-19.14); Remediation Regulations DEM-DSR-01-93 Section 8.01, A to D.	Relevant and Appropriate, Alternatives 3 + 4	This section regulates impacted media at contaminated sites	This section will be used as a performance measurement during post-removal sampling. If such sampling indicates an unacceptable human health risk, further action will be required and an additional decision document may be issued.
	Water Pollution (RI General Laws 46-12), Environmental Management (RI General Laws 42-17.1, Water Quality Regulations (R.I. Code R. 112-88.97-1), Rule #18	Applicable, Alternatives 1-4	Regulations designed to protect state surface water resources. Establishes water use classification and water quality criteria for waters of the state.	Alternatives will include provisions for the protection of the Woonasquatucket River including Allendale and Lymansville Ponds, where construction activities (dam, cap, excavation) occur in these waters.
	RI Air Pollution Control Regulation #5, Fugitive Dust	Applicable, Alternatives 1-4	Regulations designed to control releases of airborne particulate in the State of Rhode Island, including those caused by earth moving activities.	All four alternatives include earth moving activities and land clearing. Where there is a possibility of fugitive dust, this regulation will be complied with.

APPENDIX E

SUMMARY OF EE/CA REMOVAL ALTERNATIVES EVALUATION CRITERIA

APPENDIX E
SUMMARY OF EE/CA REMOVAL ALTERNATIVES EVALUATION CRITERIA
ENGINEERING EVALUATION/COST ANALYSIS
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

1. Effectiveness

This criterion refers to the alternative's ability to meet the objective of the removal action scope. Each alternative is evaluated against the scope of the removal action and against each specific objective for final disposition of the wastes and the level of cleanup desired. These objectives are discussed in terms of protectiveness of human health and the environment.

- **Overall Protection of Human Health and the Environment**

Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

The evaluation should focus on how each alternative achieves adequate protection and describe how the alternative will reduce, control, or eliminate risks at the Site through the use of treatment, engineering, or institutional controls. This evaluation should identify any unacceptable short-term impacts.

- **Compliance with ARARs**

The alternatives will be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws to the extent practicable.

The detailed analysis should summarize which requirements are applicable or relevant and appropriate to an alternative and describe how the alternative meets those requirements.

- **Long-Term Effectiveness and Permanence**

This evaluation assesses the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes at the site. The following components should be considered for each alternative:

- Magnitude of risk remaining from untreated wastes or residuals remaining at the conclusion of the site activities. Effectiveness of the alternative is considered. Because this removal action is an interim step and is expected to be followed by a remedial action, this factor may be reduced in scope or deleted.

- Adequacy and reliability of controls addresses the need for post-removal site control (PRSC).

- **Reduction of Toxicity, Mobility, or Volume Through Treatment**

The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that will be considered, as appropriate, include the following:

- The treatment or recycling processes the alternatives employ and materials they will treat;

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;

- The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reductions are occurring;

- The degree to which the treatment is irreversible;

- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents; and,

- Whether the alternative will satisfy the preference for treatment.

These factors will be limited to time and applicability restraints and may, to some extent, be beyond the scope of the removal action.

- **Short-Term Effectiveness**

The short-term impacts of the alternatives will be assessed considering the following:

- Short-term risks that might be posed to the community during implementation of an alternative;

- Potential threats to workers during the removal action and the effectiveness and reliability of protective measures that would be taken;

- Potential environmental impacts of the removal action and the effectiveness and reliability of mitigative measures during implementation; and,

- Time until the response action is achieved.

2. **Implementability**

The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors:

-Technical feasibility, including the ability of the technology to implement the removal action, technical difficulties associated with a technology, the reliability of the technology, operational difficulties including the need for large staff or technical complexity, difficulties associated with remove locations, ease of undertaking additional response actions, the ability to monitor the effectiveness of the remedy, and the extent to which the removal action contributes to the efficient performance of any long-term remedial action;

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, the ability to obtain necessary approvals and permits from other agencies (for off-site actions), and statutory limits on removal actions;

- Availability of services and materials, including: the availability of adequate off-site treatment and storage capacity and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; and availability of prospective technologies for full-scale application.

- State acceptance and assessment of state concerns will not be completed until comments on the EE/CA are received. The State of Maine is providing input to this EE/CA and the recommended removal action.

- Community acceptance will not be evaluated in the EE/CA. Community concerns will be assessed following receipt of public comment. Community acceptance and concerns will be considered in making a recommendation on a removal action and in the final selection of the action.

3. Cost

The types of costs that will be assessed include the following:

- Capital costs, including both direct and indirect costs.

- Post removal site control costs, which include operations and maintenance, materials and energy, monitoring, and residual disposal.

APPENDIX F

COST ESTIMATES

Alternative 1: Cap Residential Use Soils and Restore Allendale Dam

ASSUMPTIONS:

i. Cost estimating sources:

Means Heavy Construction Cost Data, 12th annual edition, R.S. Means Company, Inc., 1998.

Means Site Work & Landscape Cost Data, 17th annual edition, R.S. Means Company, Inc., 1998.

Means Environmental Remediation Cost Data, 6th annual edition, R.S. Means Company, Inc., 2000.

ii. Abbreviations: CF = cubic feet; CY = cubic yard; FT = feet; SF = square feet; SY = square yard; LF = linear feet; CLF = 100 linear feet; MSF = 1000 SF

iii. Use 1.5 tons/CY for soils/sludge/sediments

Estimated Time to Complete Removal Action

Once authorized to proceed, approximately one month will be required to prepare and implement the Pre-Design Investigation Work Plan. Another 6 months will be required to complete the Engineering, Design, Subcontracting, and Mobilization phases. The remaining site activities, including Demobilization, will be completed within one full construction season. Post Removal Site Control inspections will be conducted quarterly for a period of two years following completion of site activities.

Total site time (from mob to demob): 6 months

Total project duration (not including Post Removal Site Control): 13 months

Total project duration (including Post Removal Site Control): 37 months

Note: Total project duration does not include seasonal impacts or delays.

BASIS FOR COST ESTIMATE:

I. Project Documents
   1. PDI work Plan: Based on previous experience.
   2. Permitting: 500 hrs. @ $30/hr. based on previous experience and TtNUS labor rates.

II. Pre-Design Investigation
   1. Limited soil sampling: 11 residential properties x 12 samples at each = 132 samples. labor, equipment, and shipping costs: 12 samples per day, 2 persons (8 hrs. ea. @ $30/hr.), equipment ($200/day), vehicle ($40/day), shipping ($50/day), and weather contingency (20%) = $924 per 12 samples, or $77/sample.
   2. Soil analysis: 132 samples as described above, $250 for analysis.

III. Mobilization/Demobilization
   1. Office Trailer: from Means, 32' x 8', furnished, includes power and phone.
   2. Storage Trailer: from Means, 28' x 10', assume storage trailer will remain present throughout implementation and Post Removal Site Control phase (6 mos. + 2 years = 30 mos.).
   3. Portable Communications Equipment (Radios): 4 sets, assume $400/mo. per set.

4. Equipment Mobilization/Demobilization: Bobcat/Bulldozer, Backhoe 580D, 10 wheel dump truck - from Means, $178 ea.; $534 (mob) + 534 (demob) = $1068.
5. Materials Mobilization: Based on previous experience.
6. Site Utilities: Assume (monthly) $75 x 2 for phone, $100 for electricity, $50 for water service = $300
7. Security: Assume 12 hours/day, 30 days/mo. @ $10/hour = $3,600/mo.
8. Sanitary Facilities: Assume 2 units, from Means, $120/mo. each
9. Decontamination Trailer: from Means, 8' x 36' with 2 showers.
10. Dumpster: includes weekly servicing, 6 CY capacity, price from Means.

IV. Decontamination
1. Decontamination equipment/fluids: based on previous experience.
2. Decontamination water: based on previous experience.
3. Drums (spent fluids storage): assume 12 drums, 55 gal., steel, price from Means.
4. Disposal of decontamination wastewater, drums: $2,200 per drum, based on vendor quote.

V. Site Preparation
1. Site construction survey: action area (17,500 ft^2) + dam restoration work area (185' x 230') = 60,050 ft^2 or 1.4 acres. From Means, $1,248/acre.
2. Clear brush and trees (to 6" diam) and chip: same area as item 1, price from Means.
3. Grub stumps and remove: same area as item 1, price from Means.
4. Erosion controls, silt fences: Installed on the downgradient side of each work area, approx. 1,100 lf. Price from Means.
5. Dust suppression (watering) per acre-pass: Construction area = 1.4 acres = 60,050 ft^2 = 60 msf. Assume 4 passes, 4 x 60 msf = 240 msf.
6. Establish stockpile/staging areas: 1 LS based on previous experience.
7. Install snow fence, perimeter of work areas minus areas where silt fence was installed (item 4): Perimeter of dam work area = 800', total perimeter of Residential use soil areas = 2,800'. Total = 2,800' + 800' - 1,100' (item 4) = 2,500'. Price from Means.
8. Dismantle fencing: Approx. 150 ft in dam work area, assume 50 ft at ea. of 7 (out of 11) properties where fence is present, 150 ft + 350 ft = 500 ft. Price from Means.
9. Access route improvements: Lay plywood (4' x 8' x .75") across lawns to prevent damage. Assume 20 needed per residential work area, 11 areas. 32 ft^2 ea. x 20 X 11 = 7,040 ft^2, price from Means.

VI. Cap
1. Cap affected areas - mechanical: Assume one half of total cap fill materials will be placed by mechanical means using bobcat/bulldozer, price from Means.
2. Cap affected areas - hand work: Assume one half of total cap fill materials will be placed by hand, price from Means.
3. Cap materials
   a) Sand, delivered: based on cap design, 1.5 ft total x 17,500 ft^2. Price from Means.
   b) Geomembrane: installed (17,500 ft^2), price from Means.
   c) Filter fabric, installed: (17,500 ft^2), price from Means.
   d) Topsoil, delivered: based on cap design (1 ft x 17,500 ft^2), price from means.
4. Compaction: volume = total amount of cap fill material, price from Means.
5. Grading: based on capped area (17,500 ft^2), price from Means.
6. Surveying: As-built survey of capped area (17,500 ft^2). Price from Means.

VII. Dam Restoration
1. COE Estimate: $392,300 - $6,700 = $385,600 x 1.023 x 1.023 x 1.023 = $412,823. TtNUS modification does not call for gravel fill cofferdam, therefore subtract $6,700 from COE estimate. COE estimate dated June 1997. Engineering News Record (ENR) Construction Cost Index indicates an approximate 2.3% annual increase in construction costs (based on 1998 and 1999 data). Therefore, update cost 2.3% per year for 3 years.
2. TtNUS Modifications

a) Sheet pile cell cofferdam and backfill: 6,100 sf of sheet pile required, $14.87/sf for materials and labor (price from means), 936 cy gravel fill needed, $5.18/cy for materials (price from means: e2000-17-03-0430). 6,100 x $14.87 + 936 x $5.18 = $95,600.
b) Additional excavation required to implement TtNUS modification: total = 1,100 cy. COE estimated 860 cy. 1,100 cy - 860 cy = 240 cy difference. 240 cy x ($9.88/cy x 1.023 x 1.023 x 1.023) = $2,539. Price per cy based on COE estimate plus 2.3%/yr. cost adjustment discussed in VII.1.
c) Total = $95,600 + $2,539 = $98,139.

3. Disposal of excavated soil/sediment as hazardous waste: Assume excavated material can be segregated, assume 25% of material is hazardous. 25% of 1,100 cy = 275 cy. 275 cy x 1.5 ton/cy = 415 tons.
   a) Transport and disposal - Option 1, based on using 15 yd dump truck to transport soil 3 miles, unload, spread, and cap. Price based on per unit cap items listed in VI. ($4.43/sf) and transportation price from Means, $47/cy (e2000-33-19-0209). Assuming material will be spread to a depth of 2 ft., capped area = 275 cy x 27 cf/cy divided by 2 ft = 3713 sf. 3713 sf x $4.43/sf = $16,446. Transportation cost = $47/cy x 275 cy = $12,925. Total = $16,446 + $12,925 = $29,371. Unit cost = $29,371/415 tons = $71 per ton.
   b) Transport and disposal - Option 2, based on vendor quote, does not include analytical testing for disposal purposes.
   c) Transport and disposal - Option 3, based on vendor quote, does not include analytical testing for disposal purposes.
4. Dewatering: System consists of 25 gpm sump pump used to remove water from excavation into a 21,000 gal. frac tank. Water then pumped from frac tank through a pre-filter and filter into a second 21,000 gallon frac tank. Assume use of 4 filter cartridges (1 per month) and 16 pre-filters (1 per week). Water tested prior to discharge back into Allendale Pond or to POTW. Two systems to be used.

VIII. Site Restoration

1. Backfill access areas: Assume 1 cy required for each of the 11 access areas, placed using bobcat/bulldozer, price from Means.
2. Topsoil: Delivered, price from Means.
3. Grading: Assume using bulldozer/bobcat, price from Means, $3.24/sy = $0.36/sf.
4. Compaction: Assume using vibratory plate compactor, price from Means.
5. Hydroseed disturbed areas: Assume using Bluegrass #4, price from Means, $37/1,000 ft^2 = $1,627/acre. 17,500 ft^2 = 0.4 acres.
6. Final Clean-up: Price from Means.

IX. Site Staffing

1. Site manager: to coordinate and direct site activities, price based on TtNUS rates.
2. Site supervisor/foreman: to coordinate and direct site activities, price based on TtNUS rates.
3. Site engineer: to coordinate and direct site activities, price based on TtNUS rates, time.
4. Site safety officer: to coordinate and direct site activities, price based on TtNUS rates.

X. POST REMOVAL SITE CONTROL

1. Assume quarterly site visits for a period of 30 years. Assume 8 hrs. per visit, site engineer rate listed in IX. 3. Assume brush will be cleared from capped areas and in the vicinity of the dam every two years: total area = 0.4 acres + 0.25 acres = 0.65 acres. Price for brush clearing from Means.

CENTERDALE MANOR EE/CA
COST ESTIMATE FOR ALTERNATIVE 1
Cap Residential Soils and Restore Dam

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
I. PROJECT DOCUMENTS												
1. PDI Work Plan	2500	HR	0.00	0.00	30.00	0.00	0	0	75,000	0	75,000	
2. Permitting	500	HR	0.00	0.00	30.00	0.00	0	0	15,000	0	15,000	
II. PRE-DESIGN INVESTIGATION												
1. Limited soil sampling	132	EA	0.00	0.00	77.00	0.00	0	0	10,164	0	10,164	
2. Soil analysis	132	EA	250.00	0.00	0.00	0.00	33,000	0	0	0	33,000	
III. MOBILIZATION/DEMOBILIZATION												
1. Office Trailer	6	MO	215.00	0.00	0.00	0.00	1,290	0	0	0	1,290	m98-015-904-0350 & 0700
2. Storage Trailer	30	MO	95.00	0.00	0.00	0.00	2,850	0	0	0	2,850	m98-015-904-1350
3. Portable Communication Equipment, 4 sets	6	MO	400.00	0.00	0.00	0.00	2,400	0	0	0	2,400	
4. Equipment Mobilization/Demobilization	1	LS	1,068.00	0.00	0.00	0.00	1,068	0	0	0	1,068	m98-022-274-0020
5. Materials Mobilization/Demobilization	1	LS	500.00	0.00	0.00	0.00	500	0	0	0	500	
6. Site Utilities	6	MO	300.00	0.00	0.00	0.00	1,800	0	0	0	1,800	elec., phone, water
7. Security	6	MO	3,600.00	0.00	0.00	0.00	21,600	0	0	0	21,600	12 hrs./day, $10/hr.
8. Sanitary Facilities (2)	6	MO	240.00	0.00	0.00	0.00	1,440	0	0	0	1,440	m98-016-420-6410
9. Decontamination Trailer	6	MO	2,250.00	0.00	0.00	0.00	13,500	0	0	0	13,500	e2000-33-17-0822
10. Dumpster	6	MO	1,100.00	0.00	0.00	0.00	6,600	0	0	0	6,600	m98-020-620-0600
IV. DECONTAMINATION												
1. Decontamination equipment/fluids	1	LS	0.00	100.00	0.00	0.00	0	100	0	0	100	
2. Decontamination water	660	GAL	0.00	0.20	0.00	0.00	0	132	0	0	132	
3. Drums (spent fluids storage)	12	EA	0.00	60.06	0.00	0.00	0	721	0	0	721	m98-33-19-0401
4. Disposal of Decontamination wastewater, drums	12	EA	2,200.00	0.00	0.00	0.00	26,400	0	0	0	26,400	vendor quote
V. SITE PREPARATION												
1. Site construction survey	1.4	AC	1,248.00	0.00	0.00	0.00	1,747	0	0	0	1,747	m98-013-306-0100
2. Clear brush and trees (to 6" diam) and chip	1.4	AC	2,200.00	0.00	0.00	0.00	3,080	0	0	0	3,080	m98-021-104-0010
3. Grub stumps and remove	1.4	AC	1,069.00	0.00	0.00	0.00	1,497	0	0	0	1,497	m98-021-104-0150
4. Erosion controls, silt fences	1100	LF	0.00	0.23	1.11	0.00	0	253	1,221	0	1,474	m98-18-05-0206
5. Dust suppression (watering) per acre-pass	240	MSF	1.09	0.00	0.00	0.00	262	0	0	0	262	m98-33-08-0585
6. Establish stockpile/staging areas	1	LS	5,000.00	0.00	0.00	0.00	5,000	0	0	0	5,000	
7. Install snow fence, perimeter of work areas	2500	LF	0.00	1.55	1.02	0.00	0	3,875	2,550	0	6,425	m98-028-320-5000
8. Dismantle fencing	500	LF	1.45	0.00	0.00	0.00	725	0	0	0	725	m98-020-554-0755
9. Access route improvements, lay plywood	7040	SF	0.00	0.42	0.35	0.00	0	2,957	2,464	0	5,421	m98-015-552-2500
VI. CAP												
1. Cap impacted soils/sediment - mechanical	813	CY	1.13	0.00	0.00	0.00	919	0	0	0	919	m98-022-262-0010
2. Cap impacted soils/sediment - hand work	813	CY	13.75	0.00	0.00	0.00	11,179	0	0	0	11,179	m98-022-262-0100
3. Cap materials												
a) Sand, delivered (1.5 ft total x 17,500 ft^2)	975	CY	18.50	0.00	0.00	0.00	18,038	0	0	0	18,038	m98-041-032-0250
b) Geomembrane, installed (17,500 ft^2)	1950	SY	0.00	3.87	10.44	0.00	0	7,547	20,358	0	27,905	e2000-33 08 0544
c) Filter fabric, installed (17,500 ft^2)	1950	SY	0.00	0.64	0.37	0.00	0	1,248	722	0	1,970	e2000-33 08 0532
d) Topsoil, delivered (1 ft x 17,500 ft^2)	650	CY	14.00	0.00	0.00	0.00	9,100	0	0	0	9,100	m98-022-216-7000
4. Compaction	1625	CY	0.99	0.00	0.00	0.00	1,609	0	0	0	1,609	m98-R022-220
5. Grading	17500	SF	0.36	0.00	0.00	0.00	6,300	0	0	0	6,300	e2000-17-03-0101
6. Surveying (17,500 ft^2)	0.40	AC	1,248.00	0.00	0.00	0.00	499	0	0	0	499	m98-013-306-0100

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
VII. DAM RESTORATION												
1. US ACOE Estimate	1	LS	412,823.00	0.00	0.00	0.00	412,823	0	0	0	412,823	
2. TtNUS Modifications	1	LS	98,139.00	0.00	0.00	0.00	98,139	0	0	0	98,139	
3. Disposal of impacted sediments/soil as hazardous waste												
a) Transport, spread, cap - Option 1	415	TON	71.00	0.00	0.00	0.00	29,465	0	0	0	29,465	cap unit costs (IV)
b) Transport and disposal - Option 2	415	TON	222.00	0.00	0.00	0.00	92,130	0	0	0	92,130	facility quote
c) Transport and disposal - Option 3	415	TON	310.00	0.00	0.00	0.00	128,650	0	0	0	128,650	facility quote
4. Dewatering	1	LS	27,724.00	0.00	0.00	0.00	27,724	0	0	0	27,724	
VIII. SITE RESTORATION												
1. Restore access areas, backfill	11	CY	1.13	0.00	0.00	0.00	12	0	0	0	12	m98-022-262-0010
2. Topsoil	11	CY	14.00	0.00	0.00	0.00	154	0	0	0	154	m98-022-216-7000
3. Grading	11000	SF	0.36	0.00	0.00	0.00	3,960	0	0	0	3,960	e2000-98-17-03-0101
4. Compaction	11	CY	0.99	0.00	0.00	0.00	11	0	0	0	11	m98-R022-220
5. Hydroseed disturbed areas	0.4	AC	1,627.00	0.00	0.00	0.00	651	0	0	0	651	m98-029-308-1000
6. Final Clean-up	1.0	LS	1,000.00	0.00	0.00	0.00	1,000	0	0	0	1,000	e98-017-104-0010
IX. SITE STAFFING												
1. Site manager	1040	HR	0.00	0.00	37.00	0.00	0	0	38,480	0	38,480	
2. Site supervisor/foreman	1040	HR	0.00	0.00	30.00	0.00	0	0	24,960	0	24,960	
3. Site engineer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
4. Site safety officer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
X. POST REMOVAL SITE CONTROL												
1. Quarterly site visits for 30 years, brush clearing every 2 years	1	LS	5,258.00	0.00	9,530.00	0.00	5,258	0	9,530	0	14,788	from Table 4-1

		Total ($)				Total ($)
		Sub.	Mat.	Labor	Equip.	
SUBTOTAL DIRECT COST	Disposal Option 1	751,598	16,832	250,369	0	1,018,799
	Disposal Option 2	814,263	16,832	250,369	0	1,081,464
	Disposal Option 3	850,783	16,832	250,369	0	1,117,984
Direct Cost Adjustment Factors:						
Health and Safety on Labor and Equipment @ 5%	Disposal Option 1-3	0	0	12,518	0	12,518
Indirect Cost Adjustment Factors:						
Tax on materials @ 7%	Disposal Option 1-3	0	1,178	0	0	1,178
G&A @ 10% of Equipment, Material, and Labor	Disposal Option 1-3	0	1,683	25,037	0	26,720
Labor Overhead @ 95%	Disposal Option 1-3	0	0	237,850	0	237,850

Disp Option 1	Disp Option 2	Disp Option 3
75,160	81,426	85,078
1,372,226	1,441,157	1,481,329
1,099,784	1,168,716	1,208,888
65,987	70,123	72,533
68,611	72,058	74,066
1,506,824	1,583,338	1,627,929
150,683	158,334	162,793
1,657,507	1,741,672	1,790,722

Subcontract @ 10% of Sub. Cost

Subtotal Direct and Indirect

Subtotal Direct and Indirect (III. - IX.)

Engineering @ 6% of Subtotal Direct and Indirect (III. - IX.)

Home Office Mgmt. And Support @ 5% Direct and Indirect

Subtotal Total Cost

Contingency @ 10% of Total Cost

TOTAL COST

Note: Disposal Option 1: Transport to capped area at Centerdale Manor Site and cap.
Disposal Option 2: Stabilization and disposal at Stablex Facility, Canada.
Disposal Option 3: Incineration and disposal at Bennett Environmental Facility, Canada (includes required disposal analysis).

Alternative 2: Cap Residential Use Soils

ASSUMPTIONS:

i. Cost estimating sources:

Means Heavy Construction Cost Data, 12th annual edition, R.S. Means Company, Inc., 1998.

Means Site Work & Landscape Cost Data, 17th annual edition, R.S. Means Company, Inc., 1998.

Means Environmental Remediation Cost Data, 6th annual edition, R.S. Means Company, Inc., 2000.

ii. Abbreviations: CF = cubic feet; CY = cubic yard; FT = feet; SF = square feet; SY = square yard; LF = linear feet; CLF = 100 linear feet; MSF = 1000 SF

iii. Use 1.5 tons/CY for soils/sludge/sediments

Estimated Time to Complete Removal Action

Once authorized to proceed, approximately one month will be required to prepare and implement the Pre-Design Investigation Work Plan. Another 6 months will be required to complete the Engineering, Design, Subcontracting, and Mobilization phases. The remaining site activities, including Demobilization, will be completed within one full construction season. Post Removal Site Control inspections will be conducted quarterly for a period of two years following completion of site activities.

Total site time (from mob to demob): 6 months

Total project duration (not including Post Removal Site Control): 13 months

Total project duration (including Post Removal Site Control): 37 months

Note: Total project duration does not include seasonal impacts or delays.

BASIS FOR COST ESTIMATE:

I. Project Documents
   1. PDI work Plan: Based on previous experience.
   2. Permitting: 500 hrs. @ $30/hr. based on previous experience and TtNUS labor rates.

II. Pre-Design Investigation
   1. Limited soil sampling: 11 residential properties x 12 samples at each = 132 samples. labor, equipment, and shipping costs: 12 samples per day, 2 persons (8 hrs. ea. @ $30/hr.), equipment ($200/day), vehicle ($40/day), shipping ($50/day), and weather contingency (20%) = $924 per 12 samples, or $77/sample.
   2. Soil analysis: 132 samples as described above, $250 for analysis.

III. Mobilization/Demobilization
   1. Office Trailer: from Means, 32' x 8', furnished, includes air conditioning.
   2. Storage Trailer: from Means, 28' x 10', assume storage trailer will remain present throughout implementation and Post Removal Site Control phase (6 mos. + 2 years = 30 mos.).
   3. Portable Communications Equipment (Radios): 4 sets, assume $400/mo. per set.

4. Equipment Mobilization/Demobilization: 1 10-wheel dump truck, 2 Bobcat/Bulldozers, 2 Front End Loaders, 2 Excavators - from Means, $178 ea.; $1,246 (mob) + $1,246 (demob) = $2,492.
5. Materials Mobilization: Based on previous experience.
6. Site Utilities: Assume (monthly) $75 x 2 for phone, $100 for electricity, $50 for water service = $300
7. Security: Assume 12 hours/day, 30 days/mo. @ $10/hour = $3,600/mo.
8. Sanitary Facilities: Assume 2 units, from Means, $120/mo. each
9. Decontamination Trailer: from Means, 8' x 36' with 2 showers.
10. Dumpster: includes weekly servicing, 6 CY capacity, price from Means.

IV. Decontamination
1. Decontamination equipment/fluids: based on previous experience.
2. Decontamination water: based on previous experience.
3. Drums (spent fluids storage): assume 12 drums, 55 gal., steel, price from Means.
4. Disposal of decontamination wastewater, drums: $2,200 per drum, based on vendor quote.

V. Site Preparation
1. Site construction survey: action area = 257,500 ft^2 or 6 acres. From Means, $1,248/acre.
2. Clear brush and trees (to 6" diam) and chip: same area as item 1, price from Means.
3. Grub stumps and remove: same area as item 1, price from Means.
4. Erosion controls, silt fences: Installed on the downgradient side of each work area, approx. 3,415 lf. Price from Means.
5. Dust suppression (watering) per acre-pass: Construction area = 6 acres = 261,000 ft^2 = 261 msf. Assume 4 passes, 4 x 261 msf = 1,044 msf.
6. Establish stockpile/staging areas: 1 LS based on previous experience.
7. Install snow fence, perimeter of work areas minus areas where silt fence was installed (item 4): Assume remaining perimeter is same as linear footage listed in Item No. 4., 3,415 lf. Price from Means.
8. Dismantle fencing: Assume 50 lf of fencing will require dismantling in 11 locations to allow access to work areas. Price from Means.
9. Access route improvements: Lay plywood (4' x 8' x .75") across lawns to prevent damage. Assume 20 needed per work area, 11 areas. 32 ft^2 ea. x 20 x 11 = 7,040 ft^2, price from Means.

VI. Cap
1. Cap affected areas - mechanical: Assume 90% of total cap fill materials will be placed by mechanical means using bobcat/bulldozer, price from Means.
2. Cap affected areas - hand work: Assume 10% of total cap fill materials will be placed by hand, price from Means.
3. Cap materials
   a) Sand, delivered: based on cap design, 1.5 ft total x 257,500 ft^2. Price from Means.
   b) Geomembrane: installed (257,500 ft^2), price based on quote from ACF, Inc. (5/00)
   c) Filter fabric, installed: (257,500 ft^2), price from Means.
   d) Topsoil, delivered: based on cap design (1 ft x 257,500 ft^2), price from means.
4. Compaction: volume = total amount of cap fill material, price from Means.
5. Grading: based on capped area (257,500 ft^2), price from Means.
6. Surveying: As-built survey of capped area (257,500 ft^2). Price from Means.

VII. Site Restoration
1. Backfill access areas: Assume 1 cy of fill (topsoil) needed for each access area, fill placed using bobcat/bulldozer, price from Means.
2. Topsoil: Assume 1 cy needed for each access area. Delivered, price from Means.
3. Grading: Assume using bulldozer/bobcat, price from Means, $3.24/sy = $0.36/sf.
4. Compaction: Assume using vibratory plate compactor, price from Means.
5. Hydroseed disturbed areas: Assume using Bluegrass #4, price from Means, $37/1,000 ft^2 = $1,627/acre. 257,500 ft^2 = 6 acres.
6. Final Clean-up: Price from Means.

VIII. Site Staffing

1. Site manager: to coordinate and direct site activities, price based on TtNUS rates.
2. Site supervisor/foreman: to coordinate and direct site activities, price based on TtNUS rates.
3. Site engineer: to coordinate and direct site activities, price based on TtNUS rates, time.
4. Site safety officer: to coordinate and direct site activities, price based on TtNUS rates.

IX. POST REMOVAL SITE CONTROL

1. Assume quarterly site visits for a period of 30 years. Assume 8 hrs. per visit, site engineer rate listed in VIII. 3. Assume brush will be cleared from capped every two years: total area = 6 acres. Price for brush clearing from Means.

CENTERDALE MANOR EE/CA
COST ESTIMATE FOR ALTERNATIVE 2
Cap Residential Soils

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
I. PROJECT DOCUMENTS												
1. PDI Work Plan	2500	LS	0.00	0.00	30.00	0.00	0	0	75,000	0	75,000	
2. Permitting	500	HR	0.00	0.00	30.00	0.00	0	0	15,000	0	15,000	
II. PRE-DESIGN INVESTIGATION												
1. Limited soil sampling	50	EA	0.00	0.00	77.00	0.00	0	0	3,850	0	3,850	
2. Soil analysis	50	EA	250.00	0.00	0.00	0.00	12,500	0	0	0	12,500	
III. MOBILIZATION/DEMOBILIZATION												
1. Office Trailer	6	MO	215.00	0.00	0.00	0.00	1,290	0	0	0	1,290	m98-015-904-0350 & 0700
2. Storage Trailer	30	MO	95.00	0.00	0.00	0.00	2,850	0	0	0	2,850	m98-015-904-1350
3. Portable Communication Equipment, 4 sets	6	MO	400.00	0.00	0.00	0.00	2,400	0	0	0	2,400	
4. Equipment Mobilization/Demobilization	1	LS	2,492.00	0.00	0.00	0.00	2,492	0	0	0	2,492	m98-022-274-0020
5. Materials Mobilization/Demobilization	1	LS	500.00	0.00	0.00	0.00	500	0	0	0	500	
6. Site Utilities	6	MO	300.00	0.00	0.00	0.00	1,800	0	0	0	1,800	elec., phone, water
7. Security	6	MO	3,600.00	0.00	0.00	0.00	21,600	0	0	0	21,600	12 hrs./day, $10/hr.
8. Sanitary Facilities (2)	6	MO	240.00	0.00	0.00	0.00	1,440	0	0	0	1,440	m98-016-420-6410
9. Decontamination Trailer	6	MO	2,250.00	0.00	0.00	0.00	13,500	0	0	0	13,500	e2000-33-17-0822
10. Dumpster	6	MO	1,100.00	0.00	0.00	0.00	6,600	0	0	0	6,600	m98-020-620-0600
IV. DECONTAMINATION												
1. Decontamination equipment/fluids	1	LS	0.00	100.00	0.00	0.00	0	100	0	0	100	
2. Decontamination water	660	GAL	0.00	0.20	0.00	0.00	0	132	0	0	132	
3. Drums (spent fluids storage)	12	EA	0.00	60.06	0.00	0.00	0	721	0	0	721	m98-33-19-0401
4. Disposal of decontamination wastewater, drums	12.00	EA	2,200.00	0.00	0.00	0.00	26,400	0	0	0	26,400	vendor quote
V. SITE PREPARATION												
1. Site construction survey	6.0	AC	1,248.00	0.00	0.00	0.00	7,488	0	0	0	7,488	m98-013-306-0100
2. Clear brush and trees (to 6" diam) and chip	6.0	AC	2,200.00	0.00	0.00	0.00	13,200	0	0	0	13,200	m98-021-104-0010
3. Grub stumps and remove	6.0	AC	1,069.00	0.00	0.00	0.00	6,414	0	0	0	6,414	m98-021-104-0150
4. Erosion controls, silt fences	3415	LF	0.00	0.23	1.11	0.00	0	785	3,791	0	4,576	m98-18-05-0206
5. Dust suppression (watering) per acre-pass	1044	MSF	1.09	0.00	0.00	0.00	1,138	0	0	0	1,138	m98-33-08-0585
6. Establish stockpile/staging areas	1	LS	5,000.00	0.00	0.00	0.00	5,000	0	0	0	5,000	
7. Install snow fence, perimeter of work areas	3415	LF	0.00	1.55	1.02	0.00	0	5,293	3,483	0	8,777	m98-028-320-5000
8. Dismantle fencing	550	LF	1.45	0.00	0.00	0.00	798	0	0	0	798	m98-020-554-0755
9. Access route improvements, lay plywood	7040	SF	0.00	0.42	0.35	0.00	0	2,957	2,464	0	5,421	m98-015-552-2500
VI. CAP												
1. Cap impacted soils/sediment - mechanical	21465	CY	1.13	0.00	0.00	0.00	24,255	0	0	0	24,255	m98-022-262-0010
2. Cap impacted soils/sediment - hand work	2385	CY	13.75	0.00	0.00	0.00	32,794	0	0	0	32,794	m98-022-262-0100
3. Cap materials												
a) Sand, delivered (1.5 ft total x 257,500 ft^2)	14310	CY	18.50	0.00	0.00	0.00	264,735	0	0	0	264,735	m98-041-032-0250
b) Geomembrane, installed (257,500 ft^2)	28615	SY	0.00	3.87	10.44	0.00	0	110,740	298,741	0	409,481	e2000-33 08 0544
c) Filter fabric, installed (257,500 ft^2)	28615	SY	0.00	0.64	0.37	0.00	0	18,314	10,588	0	28,901	e2000-33 08 0532
d) Topsoil, delivered (1 ft x 257,500 ft^2)	9540	CY	14.00	0.00	0.00	0.00	133,560	0	0	0	133,560	m98-022-216-7000
4. Compaction	23850	CY	0.99	0.00	0.00	0.00	23,612	0	0	0	23,612	m98-R022-220
5. Grading	257500	SF	0.36	0.00	0.00	0.00	92,700	0	0	0	92,700	e2000-17-03-0101
6. Surveying (257,500 ft^2)	6.0	AC	1,248.00	0.00	0.00	0.00	7,488	0	0	0	7,488	m98-013-306-0100

Item	Qty	Unit	Unit Cost ($) Sub.	Mat.	Labor	Equip.	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
VII. SITE RESTORATION												
1. Restore access areas, backfill	11	CY	1.13	0.00	0.00	0.00	12	0	0	0	12	m98-022-262-0010
2. Topsoil	11	CY	14.00	0.00	0.00	0.00	154	0	0	0	154	m98-022-216-7000
3. Grading	11000	SF	0.36	0.00	0.00	0.00	3,960	0	0	0	3,960	e2000-17-03-0101
4. Compaction	11	CY	0.99	0.00	0.00	0.00	11	0	0	0	11	m98-R022-220
5. Hydroseed disturbed areas	6.0	AC	1,627.00	0.00	0.00	0.00	9,762	0	0	0	9,762	m98-029-308-1000
6. Final Clean-up	1.0	LS	1,000.00	0.00	0.00	0.00	1,000	0	0	0	1,000	e98-017-104-0010
VIII. SITE STAFFING												
1. Site manager	1040	HR	0.00	0.00	37.00	0.00	0	0	38,480	0	38,480	
2. Site supervisor/foreman	1040	HR	0.00	0.00	30.00	0.00	0	0	31,200	0	31,200	
3. Site engineer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
4. Site safety officer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
IX. POST REMOVAL SITE CONTROL												
1. Quarterly site visits for 30 years, brush clearing every 2 years	1	LS	48,557.00	0.00	9,530.00	0.00	48,557	0	9,530	0	58,087	from Table 4-2
SUBTOTAL DIRECT COST							770,009	139,042	542,046	0	1,451,097	
Direct Cost Adjustment Factors:												
Health and Safety on Labor and Equipment @ 5%							0	0	27,102	0	27,102	
Indirect Cost Adjustment Factors:												
Tax on materials @ 7%							0	9,733	0	0	9,733	
G&A @ 10% of Equipment, Material, and Labor							0	13,904	54,205	0	68,109	
Labor Overhead @ .95%							0	0	514,944	0	514,944	
Subcontract @ 10% of Sub. Cost							77,001	0	0	0	77,001	
Subtotal Direct and Indirect											2,147,986	
Subtotal Direct and Indirect (III. - VIII.)											1,863,726	
Engineering @ 6% of Subtotal Direct and Indirect (III. - VIII.)											111,824	
Home Office Mgmt. And Support @ 5% Direct and Indirect											107,399	
Subtotal Total Cost											2,367,209	
Contingency @ 10% of Total Cost											236,721	
TOTAL COST											2,603,930	

Alternative 3: Cap Residential Use Soils and Restore Allendale Dam

ASSUMPTIONS:

i. Cost estimating sources:

Means Heavy Construction Cost Data, 12th annual edition, R.S. Means Company, Inc., 1998.

Means Site Work & Landscape Cost Data, 17th annual edition, R.S. Means Company, Inc., 1998.

Means Environmental Remediation Cost Data, 6th annual edition, R.S. Means Company, Inc., 2000.

ii. Abbreviations: CF = cubic feet; CY = cubic yard; FT = feet; SF = square feet; SY = square yard; LF = linear feet; CLF = 100 linear feet; MSF = 1000 SF

iii. Use 1.5 tons/CY for soils/sludge/sediments

Estimated Time to Complete Removal Action

Once authorized to proceed, approximately one month will be required to prepare and implement the Pre-Design Investigation Work Plan. Another 6 months will be required to complete the Engineering, Design, Subcontracting, and Mobilization phases. The remaining site activities, including Demobilization, will be completed within one full construction season. Post Removal Site Control inspections will be conducted quarterly for a period of two years following completion of site activities.

Total site time (from mob to demob): 6 months

Total project duration (not including Post Removal Site Control): 13 months

Total project duration (including Post Removal Site Control): 37 months

Note: Total project duration does not include seasonal impacts or delays.

BASIS FOR COST ESTIMATE:

I. Project Documents
   1. PDI work Plan: Based on previous experience.
   2. Permitting: 500 hrs. @ $30/hr. based on previous experience and TtNUS labor rates.

II. Pre-Design Investigation
   1. Limited soil sampling: 11 residential properties x 12 samples at each = 132 samples. labor, equipment, and shipping costs: 12 samples per day, 2 persons (8 hrs. ea. @ $30/hr.), equipment ($200/day), vehicle ($40/day), shipping ($50/day), and weather contingency (20%) = $924 per 12 samples, or $77/sample.
   2. Soil analysis: 132 samples as described above, $250 for analysis.

III. Mobilization/Demobilization
   1. Office Trailer: from Means, 32' x 8', furnished, includes air conditioning.
   2. Storage Trailer: from Means, 28' x 10', assume storage trailer will remain present throughout implementation and Post Removal Site Control phase (6 mos. + 2 years = 30 mos.).
   3. Portable Communications Equipment (Radios): 4 sets, assume $400/mo. per set.

4. Equipment Mobilization/Demobilization: Bobcat/Bulldozer, Backhoe 580D, 10 wheel dump truck - from Means, $178 ea.; $534 (mob) + 534 (demob) = $1068.
5. Materials Mobilization: Based on previous experience.
6. Site Utilities: Assume (monthly) $75 x 2 for phone, $100 for electricity, $50 for water service = $300
7. Security: Assume 12 hours/day, 30 days/mo. @ $10/hour = $3,600/mo.
8. Sanitary Facilities: Assume 2 units, from Means, $120/mo. each
9. Decontamination Trailer: from Means, 8' x 36' with 2 showers.
10. Dumpster: includes weekly servicing, 6 CY capacity, price from Means.

IV. Decontamination

1. Decontamination equipment/fluids: based on previous experience.
2. Decontamination water: based on previous experience.
3. Drums (spent fluids storage): assume 12 drums, 55 gal., steel, price from Means.
4. Disposal of decontamination wastewater, drums: $2,200 per drum, based on vendor quote.

V. Site Preparation

1. Site construction survey: action area (17,500 ft^2) + dam restoration work area (185' x 230') = 60,050 ft^2 or 1.4 acres. From Means, $1,248/acre.
2. Clear brush and trees (to 6" diam) and chip: same area as item 1, price from Means.
3. Grub stumps and remove: same area as item 1, price from Means.
4. Erosion controls, silt fences: Installed on the downgradient side of each work area, approx. 1,100 lf. Price from Means.
5. Dust suppression (watering) per acre-pass: Construction area = 1.4 acres = 60,050 ft^2 = 60 msf. Assume 4 passes, 4 x 60 msf = 240 msf.
6. Establish stockpile/staging areas: 1 LS based on previous experience.
7. Install snow fence, perimeter of work areas minus areas where silt fence was installed (item 4): Perimeter of dam work area = 800', total perimeter of Residential use soil areas = 2,800'. Total = 2,800' + 800' - 1,100' (item 4) = 2,500'. Price from Means.
8. Dismantle fencing: Approx. 150 ft in dam work area, assume 50 ft at ea. of 7 (out of 11) properties where fence is present, 150 ft + 350 ft = 500 ft. Price from Means.
9. Access route improvements: Lay plywood (4' x 8' x .75") across lawns to prevent damage. Assume 20 needed per work area, 11 areas. 32 ft^2 ea. x 20 X 11 = 7,040 ft^2, price from Means.

VI. Excavation

1. Excavate affected areas - mechanical: Assume 50% of soils will be excavated by mechanical means using backhoe. 17,500 ft^2 x 2 ft. depth = 35,000 cf = 1,300 cy, subtract 50% = 650 cy. Price from Means, includes hauling to staging area at Site.
2. Excavate affected areas - hand work: Assume one half of soils will be excavated by hand, price from Means. 50% of 1,300 cy = 650 cy.
3. Backfill, topsoil: 1,300 cy. Price from Means, delivered.
4. Compaction: volume = total amount of backfill material, price from Means.
5. Grading: based on excavated area (17,500 ft^2), price from Means.
6. Surveying: As-built survey of excavated area (17,500 ft^2). Price from Means.
7. Dewatering: Assume using a vacuum truck 2 days at each of 11 properties = 22 days. Assume using filtration system outlined in VII. 4. (system will be shared).

VII. Dam Restoration

1. COE Estimate: $392,300 - $6,700 = $385,600 x 1.023 x 1.023 x 1.023 = $412,823. TtNUS modification does not call for gravel fill cofferdam, therefore subtract $6,700 from COE estimate. COE estimate dated June 1997. Engineering News Record (ENR) Construction Cost Index indicates an approximate 2.3% annual increase in construction costs (based on 1998 and 1999 data). Therefore, update cost 2.3% per year for 3 years.
2. TtNUS Modifications
   a) Sheet pile cell cofferdam and backfill: 6,100 sf of sheet pile required, $14.87/sf for materials and labor (price from means), 936 cy gravel fill needed, $5.18/cy for materials (price from means: e2000-17-03-0430). 6,100 x $14.87 + 936 x $5.18 = $95,600.

b) Additional excavation required to implement TtNUS modification: total = 1,100 cy. COE estimated 860 cy. 1,100 cy - 860 cy = 240 cy difference. 240 cy x ($9.88/cy x 1.023 x 1.023 x 1.023) = $2,539. Price per cy based on COE estimate plus 2.3%/yr. cost adjustment discussed in VII.1.

c) Total = $95,600 + $2,539 = $98,139.

3. Disposal of excavated soil/sediment as hazardous waste: Assume excavated material can be segregated, assume 25% of material is hazardous. 25% of 1,100 cy = 275 cy. 275 cy x 1.5 ton/cy = 415 tons.
   a) Transport and disposal - Option 1, based on using 15 yd dump truck to transport soil 3 miles, unload, spread, and cap. Price based on per unit cap items listed in Alternative I, Item VI. and transportation price from Means, $47/cy (e2000-33-19-0209). Assume cap will be placed using mechanical means.
   b) Transport and disposal - Option 2, based on vendor quote, does not include analytical testing for disposal purposes.
   c) Transport and disposal - Option 3, based on vendor quote, does not include analytical testing for disposal purposes.
4. Dewatering: System consists of 25 gpm sump pump used to remove water from excavation into a 21,000 gal. frac tank. Water then pumped from frac tank through a pre-filter and filter into a second 21,000 gallon frac tank. Assume use of 4 filter cartridges (1 per month) and 16 pre-filters (1 per week). Water tested prior to discharge back into Allendale Pond or to POTW. Two systems to be used.

VIII. Disposal

1. Contaminated soil from VI.
   a) Transport and disposal - Option 1, based on using 15 yd dump truck to transport soil 3 miles, unload, spread, and cap. Price based on per unit cap items listed in VI. of Alternative 1 and transportation price from Means, $47/cy (e2000-33-19-0209). Assume cap will be placed using mechanical means.
   b) Transport and disposal - Option 2, based on vendor quote, does not include analytical testing for disposal purposes.
   c) Transport and disposal - Option 3, based on vendor quote, does not include analytical testing for disposal purposes.

IX. Site Restoration

1. Backfill access areas: Assume 1 cy required for each of the 11 access areas, place using bobcat/bulldozer, price from Means.
2. Topsoil: Delivered, price from Means.
3. Grading: Assume using bulldozer/bobcat, price from Means, $3.24/sy = $0.36/sf.
4. Compaction: Assume using vibratory plate compactor, price from Means.
5. Hydroseed disturbed areas: Assume using Bluegrass #4, price from Means, $37/1,000 ft^2 = $1,627/acre. 17,500 ft^2 = 0.40 acres.
6. Final Clean-up: Price from Means.

X. Site Staffing

1. Site manager: to coordinate and direct site activities, price based on TtNUS rates.
2. Site supervisor/foreman: to coordinate and direct site activities, price based on TtNUS rates.
3. Site engineer: to coordinate and direct site activities, price based on TtNUS rates, time.
4. Site safety officer: to coordinate and direct site activities, price based on TtNUS rates.

XI. POST REMOVAL SITE CONTROL

1. Assume quarterly site visits for a period of 30 years. Assume 8 hrs. per visit, site engineer rate listed in X. 3. Assume brush will be cleared in the vicinity of the dam every two years: total area = 0.25 acres. Price for brush clearing from Means.

CENTERDALE MANOR EE/CA
COST ESTIMATE FOR ALTERNATIVE 3
Excavate Residential Soils and Restore Dam

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
I. PROJECT DOCUMENTS												
1. PDI Work Plan	2500	LS	0.00	0.00	30.00	0.00	0	0	75,000	0	75,000	
2. Permitting	500	HR	0.00	0.00	30.00	0.00	0	0	15,000	0	15,000	
II. PRE-DESIGN INVESTIGATION												
1. Limited soil sampling	132	EA	0.00	0.00	77.00	0.00	0	0	10,164	0	10,164	
2. Soil analysis	132	EA	250.00	0.00	0.00	0.00	33,000	0	0	0	33,000	
III. MOBILIZATION/DEMOBILIZATION												
1. Office Trailer	6	MO	215.00	0.00	0.00	0.00	1,290	0	0	0	1,290	m98-015-904-0350 & 0700
2. Storage Trailer	30	MO	95.00	0.00	0.00	0.00	2,850	0	0	0	2,850	m98-015-904-1350
3. Portable Communication Equipment, 4 sets	6	MO	400.00	0.00	0.00	0.00	2,400	0	0	0	2,400	
4. Equipment Mobilization/Demobilization	1	LS	1,068.00	0.00	0.00	0.00	1,068	0	0	0	1,068	m98-022-274-0020
5. Materials Mobilization/Demobilization	1	LS	500.00	0.00	0.00	0.00	500	0	0	0	500	
6. Site Utilities	6	MO	300.00	0.00	0.00	0.00	1,800	0	0	0	1,800	elec., phone, water
7. Security	6	MO	3,600.00	0.00	0.00	0.00	21,600	0	0	0	21,600	12 hrs./day, $10/hr.
8. Sanitary Facilities (2)	6	MO	240.00	0.00	0.00	0.00	1,440	0	0	0	1,440	m98-016-420-6410
9. Decontamination Trailer	6	MO	2,250.00	0.00	0.00	0.00	13,500	0	0	0	13,500	e2000-33-17-0822
10. Dumpster	6	MO	1,100.00	0.00	0.00	0.00	6,600	0	0	0	6,600	m98-020-620-0600
IV. DECONTAMINATION												
1. Decontamination equipment/fluids	1	LS	0.00	100.00	0.00	0.00	0	100	0	0	100	
2. Decontamination water	660	GAL	0.00	0.20	0.00	0.00	0	132	0	0	132	
3. Drums (spent fluids storage)	12	EA	0.00	60.06	0.00	0.00	0	721	0	0	721	m98-33-19-0401
4. Decontamination water disposal, drums	12	EA	2,200.00	0.00	0.00	0.00	26,400	0	0	0	26,400	facility quote
V. SITE PREPARATION												
1. Site construction survey	1.4	AC	1,248.00	0.00	0.00	0.00	1,747	0	0	0	1,747	m98-013-306-0100
2. Clear brush and trees (to 6" diam) and chip	1.4	AC	2,200.00	0.00	0.00	0.00	3,080	0	0	0	3,080	m98-021-104-0010
3. Grub stumps and remove	1.4	AC	1,069.00	0.00	0.00	0.00	1,497	0	0	0	1,497	m98-021-104-0150
4. Erosion controls, silt fences	1100	LF	0.00	0.23	1.11	0.00	0	253	1,221	0	1,474	m98-18-05-0206
5. Dust suppression (watering) per acre-pass	240	MSF	1.09	0.00	0.00	0.00	262	0	0	0	262	m98-33-08-0585
6. Establish stockpile/staging areas	1	LS	5,000.00	0.00	0.00	0.00	5,000	0	0	0	5,000	
7. Install snow fence, perimeter of work areas	2500	LF	0.00	1.55	1.02	0.00	0	3,875	2,550	0	6,425	m98-028-320-5000
8. Dismantle fencing	500	LF	1.45	0.00	0.00	0.00	725	0	0	0	725	m98-020-554-0755
9. Access route improvements, lay plywood	7040	SF	0.00	0.42	0.35	0.00	0	2,957	2,464	0	5,421	m98-015-552-2500
VI. EXCAVATION												
1. Excavate impacted soils/sediments - mechanical	650	CY	6.59	0.00	0.00	0.00	4,284	0	0	0	4,284	m98-A12.1-414-1000
2. Excavate impacted soils/sediments - hand work	650	CY	32.36	0.00	0.00	0.00	21,034	0	0	0	21,034	e2000-17-03-0211
3. Topsoil, delivered	1300	CY	14.00	0.00	0.00	0.00	18,200	0	0	0	18,200	m98-022-216-7000
4. Compaction	1300	CY	0.99	0.00	0.00	0.00	1,287	0	0	0	1,287	m98-R022-220
5. Grading (17,500 ft^2)	17500	SF	0.36	0.00	0.00	0.00	6,300	0	0	0	6,300	e2000-17-03-0101
6. Surveying (17,500 ft^2)	0.40	AC	1,248.00	0.00	0.00	0.00	562	0	0	0	562	m98-013-306-0100
7. Dewatering	22	DAY	765.00	0.00	0.00	0.00	16,830	0	0	0	16,830	e2000-33-19-0273

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
VII. DAM RESTORATION												
1. US ACOE Estimate	1	LS	412,823.00	0.00	0.00	0.00	412,823	0	0	0	412,823	
2. TtNUS Modifications	1	LS	98,139.00	0.00	0.00	0.00	98,139	0	0	0	98,139	
3. Disposal of sediments/soil as hazardous waste												
a) Transport, spread, cap - Option 1	415	TON	71.00	0.00	0.00	0.00	29,465	0	0	0	29,465	cap unit costs (Alt. 1 - VI)
b) Transport and disposal - Option 2	415	TON	222.00	0.00	0.00	0.00	92,130	0	0	0	92,130	facility quote
c) Transport and disposal - Option 3	415	TON	310.00	0.00	0.00	0.00	128,650	0	0	0	128,650	facility quote
4. Dewatering	1	LS	27,724.00	0.00	0.00	0.00	27,724	0	0	0	27,724	
VIII. DISPOSAL												
1. Impacted soils/sediments from VI.												
a) Transport, spread, cap - Option 1	1950	TON	71.00	0.00	0.00	0.00	138,450	0	0	0	138,450	cap unit costs (Alt. 1 - VI)
b) Transport and disposal - Option 2	1950	TON	222.00	0.00	0.00	0.00	432,900	0	0	0	432,900	facility quote
c) Transport and disposal - Option 3	1950	TON	310.00	0.00	0.00	0.00	604,500	0	0	0	604,500	facility quote
IX. SITE RESTORATION												
1. Restore access areas, backfill	11	CY	1.13	0.00	0.00	0.00	12	0	0	0	12	m98-022-262-0010
2. Topsoil	11	CY	14.00	0.00	0.00	0.00	154	0	0	0	154	m98-022-216-7000
3. Grading	11000	SF	0.36	0.00	0.00	0.00	3,960	0	0	0	3,960	e2000-98-17-03-0101
4. Compaction	11	CY	0.99	0.00	0.00	0.00	11	0	0	0	11	m98-R022-220
5. Hydroseed disturbed areas	0.40	AC	1,627.00	0.00	0.00	0.00	651	0	0	0	651	m98-029-308-1000
6. Final Clean-up	1.0	LS	1,000.00	0.00	0.00	0.00	1,000	0	0	0	1,000	e98-017-104-0010
X. SITE STAFFING												
1. Site manager	1040	HR	0.00	0.00	37.00	0.00	0	0	38,480	0	38,480	
2. Site supervisor/foreman	1040	HR	0.00	0.00	30.00	0.00	0	0	31,200	0	31,200	
3. Site engineer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
4. Site safety officer	1040	HR	0.00	0.00	24.00	0.00	0	0	24,960	0	24,960	
XI. POST REMOVAL SITE CONTROL												
1. Quarterly site visits for 30 years, brush clearing every 2 years	1	LS	2,023.00	0.00	9,530.00	0.00	2,023	0	9,530	0	11,553	from Table 4-3

		Total ($)				Total ($)
		Sub.	Mat.	Labor	Equip.	
SUBTOTAL DIRECT COST	Disposal Option 1	907,667	8,038	235,529	0	1,151,233
	Disposal Option 2	1,264,782	8,038	235,529	0	1,508,348
	Disposal Option 3	1,472,902	8,038	235,529	0	1,716,468
Direct Cost Adjustment Factors:						
Health and Safety on Labor and Equipment @ 5%	Disposal Option 1-3	0	0	11,776	0	11,776
Indirect Cost Adjustment Factors:						
Tax on materials @ 7%	Disposal Option 1-3	0	563	0	0	563
G&A @ 10% of Equipment, Material, and Labor	Disposal Option 1-3	0	804	23,553	0	24,357
Labor Overhead @ 95%	Disposal Option 1-3	0	0	223,753	0	223,753

Disp Option 1	Disp Option 2	Disp Option 3
Subcontract @ 10% of Sub. Cost	90,767	126,478	147,290
Subtotal Direct and Indirect	1,502,448	1,895,275	2,124,207
Subtotal Direct and Indirect (III. - X.)	1,233,585	1,626,392	1,855,324
Engineering @ 6% of Subtotal Direct and Indirect (III. - X.)	74,014	97,584	111,319
Home Office Mgmt. And Support @ 5% Direct and Indirect	75,122	94,764	106,210
Subtotal Total Cost	1,651,584	2,087,822	2,341,736
Contingency @ 10% of Total Cost	165,158	208,762	234,174
TOTAL COST	**1,816,743**	**2,296,384**	**2,575,910**

Note: Disposal Option 1: Transport to capped area at Centerdale Manor Site and cap.
Disposal Option 2: Stabilization and disposal at Stablex Facility, Canada.
Disposal Option 3: Incineration and disposal at Bennett Environmental Facility, Canada (includes required disposal analysis).

Alternative 4: Excavate Residential Use Soils

ASSUMPTIONS:

i. Cost estimating sources:

Means Heavy Construction Cost Data, 12th annual edition, R.S. Means Company, Inc., 1998.

Means Site Work & Landscape Cost Data, 17th annual edition, R.S. Means Company, Inc., 1998.

Means Environmental Remediation Cost Data, 6th annual edition, R.S. Means Company, Inc., 2000.

ii. Abbreviations: CF = cubic feet; CY = cubic yard; FT = feet; SF = square feet; SY = square yard; LF = linear feet; CLF = 100 linear feet; MSF = 1000 SF

iii. Use 1.5 tons/CY for soils/sludge/sediments

Estimated Time to Complete Removal Action

Once authorized to proceed, approximately one month will be required to prepare and implement the Pre-Design Investigation Work Plan. Another 6 months will be required to complete the Engineering, Design, Subcontracting, and Mobilization phases. The remaining site activities, including Demobilization, will be completed within one full construction season. Post Removal Site Control inspections will be conducted quarterly for a period of two years following completion of site activities.

Total site time (from mob to demob): 9 months

Total project duration (not including Post Removal Site Control): 16 months

Total project duration (including Post Removal Site Control): 40 months

Note: Total project duration does not include seasonal impacts or delays.

BASIS FOR COST ESTIMATE:

I. Project Documents
   1. PDI work Plan: Based on previous experience.
   2. Permitting: 500 hrs. @ $30/hr. based on previous experience and TtNUS labor rates.

II. Pre-Design Investigation
   1. Limited soil sampling: 11 residential properties x 12 samples at each = 132 samples. labor, equipment, and shipping costs: 12 samples per day, 2 persons (8 hrs. ea. @ $30/hr.), equipment ($200/day), vehicle ($40/day), shipping ($50/day), and weather contingency (20%) = $924 per 12 samples, or $77/sample.
   2. Soil analysis: 132 samples as described above, $250 for analysis.

III. Mobilization/Demobilization
   1. Office Trailer: from Means, 32' x 8', furnished, includes air conditioning.
   2. Storage Trailer: from Means, 28' x 10', assume storage trailer will remain present throughout implementation and Post Removal Site Control phase (9 mos. + 2 years = 33 mos.).
   3. Portable Communications Equipment (Radios): 4 sets, assume $400/mo. per set.

4. Equipment Mobilization/Demobilization: 1 10-wheel dump truck, 2 Bobcat/Bulldozers, 2 Front End Loaders, 2 Excavators - from Means, $178 ea.; $1,246 (mob) + $1,246 (demob) = $2,492.
5. Materials Mobilization: Based on previous experience.
6. Site Utilities: Assume (monthly) $75 x 2 for phone, $100 for electricity, $50 for water service = $300
7. Security: Assume 12 hours/day, 30 days/mo. @ $10/hour = $3,600/mo.
8. Sanitary Facilities: Assume 2 units, from Means, $120/mo. each
9. Decontamination Trailer: from Means, 8' x 36' with 2 showers.
10. Dumpster: includes weekly servicing, 6 CY capacity, price from Means.

IV. Decontamination
1. Decontamination equipment/fluids: based on previous experience.
2. Decontamination water: based on previous experience.
3. Drums (spent fluids storage): assume 12 drums, 55 gal., steel, price from Means.
4. Disposal of decontamination wastewater, drums: $2,200 per drum, based on vendor quote.

V. Site Preparation
1. Site construction survey: action area = 257,500 ft^2 or 6 acres. From Means, $1,248/acre.
2. Clear brush and trees (to 6" diam) and chip: same area as item 1, price from Means.
3. Grub stumps and remove: same area as item 1, price from Means.
4. Erosion controls, silt fences: Installed on the downgradient side of each work area, approx. 3,415 lf. Price from Means.
5. Dust suppression (watering) per acre-pass: Construction area = 6 acres = 261,000 ft^2 = 261 msf. Assume 4 passes, 4 x 261 msf = 1,044 msf.
6. Establish stockpile/staging areas: 1 LS based on previous experience.
7. Install snow fence, perimeter of work areas minus areas where silt fence was installed (item 4): Assume remaining perimeter is same as linear footage listed in Item No. 4., 3,415 lf. Price from Means.
8. Dismantle fencing: Assume 50 lf of fencing will require dismantling in 11 locations to allow access to work areas. Price from Means.
9. Access route improvements: Lay plywood (4' x 8' x .75") across lawns to prevent damage. Assume 20 needed per work area, 11 areas. 32 ft^2 ea. x 20 x 11 = 7,040 ft^2, price from Means.

VI. Excavation
1. Excavate affected areas - mechanical: Assume 90% of soils will be excavated by mechanical means using backhoe. 257,500 ft^2 x 2 ft. depth = 515,000 cf = 19,075 cy, subtract 10% = 17,170 cy. Price from Means, includes hauling to staging area at Site.
2. Excavate affected areas - hand work: Assume 10% of soils will be excavated by hand, price from Means. 10% of 19,075 cy = 1,910 cy.
3. Backfill, topsoil: Assume 50% of backfill is topsoil. 19,075 x .5 = 9,540 cy. Price from Means, delivered.
4. Backfill, gravel: Assume 50% of backfill is gravel. 19,075 x .5 = 9,540 cy. Price from Means, delivered.
5. Compaction: Volume = total amount of backfill material = 19,075 cy. Price from Means.
6. Grading: Based on excavated area (257,500 ft^2), price from Means.
7. Surveying: As-built survey of excavated area (257,500 ft^2). Price from Means.
8. Dewatering: Water removed from excavations and pumped into four 21,000-gallon frac tanks. Water then pumped from frac tanks through pre-filter and filter and into 4 additional 21,000-gallon frac tanks. Assume vacuum truck(s) needed intermittently, total = 22 days. Water tested prior to discharge back into Allendale Pond or to POTW. Assume use of 8 filter cartridges (1 per month) and 32 pre-filters (1 per week).

VII. Disposal
1. Disposal of contaminated soil/sediment from VI:
   a) Transport and disposal - Option 1, based on using 15 yd dump truck to transport soil 3 miles, unload, spread, and cap. Price based on per unit cap items listed in Alternative 1, Item VI.

and transportation price from Means, $47/cy (e2000-33-19-0209). Assume cap will be placed using mechanical means.

b) Transport and disposal - Option 2, based on vendor quote, does not include analytical testing for disposal purposes.

c) Transport and disposal - Option 3, based on vendor quote, does not include analytical testing for disposal purposes.

3. Decontamination wastewater, disposal of drums: price based on vendor quote, assume drums are classified as hazardous waste..

VIII. Site Restoration

1. Backfill access areas: Assume 1 cy needed for each of the 11 access areas, placed using bobcat/bulldozer, price from Means.
2. Topsoil: Assume 1 cy needed for each of the 11 access areas. Delivered, price from Means.
3. Grading: Assume 1,000 sf per access area will require grading, using bulldozer/bobcat, price from Means, $3.24/sy = $0.36/sf.
4. Compaction: Assume using vibratory plate compactor, price from Means.
5. Hydroseed disturbed areas: Assume using Bluegrass #4, price from Means, $37/1,000 ft^2 = $1,627/acre. 257,500 ft^2 = 6 acres.
6. Final Clean-up: Price from Means.

IX. Site Staffing

1. Site manager: to coordinate and direct site activities, price based on TtNUS rates, time = 9 mos.
2. Site supervisor/foreman: to coordinate and direct site activities, price based on TtNUS rates, time = 9 mos.
3. Site engineer: to coordinate and direct site activities, price based on TtNUS rates, time = 9 mos.
4. Site safety officer: to coordinate and direct site activities, price based on TtNUS rates, time = 9 mos.

CENTERDALE MANOR EE/CA
COST ESTIMATE FOR ALTERNATIVE 4
Excavate Residential Soils

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
I. PROJECT DOCUMENTS												
1. PDI Work Plan	2500	LS	0.00	0.00	30.00	0.00	0	0	75,000	0	75,000	
2. Permitting	500	HR	0.00	0.00	30.00	0.00	0	0	15,000	0	15,000	
II. PRE-DESIGN INVESTIGATION												
1. Limited soil sampling	132	EA	0.00	0.00	77.00	0.00	0	0	10,164	0	10,164	
2. Soil analysis	132	EA	250.00	0.00	0.00	0.00	33,000	0	0	0	33,000	
III. MOBILIZATION/DEMOBILIZATION												
1. Office Trailer	9	MO	215.00	0.00	0.00	0.00	1,935	0	0	0	1,935	m98-015-904-0350 & 0700
2. Storage Trailer	33	MO	95.00	0.00	0.00	0.00	3,135	0	0	0	3,135	m98-015-904-1350
3. Portable Communication Equipment, 4 sets	9	MO	400.00	0.00	0.00	0.00	3,600	0	0	0	3,600	
4. Equipment Mobilization/Demobilization	1	LS	2,492.00	0.00	0.00	0.00	2,492	0	0	0	2,492	m98-022-274-0020
5. Materials Mobilization/Demobilization	1	LS	500.00	0.00	0.00	0.00	500	0	0	0	500	
6. Site Utilities	9	MO	300.00	0.00	0.00	0.00	2,700	0	0	0	2,700	elec., phone, water
7. Security	9	MO	3,600.00	0.00	0.00	0.00	32,400	0	0	0	32,400	12 hrs./day, $10/hr.
8. Sanitary Facilities (2)	9	MO	240.00	0.00	0.00	0.00	2,160	0	0	0	2,160	m98-016-420-6410
9. Decontamination Trailer	9	MO	2,250.00	0.00	0.00	0.00	20,250	0	0	0	20,250	e2000-33-17-0822
10. Dumpster	9	MO	1,100.00	0.00	0.00	0.00	9,900	0	0	0	9,900	m98-020-620-0600
IV. DECONTAMINATION												
1. Decontamination equipment/fluids	1	LS	0.00	100.00	0.00	0.00	0	100	0	0	100	
2. Decontamination water	660	GAL	0.00	0.20	0.00	0.00	0	132	0	0	132	
3. Drums (spent fluids storage)	12	EA	0.00	60.06	0.00	0.00	0	721	0	0	721	m98-33-19-0401
4. Decontamination water disposal, drums	12	EA	2,200.00	0.00	0.00	0.00	26,400	0	0	0	26,400	facility quote
V. SITE PREPARATION												
1. Site construction survey	6.0	AC	1,248.00	0.00	0.00	0.00	7,488	0	0	0	7,488	m98-013-306-0100
2. Clear brush and trees (to 6" diam) and chip	6.0	AC	2,200.00	0.00	0.00	0.00	13,200	0	0	0	13,200	m98-021-104-0010
3. Grub stumps and remove	6.0	AC	1,069.00	0.00	0.00	0.00	6,414	0	0	0	6,414	m98-021-104-0150
4. Erosion controls, silt fences	3415	LF	0.00	0.23	1.11	0.00	0	785	3,791	0	4,576	m98-18-05-0206
5. Dust suppression (watering) per acre-pass	260	MSF	1.09	0.00	0.00	0.00	283	0	0	0	283	m98-33-08-0585
6. Establish stockpile/staging areas	1	LS	5,000.00	0.00	0.00	0.00	5,000	0	0	0	5,000	
7. Install snow fence, perimeter of work areas	3415	LF	0.00	1.55	1.02	0.00	0	5,293	3,483	0	8,777	m98-028-320-5000
8. Dismantle fencing	500	LF	1.45	0.00	0.00	0.00	725	0	0	0	725	m98-020-554-0755
9. Access route improvements, lay plywood	7040	SF	0.00	0.42	0.35	0.00	0	2,957	2,464	0	5,421	m98-015-552-2500
VI. EXCAVATION												
1. Excavate impacted soils/sediment - mechanical	17170	CY	6.59	0.00	0.00	0.00	113,150	0	0	0	113,150	m98-A12.1-414-1000
2. Excavate impacted soils/sediment - hand work	1910	CY	32.36	0.00	0.00	0.00	61,808	0	0	0	61,808	e2000-17-03-0211
3. Topsoil, delivered	9540	CY	14.00	0.00	0.00	0.00	133,560	0	0	0	133,560	m98-022-216-7000
4. Gravel, delivered	9540	CY	5.18	0.00	0.00	0.00	49,417	0	0	0	49,417	e2000-17-03-0430
5. Compaction	19075	CY	0.99	0.00	0.00	0.00	18,884	0	0	0	18,884	m98-R022-220
6. Grading	257500	SF	0.36	0.00	0.00	0.00	92,700	0	0	0	92,700	e2000-17-03-0101
7. Surveying (257,500 ft^2)	6.0	AC	1,248.00	0.00	0.00	0.00	8,112	0	0	0	8,112	m98-013-306-0100
8. Dewatering	1	LS	89,108.00	0.00	0.00	0.00	89,108	0	0	0	89,108	

Item	Qty	Unit	Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
VII. DISPOSAL												
1. Impacted soil/sediment from VI.												
a) Transport, spread, cap - Option 1	28615	TON	71.00	0.00	0.00	0.00	2,031,665	0	0	0	2,031,665	cap unit costs (Alt. 1 - VI)
b) Transport and disposal - Option 2	28615	TON	222.00	0.00	0.00	0.00	6,352,530	0	0	0	6,352,530	facility quote
c) Transport and disposal - Option 3	28615	TON	310.00	0.00	0.00	0.00	8,870,650	0	0	0	8,870,650	facility quote
VIII. SITE RESTORATION												
1. Restore access areas, backfill	11	CY	1.13	0.00	0.00	0.00	12	0	0	0	12	m98-022-262-0010
2. Topsoil	11	CY	14.00	0.00	0.00	0.00	154	0	0	0	154	m98-022-216-7000
3. Grading	11000	SF	0.36	0.00	0.00	0.00	3,960	0	0	0	3,960	e2000-98-17-03-0101
4. Compaction	11	CY	0.99	0.00	0.00	0.00	11	0	0	0	11	m98-R022-220
5. Hydroseed disturbed areas	6.0	AC	1,627.00	0.00	0.00	0.00	9,762	0	0	0	9,762	m98-029-308-1000
6. Final Clean-up	1.0	LS	1,000.00	0.00	0.00	0.00	1,000	0	0	0	1,000	e98-017-104-0010
IX. SITE STAFFING												
1. Site manager	1560	HR	0.00	0.00	37.00	0.00	0	0	57,720	0	57,720	
2. Site supervisor/foreman	1560	HR	0.00	0.00	30.00	0.00	0	0	46,800	0	46,800	
3. Site engineer	1560	HR	0.00	0.00	24.00	0.00	0	0	37,440	0	37,440	
4. Site safety officer	1560	HR	0.00	0.00	24.00	0.00	0	0	37,440	0	37,440	

		Total ($)				Total ($)
		Sub.	Mat.	Labor	Equip.	
SUBTOTAL DIRECT COST						
	Disposal Option 1	2,784,886	9,988	289,302	0	3,084,176
	Disposal Option 2	7,105,751	9,988	289,302	0	7,405,041
	Disposal Option 3	9,623,871	9,988	289,302	0	9,923,161
Direct Cost Adjustment Factors:						
Health and Safety on Labor and Equipment @ 5%	Disposal Option 1-3	0	0	14,465	0	14,465
Indirect Cost Adjustment Factors:						
Tax on materials @ 7%	Disposal Option 1-3	0	699	0	0	699
G&A @ 10% of Equipment, Material, and Labor	Disposal Option 1-3	0	999	28,930	0	29,929
Labor Overhead @ 95%	Disposal Option 1-3	0	0	274,837	0	274,837

Disp Option 1	Disp Option 2	Disp Option 3
278,489	710,575	962,387
3,682,595	8,435,546	11,205,478
3,435,951	8,188,902	10,958,834
206,157	491,334	657,530
184,130	421,777	560,274
4,072,882	9,348,658	12,423,282
407,288	934,866	1,242,328
4,480,170	**10,283,524**	**13,665,611**

Subcontract @ 10% of Sub. Cost

Subtotal Direct and Indirect

Subtotal Direct and Indirect (III. - IX.)

Engineering @ 6% of Subtotal Direct and Indirect (III. - IX.)

Home Office Mgmt. And Support @ 5% Direct and Indirect

Subtotal Total Cost

Contingency @ 10% of Total Cost

TOTAL COST

Note: Disposal Option 1: Transport to capped area at Centerdale Manor Site and cap.
Disposal Option 2: Stabilization and disposal at Stablex Facility, Canada.
Disposal Option 3: Incineration and disposal at Bennett Environmental Facility, Canada (includes required disposal analysis).

APPENDIX G

APPROVAL MEMORANDUM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
1 CONGRESS STREET, BOSTON, MA 02114

DATE: January 26, 2000

SUBJ: Centredale Manor Restoration Project Superfund Site - Approval Memorandum to perform an Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action

FROM: Anna Krasko, Remedial Project Manager NH/RI Superfund Section

THRU: Larry Brill, Chief
Office of Site Remediation and Restoration I

Rich Cavagnero, Chief
Emergency Planning and Response Branch

TO: Patricia L. Meaney, Director
Office of Site Remediation and Restoration

I. Subject

Investigations by the United States Environmental Protection Agency (EPA) and the Rhode Island Department of Environmental Management (RIDEM) have determined that there has been a release of hazardous substances to the environment at the Centredale Manor Restoration Project Superfund Site (the Site) in North Providence, Rhode Island. This Site was proposed for listing on the National Priorities List (NPL) on October 22, 1999, with the concurrence of the Governor of Rhode Island.

This memorandum documents the decision to proceed with two Engineering Evaluation/Cost Analyses (EE/CAs) for two non-time critical removal actions (NTCRAs) at the Site. The first EE/CA will address contaminated soils in the primarily residential parcels located in the floodplain of the Woonasquatucket River southerly from Route 44 (sampling analysis currently available shows that impacted residential parcels at the Site are primarily on the east side of Allendale Pond). The second EE/CA will address contaminants in the Woonasquatucket River

sediment and soils in its floodplain, including but not limited to the Allendale Pond and the Lymansville Pond areas. This approval memorandum authorizes the expenditure of federal funds for the EE/CAs. EPA is now in the process of conducting a remedial investigation and feasibility study to evaluate the full nature and extent of the contamination at the Site not already addressed by ongoing EPA time-critical removal activities or by these EE/CAs.

The decision to proceed with two EE/CAs is consistent with EPA guidance regarding Superfund Accelerated Cleanup Model (SACM) early actions and the long-term remedial strategy for this Site to minimize exposure to and migration of contaminants and to restore the River to its productive uses. This memorandum is not a final Agency decision regarding the selection of a response action for the Site.

II. Background

A. Site Description and History

The Centredale Manor Restoration Project Superfund Site is located in the town of North Providence, Providence County, Rhode Island. The Site consists of two parcels, 2072 and 2074 Smith Street (or, Plat 14, Lots 200 and 250, encompassing approximately 9.7 acres) and the Woonasquatucket River (including its floodplain) from Route 44 southerly to a point just below the Allendale Dam. The Woonasquatucket River runs along the western portion of parcels 2072 and 2074; a drainage swale runs along the eastern portion of the parcel 2074 until it discharges into the Woonasquatucket River in the southern portion of the property. The Woonasquatucket River widens at a point approximately 2,000 feet south of Route 44, where it becomes Allendale Pond. Allendale Pond ends at Allendale Dam. The Site consists of all contaminated areas within this area as well as any other location to which contamination from this area has come to be located, or from which this contamination originated.

2072 and 2074 Smith Street are zoned for residential occupancy and are occupied by the Brook Village and Centredale Manor Apartments, consisting of multi-story apartment buildings housing approximately 135 and 200 elderly residents, respectively. The remainder of the two parcels includes parking lots and landscaped areas with grass cover. Both parcels are located within the floodplain and flood periodically. Most of the properties within the floodplain downstream from the Site on the North Providence (east) side of the river are zoned residential with a few parcels zoned for commercial use. On the Johnston (west) side of the river, properties are primarily zoned for industrial/commercial use.

Prior to 1936, the properties were occupied by Centredale Worsted Mills, a woolens manufacturing plant. Atlantic Chemical Company, a chemical manufacturer, began operating on a portion of the Site in approximately 1940. Atlantic Chemical Company changed its name in 1953 to Metro-Atlantic, Inc. and operated until the late 1960s or early 1970s. In the late 1960s or

early 1970s, Metro-Atlantic, Inc., changed its name to Crown-Metro, Inc. The chemical company ceased operating in the early 1970s. New England Container Company operated a drum reconditioning facility on a portion of the Site from 1952 until approximately 1969. A major fire in the early 1970s destroyed most of the structures at the Site. In the 1970s, RIDOH conducted a number of investigations at the property in response to complaints of fires, odors and fumes. Evidence suggests that the operations of the chemical company and the drum reconditioning facility at the Site included disposal of wastes from the facilities on-site into the soil and directly into Woonasquatucket River and resulted in releases and threats of releases of hazardous substances at the Site. Disposal also may have occurred during the construction of the two apartment building located at the Site.

Analyses of soil, wetland and floodplain samples at the Site indicates elevated levels of a number of hazardous substances or pollutants or contaminants, including dioxin, polychlorinated biphenyls (PCBs), chlorobenzene, tetrachloroethylene, trichloroethlene, benzene, toluene, and xylene. There is also evidence in historical records, interviews of certain individuals, and geophysical surveys that buried drums may be present on the property. With respect to sources of dioxin releases, there are reports of hexachlorophene being manufactured by the chemical company operating at the Site and the burning of chemical residuals in drums being recycled at the Site.

From approximately 1970 to approximately 1986 the Rhode Island Department of Environmental Management (RIDEM) was involved in the inspection of the Site as well as oversight of response actions taken by others at the Site. Approximately 800 drums were observed by RIDEM representatives at the Site, some of which were visibly smoking. Many of these drums contained hazardous waste materials requiring off-site disposal; other (empty) drums were crushed and disposed of as non-hazardous. RIDEM also directed that soil unearthed at the Site be disposed of at a solid waste landfill.

The Brook Village apartment complex was built in approximately 1977.

In November 1981, a Notice of Violation and Order was issued by RIDEM to the then-property owners (Joseph Buonanno and Edward Ricci) for violations of the State Hazardous Waste Management Act requiring the property owners to immediately identify all hazardous material on-site, then dispose of all hazardous wastes off-site. EPA has not been able to determine if Buonanno and Ricci ever attempted to comply with this Order.

The Centredale Manor apartment complex was built in approximately 1982.

In August 1986, EPA's contractors conducted a Preliminary Assessment (PA) of the Centredale Manor property. The PA recommended a Screening Site Inspection, which was completed in October 1990. Soil sample analysis detected several volatile organic compounds (VOCs),

semivolatile organic compounds (SVOCs), pesticides, and two PCB cogeners (Aroclors 1242 and 1254).

In 1996, as part of the EPA Providence Urban Initiative Program, fish and eel tissue samples from the Woonasquatucket watershed were analyzed. This lead to a joint advisory from the Rhode Island Department of Health and EPA against eating fish and eels from the Woonasquatucket River, due to PCB, mercury, and dioxin contamination concerns.

In June 1998, EPA initiated an Expanded Site Inspection (ESI) of the Centredale Manor property. The ESI assessed the extent of contamination in areas of potential human exposure, the potential for source areas to be located up-river from the Centredale Manor property, and the presence of dioxin/furan and hexachloroxanthene contamination on the Centredale Manor property.

Additional soil and sediment samples were collected for dioxin analysis in September of 1998. Preliminary analytical results of the were available in January of 1999, and indicated that there were elevated levels of dioxin in surface soils adjacent to residential properties

In January of 1999, EPA initiated an emergency action in response to the preliminary data from the September 1998 sampling event. Temporary fencing was installed around areas of surface soil contamination. Over 300 additional surface soil samples were collected in February of 1999 to assess the extent of surface soil contamination.

An Action Memorandum was signed in May of 1999 to secure funds for performing a range of response actions including installation of chain-link fencing to prevent access to contaminated areas; characterization of subsurface contamination; locating and controlling the source(s) of contamination; and expansion of the community outreach efforts. In September of 1999, an Action Memorandum Addendum was signed to change the scope of the action and secure additional funds. The Addendum proposed that several interim actions be employed until such time that a long-term remedy can be initiated through the Remedial Program. These actions included the construction of temporary protective caps over areas of high soil contamination near residential housing; evaluation of flood conditions via an interagency agreement with the Army Corps of Engineers; implementation of flood management as recommended by the ACOE; and reconstruction of a drainage swale (the former tailrace) on the eastern edge of the property.

As of January 2000, the Removal program has collected several hundred additional soil and sediment samples for site characterization; completed one protective cap and partially completed another protective cap; installed chain-link fence to replace temporary fencing; and coordinated with the ACOE on a flood impact study for the site area. Currently, site activities have ceased for the winter and will resume early in spring of 2000 when work continues on the second protective cap.

A third cap south of the 2074 Smith Street parcel was originally planned as part of the EPA time-critical removal action, but when additional sampling showed contamination extending from that area much further south, EPA determined that addressing contamination in that area would be beyond the scope of a the time-critical removal action. Reconstruction of the drainage swale, based on preliminary flood control evaluations, was also determined to be beyond the time-critical removal action.

EPA initiated Remedial Investigation (RI) activities at the Site in August 1999. These activities include: the use of vapor-diffusion samplers to identify potential discharge areas for contaminated groundwater into the surface water bodies at the Site and collection of sediment, surface water and soil samples at the Site (including the floodplain area from Route 44 southerly to the Lymansville Dam). Data from these sampling activities will be available in early Spring of 2000. Additional Site evaluations for ecological risk assessments are currently being planned.

Results of investigations conducted to date show elevated levels of dioxin, PCBs, chlorinated solvents, such as trichloroethylene (TCE) and tetrachloroethylene (PCE), and numerous other compounds in soil/sediment on the 2072 and 2074 parcels in the area where the chemical manufacturing and drum recycling facilities formerly operated. Elevated levels of dioxin have been found in soil at residential properties in the floodplain located downstream from the 2072 and 2074 parcels. Elevated levels of dioxin and other hazardous substances have been found in soil and sediment in the Allendale Pond area and immediately downstream from the Allendale Dam. The Allendale Dam is currently breached, causing sediment to wash downstream. This information, along with material from the COE flood study which is currently being prepared and preliminary RI data, will be used by EPA in developing the EE/CAs.

C. Nature and Extent of Contamination

As described above, several investigations have been performed and others are on-going at the Site. The current conceptual Site model is that there has been an ongoing release of hazardous substances from the former industrial operations at the 2072 and 2074 Smith Street parcels. When the chemical companies were operating it appears that releases were made directly to soil and wetland areas at the 2072 and 2074 Smith Street parcels, as well as directly to the Woonasquatucket River. There may have also been releases made directly to these areas during construction of the apartment buildings now located on-site. During former industrial operations and after those operations ceased, riverbank and floodplain areas, including downstream primarily residential properties, were impacted through transport and deposition of contaminated soils and sediment. Significant depositions of dioxin- and PCB-contaminated sediment exist within the areas of Allendale Pond, at the Allendale Dam, and just downstream from the Allendale Dam, approximately 2,000 feet downstream from the original source areas (2072 and 2074 Smith Street). Breach of the Allendale Dam in 1991 and its continuing deterioration are

likely to facilitate continued transportation of contaminated sediment further downstream, in the Lymansville Pond portion of the Woonasquatucket River.

Substantial quantities of contamination, possibly including buried drums, are thought to be in the ground on the two parcels where former industrial activities and dumping occurred along the Woonasquatucket River and at the southern-most end of these properties. Contamination in this area of the Site has migrated into the groundwater and is leaching into the River and adjacent wetlands. Groundwater is not being used as drinking water source and all residences are connected to public water supply. Discharge of contaminated groundwater, however, affects Woonasquatucket River, which is a valuable resource and is part of the American Heritage Rivers program. The river is expected to be useable for swimming, wading, and fishing in the future.

In addition to PCBs and dioxins, several VOCs, SVOCs and metals exceed the upper end of EPA's cancer risk range of 10^{-4} or EPA's noncancer hazard quotient of concern, in soils on the Centredale Manor and Brooks Village property, including the following highest concentrations, with "NC" denoting noncancer endpoints and "C" denoting cancer endpoints:

- 1,2-dichlorobenzene at 2,800,000 ppb (NC);
- benzene at 480,000 ppb (C);
- chlorobenzene at 1,000,000 ppb (NC);
- tetrachloroethene at 1,7000,000 ppb (C);
- trichloroethene at 2,400,000 ppb (C);
- cadmuim at 180,000 ppb (NC);
- lead at 3,160,000 ppb (NC); and
- manganese at 6,420,000 ppb (NC).

Soil on Centredale Manor and Brook Village properties, and in the floodplain downstream are contaminated by VOCs, SVOCs, Pesticides/PCBs and Dioxins that also exceeded risk-based soil ecological benchmarks, including the following highest concentrations:

- 1,2,4-trichlorobenzene at 340,000 ppb;
- benzene at 480,000 ppb;
- chlorobenzene at 1,000,000 ppb;
- toluene at 430,000 ppb;
- xylenes at 380,000 ppb;
- benzo(a)pyrene at 7,100 ppb;
- 4,4'-DDD at 1,200 ppb;
- 4,4'-DDE at 2,200 ppb;
- 4,4'-DDT at 410 ppb;
- aldrin at 1,200 ppb;
- chlordane at 350 ppb;

- dieldrin at 9,900 ppb;
- Aroclors 1242, 1248 and 1254 at 230,000 to 1,300,000 ppb;
- total PCBs at 1,300,000 ppb; and
- 2,3,7,8-TCDD at 140 ppb.

Metals in soil also exceed risk-based ecological benchmarks for soil, including the following highest levels:

- aluminum at 16,100,000 ppb;
- antimony at 27,800 ppb;
- arsenic at 49,300 ppb;
- cadmium at 180,000 ppb;
- chromium at 472,000 ppb;
- copper at 934,000 ppb;
- lead at 3,160,000 ppb;
- manganese at 6,420,000 ppb;
- mercury at 7,400 ppb;
- silver at 35,500 ppb;
- vanadium at 72,500 ppb; and
- zinc at 3,330,000 ppb.

While recent fencing and capping of several areas on-site have limited direct human exposure to contaminated surface soil and have slowed the continuing erosion of the contaminated soil into the River and wetlands, contaminated soil/sediment historically deposited into the River and floodplain represents a long-term source of exposure to hazardous substances as well as a continuing secondary source of contamination for the downstream areas. Surface and subsurface soils and sediments have been found to contain levels of dioxin as high as 45 ppb on the primarily residential properties along the Allendale Pond, 96 ppb at the Allendale Dam, and 340 ppb at the Centredale Manor property. Preliminary data indicates that levels of PCBs are as high as 1,300,000 ppb in soil at 2072 and 2073 Smith Street, and as high as 28,000 ppb in the Allendale Pond sediments.

Sediments near Allendale Dam are contaminated with SVOCs, Pesticides/PCBs, Dioxins, and metals that exceeded risk-based sediment ecological benchmarks, including the following highest concentrations:

- Anthracene at 720 ppb;
- Acenaphthylene at 770 ppb;
- benzo(a)anthracene at 2,500 ppb;
- benzo(a)pyrene at 2,900 ppb;
- phenanthrene at 2,100 ppb;
- pyrene at 6,600 ppb;

- fluoranthene at 4,100 ppb;
- fluorene at 320 ppb;
- naphthalene at 290 ppb;
- chrysene at 3,600 ppb;
- dieldrin at 170 ppb;
- 4,4'-DDE at 170 ppb;
- endosulfan I at 28 ppb;
- total PCBs at 9,100 ppb;
- 2,3,7,8-TCDD at 93 ppb;
- lead at 629,000 ppb;
- silver at 8,900 ppb;
- cadmium at 5,500 ppb;
- chromium at 382,000 ppb; and
- mercury at 890 ppb.

III. Threat to Public Health, Welfare, or the Environment

Section 300.415(b)(2) of the National Contingency Plan (NCP) lists a number of factors for EPA to consider in determining whether a removal action is appropriate, including:

- (i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;

- (ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

- (iii) Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release;

- (iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;

- (v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released;

- (vi) Threat of fire or explosion;

- (vii) The availability of other appropriate federal or state response mechanisms to respond to the release; and

- (viii) Other situations or factors that may pose threats to public health or welfare or the environment.

An evaluation of the conditions at the Centredale Manor Restoration Project Superfund Site conclude that factors (i), (ii), (iii), (iv), (v), and (vii) are applicable as described below.

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants -

With regard to actual or potential exposure to nearby human populations, EPA has documented elevated levels of contaminants including dioxin and PCBs in numerous areas at the Site which could result in human exposure. First, elevated levels of dioxin have been found in surface soils at primarily residential parcels along the floodplain of the Woonasquatucket River. Elevated levels of dioxin in surface soil include levels above the Agency-recommended 1 ppb (TEQs, or toxicity equivalent) to be used as a starting point for residential soil cleanup level for CERCLA non-time critical removal sites and as a preliminary remediation goal for remedial sites (Approach for Addressing Dioxin on Soil at CERCLA and RCRA Sites, OSWER Directive 9200.4-26, April 13, 1998). EPA's time critical removal activities included placing a fence between houses and known areas of contamination at primarily residential parcels. However, the residential parcels have not been fully evaluated and a fence is clearly a temporary measure. Second, elevated levels of numerous hazardous substances have been found in surface soils at 2072 and 2074 Smith Street–including areas as close as 50 feet from the apartment complexes located on these parcels. Because the contaminants are found at the surface of the soil, they are readily accessible to residents of and visitors to the apartment complexes at 2072 and 2074 Smith Street, as well as neighborhood children who have been known to play in the southern portion of this area.

EPA's time critical removal activities included placing fences and interim caps in the areas of surface soil contamination. However, the fences are clearly temporary measures and the caps are interim and will ultimately fail if no further action is taken where they are located. Further, contamination was found in Woonasquatucket River sediments between Route 44 and a point just below the Allendale Dam. The Woonasquatucket River becomes relatively shallow approximately 2,000 feet south of Route 44, in an area known as the Allendale Pond. Due to a 1991 break in the Allendale Dam, the sediments in this portion of the river are readily accessible to neighborhood children who have been known to play in the area. Finally, data from the initial RI activities indicate that there are elevated levels of contaminants entering the Woonasquatucket River itself. The river is occasionally used by recreational boaters and wading fishermen. It is possible that these boaters and fishermen could come in contact with surface water contamination while in the Site area.

With regard to actual or potential exposure to animals or the food chain, in the fall of 1999 the Rhode Island Department of Health (DOH) documented elevated levels of dioxin in fish tissue from fish collected in the portion of the Woonasquatucket River which flows through the Site. A joint advisory from DOH and EPA which warns against eating fish and eels from the

Woonasquatucket River is currently in effect due to PCBs, mercury and dioxin contamination concerns. Although other animal/food chain studies have not been conducted, there is potential for exposure of animals or the food chain to hazardous substances or pollutants or contaminants. As explained above, elevated levels of hazardous substances have been found in surface soils, sediment, surface water and wetland areas. All of these areas are natural habitat for numerous species of plants and animals (ecological receptors). Although interim caps may temporarily prevent access to certain surface soils at the Site, fences do not restrict animal access to contaminants.

(ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems -

The Woonasquatucket River and its associated wetlands and floodplain represent a sensitive ecosystem at the Site. Numerous media in this ecosystem have been affected by contamination: sediment, surface water, soil, and wetland areas. Although an ecological risk assessment has not yet been conducted at the Site, numerous birds, fish and animals have been observed at the Site by EPA employees and EPA contractors, including but not limited to:

- great blue herons;
- black crown night herons;
- black ducks;
- mallard ducks;
- Canada geese;
- spotted sandpipers;
- hooded merganser;
- bufflehead;
- muskrat;
- mink;
- squirrels;
- snapping turtles;
- small mouth bass;
- large mouth bass;
- sucker fish; and
- sunfish

These ecological receptors would likely be damaged by exposure to the types of hazardous substances found at the Site.

(iii) Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release - There is evidence in historical records, interviews of certain individuals, and geophysical surveys that drums and other waste material may be buried at the property. Drum carcasses were found by EPA in some areas of the Site. Buried drums and waste material may be leaching contaminants into the Woonasquatucket River.

(iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate - High levels of hazardous substances have been found in soils largely at or near the surface of the Site. These soils are in areas subject to erosion by the Woonasquatucket River as well as periodic flooding. Erosion and flooding appear to have caused the contaminated soil to migrate, since elevated levels hazardous substances have been found in Woonasquatucket River sediments located in the downstream portion of the Site, including below the Allendale Dam. In addition, high levels of chlorinated solvents (TCE and PCE) found at the groundwater/surface water interface in the river indicate migration of contaminants from suspected buried waste near the riverbanks and likelihood of a non-aqeous phase liquid source of contamination that may continue to impact surface water and sediment.

(v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released - The land portions of the Site are located in the floodplain and have been frequently flooded during high river stage. These weather conditions have caused and will continue to cause the migration of contaminated soil at the Site (particularly from those areas which are not covered by an interim cap) into the Woonasquatucket River and the migration of contaminated sediments further downstream. Allendale Dam, the first flood control structure downstream from 2072 and 2074 Smith Street, was breached in 1991 and its condition is continuing to deteriorate. This is causing the release of contaminated sediment into downstream reaches of the river, particularly during flood events.

(vii) The availability of other appropriate federal or state response mechanisms to respond to the release - There are no other known federal or state funds or response mechanisms available to finance this action.

Based upon the NCP factors previously listed, a current or potential threat exists to public health or welfare or the environment due to the release or threat of release of hazardous substances into the environment. A NTCRA is therefore appropriate to abate, prevent, minimize, stabilize, mitigate, or eliminate such threats. In particular, NTCRAs are necessary to remove, control or contain the risk from the potential exposure to the release of hazardous substances from the Site. The first NTCRA will remove, control or contain the risk of potential exposure to contaminated soils in the primarily residential parcels located in the floodplain of the Woonasquatucket River southerly from Route 44 (sampling analysis currently available shows that impacted primarily residential parcels at the Site are primarily on the east side of Allendale Pond). The second NTCRA will remove, control or contain the risk of actual or potential exposure to contaminants in the Woonasquatucket River sediment and soils in its floodplain southerly from Route 44, including but not limited to the Allendale Pond and the Lymansville Pond areas.

This removal is designated as non-time critical because more than six months planning time is available before on-site activities must be initiated. Prior to the actual performance of a non-time critical removal at this Site, Section 300.415(b)(4) of the NCP requires that an engineering

evaluation/cost analysis (EE/CA) be performed in order to weigh different response options.

IV. Endangerment Determination

There may be an imminent and substantial endangerment to the public health or welfare or the environment because of an actual or threatened release of a hazardous substance from the Site.

V. Scope of the EE/CA.

The purpose of the EE/CA will be to evaluate alternatives for response measures to the contaminated sediments and soil at the Site within the floodplain downgradient from the Centredale Manor property. The EE/CA will consider alternatives which meet the following general removal action objectives:

* Prevent, to the extent practicable, human exposure to contaminated soils in the primarily residential parcels located in the floodplain of the Woonasquatucket River southerly from Route 44 (sampling analysis currently available shows that impacted primarily residential parcels at the Site are primarily on the east side of Allendale Pond) ; and

* Prevent, to the extent practicable, continued environmental impacts from high concentrations of contaminants in the Woonasquatucket River sediment and soils in its floodplain, including but not limited to the Allendale Pond and the Lymansville Pond areas.

Pursuant to EPA guidance on EE/CAs, alternatives will be evaluated based upon effectiveness, implementability, cost and compliance with ARARs to the extent practicable. Further, alternatives which exceed $2 million dollars will be evaluated to determine their consistency with future remedial actions to be taken at the Site.

In developing the range of alternatives to be evaluated in the EE/CA, EPA will consider 300.415(d) of the NCP as well as relevant guidance.

EPA plans to develop two EE/CA based upon the above objectives. The first EE/CA will evaluate options to address the contaminated soils in the primarily residential parcels located in the floodplain of the Woonasquatucket River southerly from Route 44. The second EE/CA will address contaminants in the Woonasquatucket River sediment and soils in its floodplain southerly from Route 44, including but not limited to the Allendale Pond and the Lymansville Pond areas.

VI. Enforcement Strategy

On September 15,1999, EPA mailed Notice of Potential Liability letters to three Potentially Liable Parties (PRPs): Centredale Manor Associates Limited Partnership (CMA), Brook Village Associates Limited Partnership (BVA), and New England Container Corporation (NECC). CMA is a current

owner of the Site, through its purchase of 2074 Smith Street on March 18, 1982. BVA is a current owner of the Site, through its purchase of 2072 Smith Street on October 19, 1976. NECC is a former operator at the time of disposal of hazardous substances at the Site.

On November 26, 1999 and December 2, 1999, EPA mailed Administrative Orders by Consent for the Remedial Investigation/Feasibility Study (RI/FS) and remaining time-critical removal actions, respectively, starting the formal negotiation period with BVA and CMA - the two parties who originally indicated willingness to participate in Site activities. Negotiations of both AOCs concluded unsuccessfully on December 20, 1999. EPA is currently evaluating whether it is appropriate to order the PRPs to perform the work described in the proposed AOCs. EPA expects to offer the PRPs the opportunity to perform any additional work determined by EPA to be appropriate for the Site, such as conducting an EE/CA or implementing any future Action Memorandum or Record of Decision.

VII. Estimated Costs

The EE/CAs for the proposed NTCRAs at the Centredale Manor Restoration Project Superfund Site will either be performed by one or more PRPs with oversight by EPA or will be performed by EPA. If EPA performs the EE/CAs, they will likely be developed by an EPA contractor under the Response Action Contracts (RACs) program.

Extramural costs associate with the preparation of each EE/CA described above, including community relations activities and development of an Administrative Record, is expected to be approximately $100,000. Based upon preliminary EPA estimates, costs associate with the removal action for the soil on primarily residential properties may be in $3 to $6 million range. An additional $5 - $10 million may be required to address the contaminants in the Woonasquatucket River sediment and soils in its floodplain. The costs will be significantly impacted by the volume of soil that may require disposal as hazardous waste.

VIII. Other Considerations

The proposed NTCRAs are congruent with the anticipated remedial actions to minimize exposure to and migration of contaminants and to restore the River to its productive uses. The data collected to date by the removal and remedial programs and the conceptual Site model presented in Section II of this memorandum documents that the nature of the threat at the Site requires a remedial response consistent with the proposed NTCRAs.

The proposed NTCRAs are one part of a three phased approach to address concerns at the Centredale Manor Restoration project Superfund Site. The other two components are (1) the EPA time-critical removal action which began in January of 1999 and is currently nearing completion which provides interim soil caps over certain source areas, protective fencing around areas with elevated contaminant levels, and flood control measures as recommended in the COE flood study which is

currently being prepared, and (2) the two-year phased RI/FS which will fully characterize the Site, followed by implementation of the selected remedy.

It is anticipated that the first EE/CA will be completed within four months of being funded and the second EE/CA will be completed within six months of being funded. These EE/CAs will form the basis of Action Memoranda which will document the cleanup approach. Procurement of the response action contractor and construction of the NTCRAs will begin immediately following approval of the Action Memoranda.

The State of Rhode Island supports an early action at this Site.

IX. Recommendation

Ongoing investigations have determined that there has been a release of hazardous substances to the environment. Additionally, the conditions at the Site meet the NCP Section 300.415(b) criteria for a removal. Consistent with Section 104(b) of CERCLA and NCP Section 300.415(b)(4), further investigation is necessary to plan and direct the future removal actions. We recommend your approval of this request to perform two EE/CAs at the Centredale Manor Restoration Project Superfund Site. The total estimated extramural cost of performing both EE/CAs is $200,000.

2/1/00
Date

Patricia L. Meaney, Director
Office of Site Remediation and
Restoration

Centredale Manor
Restoration Project Superfund Site

INTERIM

EE/CA Approval Memorandum
Administrative Record
INDEX

Compiled: January, 2000

Prepared By
EPA - New England
Office of Site Remediation & Restoration
U.S. Environmental Protection Agency

INTRODUCTION

This is Index to the administrative record file for the removal action compiled at the time that the Engineering Evaluation/Cost Analysis (EE/CA) Approval Memorandum for the Centredale Manor Restoration Project Superfund Site was prepared by U.S. EPA. Included in the Index are citations for documents containing all of the underlying information considered by the Region relevant to the findings and key decision contained in the EE/CA Approval Memorandum. Although this administrative record is not a continuation of the administrative record for the time-critical removal action, all documents contained in the administrative record for the Action Memorandum issued on May 4, 1999, as amended on September 13, 1999, are incorporated by reference herein.

The administrative record file is available for public review at the EPA Region I Office of Site Remediation and Restoration (OSRR) Records Center at 1 Congress Street in Boston, MA, and the Centredale Manor Restoration Project Superfund Site records repository, located at the Salvatore Mancini Union Free Library at 1810 Mineral Spring Avenue, North Providence, RI. The staff of the EPA Region I OSRR Records Center asks that you set up an appointment in advance to review the administrative record file by calling telephone number (617) 918-1440. Questions concerning the content of the administrative record file for the Centredale Manor Restoration Project Superfund Site should be addressed to the EPA Region I site manager.

The administrative record file for the removal action is required pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

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No.	Date	Description
1.	01/00	Centredale Manor Restoration Project Update, Volume II, No. 1, EPA Region 1.
2.	01/10/00	Comparison of Maximum Detected Concentrations Reported in Draft EE/CA Approval Memo for Centredale Manor to EPA's Risk Range, Memorandum from Ann-Marie Burke, EPA Region 1, to Anna Krasko, EPA Region 1.
3.	01/06/00	Identification of Soil and Sediment Maximum Concentrations that Exceed Ecological Screening-Level Benchmarks, Memorandum from Cornell Rosie, EPA Region 1, to Anna Krasko, EPA Region 1.
4.	12/06/99	Flood Insurance Study and Flood Insurance Rate Map (FIRM), Town of North Providence, Providence County, Rhode Island, FEMA.
5.	12/01-02/99	Summary tables and location map for the soil/sediment sampling data collected in February, 1999, June 21 through August 12, 1999, and September 29, 1999 through October 5, 1999, by IT Corporation (ERRS 1) for EPA Region 1.
6.	11/30/99	Deposition [name withheld] in the matter of Centredale Manor Superfund Site, North Providence, RI, EPA Region 1.
7.	11/30/99	Deposition of John Turcone in the matter of Centredale Manor Superfund Site, North Providence, RI, EPA Region 1.
8.	11/05/99	Press Release, EPA Region 1, proposal to the EPA's National Priority List (NPL).
9.	10/06/99	Summary tables and graphs of the preliminary data (Centredale Manor, North Providence, RI) collected by USGS using passive vapor samplers for VOC analyses performed on September 21 and 22, 1999 by U.S. EPA Region 1 mobile laboratory.

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10.	10/99	Sampling and Analysis Plan, Woonasquatucket River Sediment Investigation, Centredale manor, North Providence, RI, prepared by Tetra Tech NUS, Inc., RAC, Region 1.
11.	10/99	Draft Final Work Plan, Technical Assistance, Centredale Manor, North Providence, RI, prepared by Tetra Tech NUS, Inc., RAC, Region 1.
12.	10/7/99	Response to Notice of Potential Liability, Richard J. Welch, Moses & Afonso, Ltd., on behalf of Centredale Associates, I. P.
13.	10/7/99	Response to Notice of Potential Liability, Leonard H. Freiman, Goulston & Storrs, on behalf of Centredale Manor Associates Limited Partnership.
14.	10/7/99	Response to Notice of Potential Liability, Deming E. Sherman, Edwards & Angell, LLP., on behalf of New England Container Co., Inc.
15.	09/17/99	Press Release, EPA Region1, New round of sampling results for Woonasquatucket River and Centredale Manor.
16.	09/15/99	Notice of Potential Liability, EPA Region 1, issued to Brook Village Associates Limited Partnership.
17.	09/15/99	Notice of Potential Liability, EPA Region 1, issued to Centredale Manor Associates Limited Partnership.
18.	09/15/99	Notice of Potential Liability, EPA Region 1, issued to New England Container Company, Inc.
19.	09/09/99	Report of Chemical Analyses, Determination of PCDD/PCDF Levels, Pace Analytical for RIDOH.
20.	09/99	Centredale Manor Restoration Site Update, Volume I, No.1, EPA Region 1.
21.	04/14/99	GZA GeoEnvironmental, Inc., response to Request for Information Pursuant to Section 104 of CERCLA, with an Addendum dated December 21, 1999 (CBI Claim redacted).
22.	03/19/99	New England Container Co., Inc., response to Request for

		Information Pursuant to Section 104 of CERCLA, with an Addendum dated March 22, 1999.
23.	07/31/98	Woonasquatucket River Sediment/Water Quality Analysis Project Report, USEPA Region 1 OEME, as amended by a memo dated 02/24/98.
24.	11/17/93	Flood Insurance Study and Flood Insurance Rate Map (FIRM), Town of Johnston, Providence County, Rhode Island, FEMA.

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SELECTED KEY GUIDANCE DOCUMENTS

EPA Guidance documents may be reviewed at the EPA Superfund Records Center, 1 Congress Street, Suite 1100, Boston, Massachusetts.

1. Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites, U.S. EPA, OSWER Directive 9200.4-26, April 13, 1998.

2. Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA, U.S. EPA, Office of Emergency and Remedial Response, EPA/540-R-93-057, August 1993.