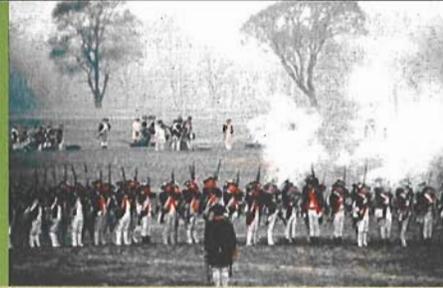




Valley Forge

National Historical Park
Pennsylvania



Record of Decision
Valley Forge Asbestos Release Site

January 18, 2007

RECORD OF DECISION

ASBESTOS RELEASE SITE

VALLEY FORGE NATIONAL HISTORICAL PARK

January 18, 2007



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LIST OF ACRONYMS

AMQ	Amphitheater Quarry
AOCs	Areas of Concern
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirement
ARS	Asbestos Release Site
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
CECs	Contaminants of Ecological Concern
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COCs	Contaminants of Concern
CPECs	Contaminants of Potential Ecological Concern
CVQ	Cave Quarry
ELCR	Excess Lifetime Cancer Risk
FEMA	Federal Emergency Management Agency
FKP	Former Keene Plant Area
FKP-CLRPDD	Former Keene Plant Area-County Line Road Potential Debris Dump
FKP-FOOT	Former Keene Plant Area-Plant Footprint
FKP-I	Former Keene Plant Area-Impoundments
FKP-LQ	Former Keene Plant Area-Lower Quarry
FKP-MISC	Former Keene Plant Area-Miscellaneous Areas
FKP-NB	Former Keene Plant Area-Northern Buildings
FKP-NWP	Former Keene Plant Area-Waste Piles
FKP-UQ	Former Keene Plant Area-Upper Quarry
FS	Feasibility Study
HHRA	Baseline Human Health Risk Assessment
HI	Hazard Index
HIB	Historic Bridge
HQ	Hazard Quotient
LOAEL	Lowest Observable Adverse Effects Level
LVQ	Lower Visitor Center Quarry
MAR	Maintenance Area Ruins
MDL	Method Detection Limit
MLE	Most Likely Exposure
MQ 1	Maintenance Quarry 1
MQ 2	Maintenance Quarry 2
MQ 3	Maintenance Quarry 3
MQ 4	Maintenance Quarry 4
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOAEL	No Observed Adverse Effects Level
NPS	National Park Service
OSHA	United States Occupational Safety and Health Administration

OU _s	Operable Units
PADEP	Pennsylvania Department of Environmental Protection
PADOT	Pennsylvania Department of Transportation
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PDQ	Pennsylvania Department of Transportation Quarry AOC
PEM	Palustrine Emergent Wetlands
PFO1	Palustrine Forested Broad-Leaved Deciduous Wetlands
PLM	Polarized Light Microscopy
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
RAGS	Risk Assessment Guidance for Superfund
RAOs	Remedial Action Objectives
RBCs	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RGs	Remediation Goals
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SAQ	Small Additional Quarry AOC
SIB	Silicate Bank AOC
SVOC	Semi-Volatile Organic Compound
TBC	To Be Considered
TEM	Transmission Electron Microscopy
TtEC	Tetra Tech EC, Inc.
TtFWI	Tetra Tech Foster Wheeler, Inc.
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VFNHP	Valley Forge National Historical Park
VOC	Volatile Organic Compound
WAP	Waste Pile AOC
WCR	Waste Channel and Railbed
WCRN	Waste Channel and Railbed – North AOC
WCRS	Waste Channel and Railbed – South AOC
yd ³	Cubic Yards

DECLARATION

Site Name and Location

Asbestos Release Site (ARS)
Valley Forge National Historical Park (VFNHP)
Montgomery County, Pennsylvania

Statement of Basis and Purpose

This decision document presents the Remedial Action (“Selected Remedy”) for the Asbestos Release Site (“the Site”), located in the Valley Forge National Historical Park (VFNHP) in Montgomery County, Pennsylvania. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Selected Remedy was chosen by the Department of the Interior, National Park Service (NPS) pursuant to its CERCLA lead agency status. This decision is based on the Administrative Record (AR) file for this Site.

The Commonwealth of Pennsylvania has concurred with the Selected Remedy outlined in this Record of Decision (ROD).

Assessment of the Site

The Selected Remedy presented in this ROD is necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

Under the Selected Remedy, shallow soil containing levels of contaminants that pose unacceptable risk to residents of, and visitors to, the VFNHP; or unacceptable risk to the environment, will be excavated and disposed off-site at appropriately licensed or permitted facilities. An estimated 52,000 cubic yards (yd³) of soil will be excavated and removed from the Site. Contaminants will remain deeper in the subsurface that do not present risks to residents, visitors, or the environment. These subsurface contaminants could pose a risk to maintenance and/or construction workers who may encounter the contamination during future excavation activities if these workers are uninformed and unprotected. Therefore, institutional controls are part of the Selected Remedy to prevent exposure and protect the health of these workers. A more detailed discussion of the principal components of the Selected Remedy is presented in Section XII of the Decision Summary of this ROD.

Statutory Determination

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. Although the Selected Remedy may not satisfy the statutory preference for treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element, this is appropriate because no potentially viable alternative exists for on-site treatment of the predominant contaminant type (asbestos) that will effectively reduce its volume, mobility, and toxicity. The Selected Remedy, by excavating contaminated soil and disposing it at an appropriate off-site facility, effectively reduces the volume of hazardous substances present at the VFNHP, and reduces its toxicity and mobility by eliminating the exposure potential and isolating it from potential migration pathways (e.g., water and wind erosion).

Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining in subsurface soil above levels that allow for unrestricted use, a statutory review will be conducted within 5 years after initiation of remedial action, and every 5 years thereafter, to ensure that the remedy is, or will be, protective of human health and the environment.

Data Certification Checklist

The following information is included in the Decision Summary of this ROD. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations (see pages 8-9, page 13, pages 15-18, and Appendix A, Tables A-1 through A-4)
- Baseline risk represented by the chemicals of concern (see pages 13-18)
- Cleanup levels established for chemicals of concern and the basis for these levels (see pages 19-22)
- Current and reasonably anticipated future land use assumptions (see pages 11-13)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (see page 34)
- Key factor(s) that led to selecting the remedy (see page 31)

Authorizing Signature

1/18/07
Date

R. Thomas Weimer
Assistant Secretary, Policy, Management and Budget
Department of the Interior

DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

The Asbestos Release Site (“ARS” or “the Site”) is located within the Valley Forge National Historical Park (VFNHP) in Montgomery County, Pennsylvania (see Figure 1). The Site is managed by the National Park Service (NPS). VFNHP has an area of approximately 3,600 acres and is maintained as an active historical park and recreation area. VFNHP is comprised of rolling hills, open fields, wooded areas, and former limestone quarry areas.

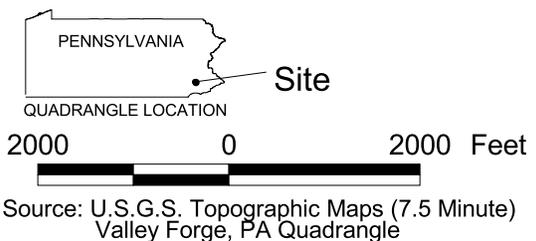
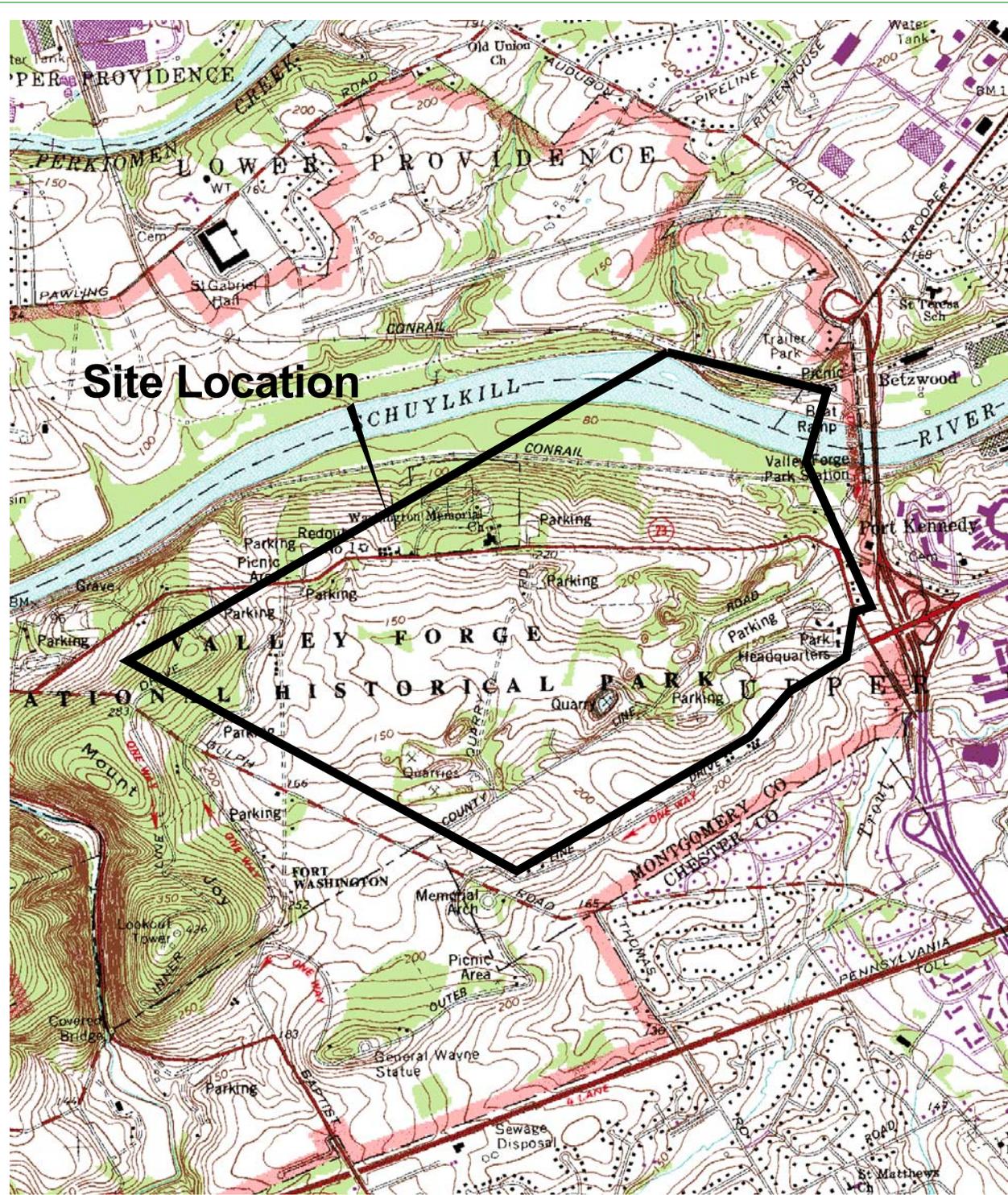
The Site is located in the central section of the eastern side of VFNHP and has an area of approximately 112 acres (see Figure 2). Surface drainage is generally towards the Schuylkill River, the northern boundary of the Site. The Site is divided into two operable units (OUs): the Keene OU and the Former State Lands OU. The Keene OU is approximately 42 acres and is bounded on two sides by the Former State Lands OU (approximately 70 acres). These OUs include 15 Areas of Concern (AOCs) which are shown on Figure 2. Only 9 of these AOCs require active remediation as determined in the Feasibility Study (FS), and these AOCs are indicated on Figure 2. Much of the Site is found along and surrounding County Line Road.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

In the early 1800s, the limestone industry developed with the quarrying of limestone and construction of kilns in portions of the VFNHP to produce limestone for use in agriculture. From the early 1890s to the 1970s, Ehret Magnesia Company (“Ehret”) and its successor, Keene Corporation (“Keene”), manufactured asbestos insulation at a plant located within the Site. The pipe insulation was manufactured by pouring a slurry mix of asbestos fibers and magnesium carbonate (from the readily available dolostone present within the local limestone deposits) into molds. Ehret disposed of waste asbestos slurry by either pumping it through pipelines into the former limestone quarries, in what was then a state park, or by directing the slurry waste to a waste channel constructed in a natural drainage swale that parallels a former railbed and ultimately discharges to the Schuylkill River. The waste slurry deposits in the abandoned quarries were subsequently covered with soil.

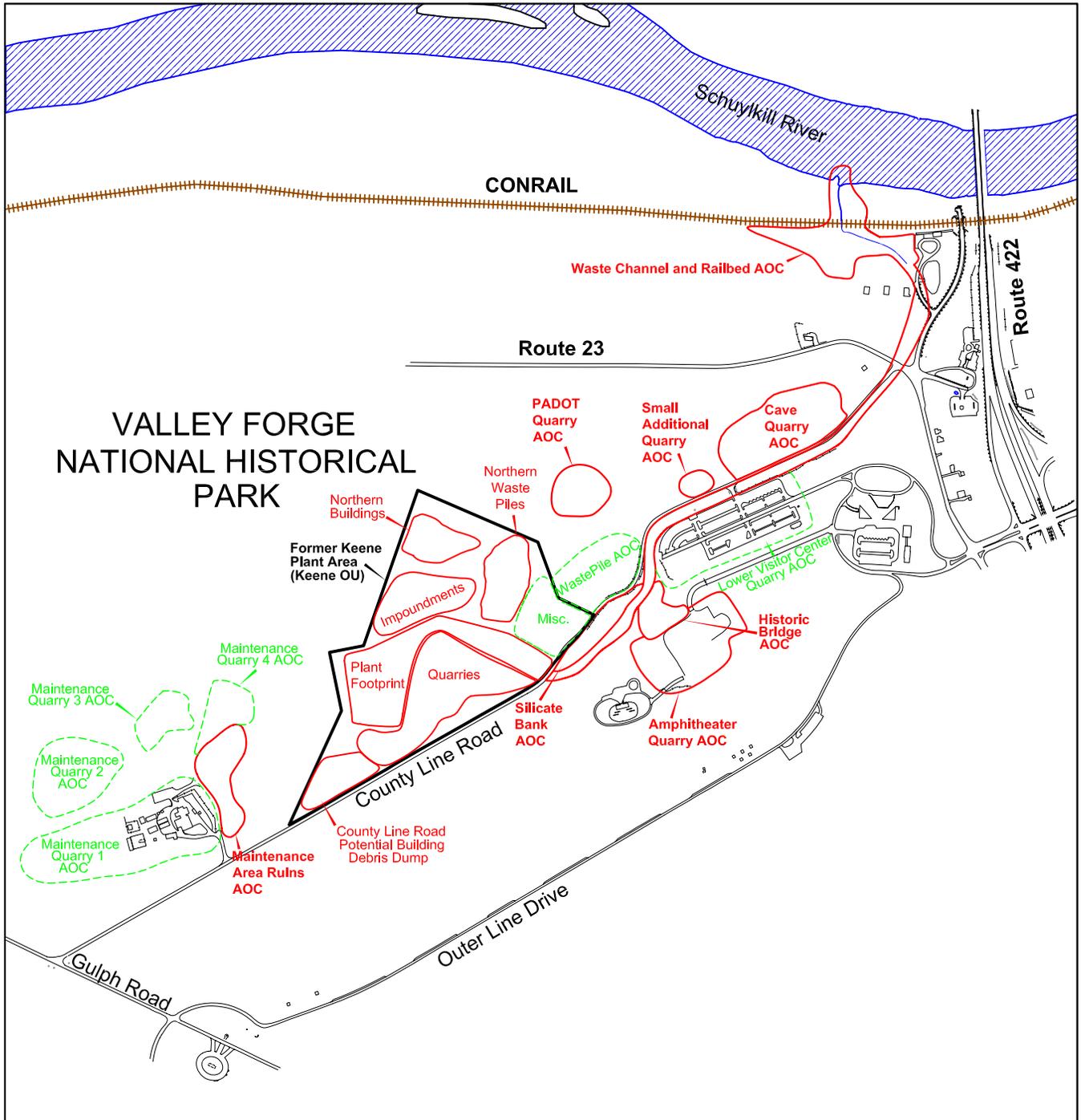
In the 1960s, Ehret sold the plant and property to Keene. Keene continued to manufacture asbestos products until the plant was closed in the early 1970s. On October 13, 1976, NPS purchased the Keene property. On November 24, 1982, following official transfer of title for the state park land to NPS, the Secretary of the Interior issued official notice establishing the Valley Forge National Historical Park as a unit of the National Park System.

The asbestos contamination at VFNHP was identified in January 1997 during the excavation of a trench for a fiber optic cable through the Amphitheater Quarry AOC. In certain soil samples, asbestos was detected at concentrations as high as 70 percent.



Valley Forge Asbestos Release Site

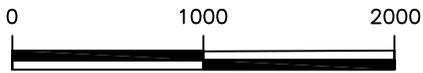
**Figure 1
Site Location Map**



KEY

- Keene OU
- AOC Requiring Remedial Action
- - - AOC Not Requiring Remedial Action

AOC = Area of Concern



Approximate Scale in Feet



The horizontal datum is PA State Coordinate System (NAD 83) and the vertical datum is NAVD 88.

Valley Forge Asbestos Release Site

**Figure 2
Site Map**

The presence of high concentrations of asbestos caused the U.S. Environmental Protection Agency (USEPA) and NPS to conduct response activities that included: removal of asbestos contamination in some areas; covering other areas with clean soil or a cement-like soil binding agent and revegetating; and installing warning fencing and signs to control public access to contaminated areas.

Following implementation of these response activities, a Remedial Investigation (TtFWI, 2005a) and Feasibility Study (NPS, 2006) were conducted to determine the nature and extent of contamination at the Site and to evaluate alternatives for responding to contamination at the Site. NPS issued the Remedial Investigation (RI) and Feasibility Study (FS) Reports in February 2005 and August 2006, respectively. The RI/FS reports are contained in the Administrative Record file for this Site.

In 2002, Reinhold Industries, the corporate successor to Keene, agreed to pay NPS \$500,000 to settle all NPS CERCLA claims against Keene at the Site.

III. COMMUNITY PARTICIPATION

The RI/FS and Proposed Plan for the Site were made available to the public September 22, 2006. These documents were placed in the Administrative Record file at the Valley Forge National Historical Park Welcome Center Desk and the NPS Environmental Management Program office in Boulder, Colorado. The Proposed Plan was also made available on the NPS website from: <http://parkplanning.nps.gov> by selecting "Valley Forge NHP", then "Clean-up of the Asbestos Release Site...", then "Document List", then "Proposed Plan...". The public was invited to use this website to submit comments. Additional information about the Site is available on the VFNHP website: www.nps.gov/vafo/. The Notice of Availability of these documents was published in the Philadelphia Inquirer and the Pottstown Mercury on September 17, 2006. A public comment period was held from September 22, 2006 to November 6, 2006. In addition, a public meeting was held on September 28, 2006, at the Education Center at VFNHP to present the Proposed Plan. NPS representatives explained the Preferred Alternative and other alternatives that were considered and answered questions from the public. Oral comments and questions were received at the meeting. The National Park Service's responses to comments received during the comment period are presented in the Responsiveness Summary, which is included at the end of this ROD (see page RS-1).

IV. SCOPE AND ROLE OF THE REMEDIAL ACTION

The overall Site Remedial Action strategy is to clean up the Site to achieve formulated remediation goals (RGs) so that the Site will not present unacceptable risk to recreational visitors, workers, residents, or relevant ecological receptors. The Selected Remedy includes excavation of all shallow soil that contains contaminants exceeding RGs; characterization of all excavated material for off-site disposal; and disposal of the material at an appropriately permitted facility (either an off-site landfill or a Resource Conservation and Recovery Act (RCRA) hazardous waste disposal facility, as appropriate). The entire disturbed area will be

backfilled with clean soil, graded, and re-vegetated to minimize erosion and return the area to a natural state. In addition, institutional controls will be put in place to manage and control potential future exposure by Park maintenance and/or construction workers to deep contamination that will remain in place. A more detailed discussion of the principal components of the Selected Remedy is provided in Section XII.

V. SITE CHARACTERISTICS

Site Overview

As noted above, the Site covers approximately 112 acres (see Figure 2). Topographic relief in the Site is generally low to moderate with elevations ranging from 80 to 200 feet above mean sea level. More moderate relief is associated with karst terrain and quarry areas. Natural surface features in the Site include rolling hills, caves and sinkholes, open fields and wooded areas. Anthropogenic features include former quarry areas, roads, parking lots, and Park buildings.

The general flow pattern within the Site watershed is from southwest to northeast. The Waste Channel, which receives stormwater runoff from the Site, starts approximately mid-site near the location of the Former Keene Plant and discharges to the Unnamed Tributary that discharges to the Schuylkill River west of the Route 422 Bridge. The Waste Channel is intermittent and the Unnamed Tributary to the Schuylkill is perennial. Together they form the main conduit for surface runoff for the area associated with the Site. Locally, quarries, caves, and sinkholes control some drainage.

Floodplain

Mapped floodplains in the Site vicinity are associated solely with the Schuylkill River. Most of the Site is located within an area determined by FEMA to be outside the 500-year floodplain. Fourteen of the 15 AOCs are entirely outside of the 500-year floodplain and only a small portion of the Waste Channel and Railbed AOC is within designated flood zones. The extreme northern portion of the Waste Channel and Railbed AOC near the Schuylkill River is subject to 100-year and 500-year flooding. The 100-year flood elevation for this region of the Schuylkill River is approximately 82 feet above mean sea level, which incorporates most of the outlet area of the Unnamed Tributary north of the active east/west Norfolk-Southern rail line crossing.

Wetlands

Two wetland habitat types were identified in the RI within the Site's AOCs: palustrine forested broad-leaved deciduous wetlands (PFO1) and palustrine emergent wetlands (PEM).

The forested wetland extends approximately 300 feet along the Unnamed Tributary in the Waste Channel and Railbed AOC from the Schuylkill River southward. Palustrine emergent wetlands were identified in the Quarry and Impoundment portions of the Former Keene Plant AOC.

Archeologically Sensitive Areas

The RI identified five archeologically sensitive areas within the Site:

- The Northern Building Area within the Former Keene Plant AOC;
- The Miscellaneous Area within the Former Keene Plant AOC;
- The Historic Bridge AOC;
- The Maintenance Area Ruins AOC; and
- Portions of the Waste Channel and Railbed AOC.

Additional archeological surveys will be needed for those archeologically sensitive areas that will be disturbed as a result of the Selected Remedy to properly identify historic and cultural resources. These resources will need to be avoided or impacts on them mitigated during excavation.

Results of Remedial Investigation

Field investigations to support the RI were conducted from June 2002 through December 2002 and June 2004 through July 2004. These investigations included:

- Geophysical surveys;
- Surface and subsurface soil sampling and analysis;
- Background soil sampling and analysis;
- Monitoring well installation;
- Groundwater sampling and analysis;
- Surface water sampling and analysis;
- Sediment sampling and analysis;
- Surveying and mapping of sample locations and other important features;
- Ecological survey; and
- Human population survey.

The results of these investigations are summarized below.

Soil

During the RI, over 1,600 surface and subsurface soil samples were collected from the Site and analyzed for asbestos, and over 200 samples were analyzed for other contaminants (volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, pesticides, and polychlorinated biphenyls (PCBs)).

Within AOCs, asbestos was detected in surface soil samples collected between 0.5 feet and 1.5 feet below ground surface with concentrations ranging from 1% to greater than 10%. The most concentrated areas of asbestos detections were in the Waste Channel and Railbed AOC.

Although VOCs, pesticides, and PCBs were detected in soil samples from a few locations, concentrations of these substances were too low to be a concern (i.e., they do not exceed RGs and do not pose unacceptable health or ecological risks).

A subset of the SVOCs, called polycyclic aromatic hydrocarbons (PAHs), and three metals (lead, mercury, and arsenic) were measured in some soil samples at levels that may cause unacceptable risks to humans and/or ecological receptors (see the risk discussion below).

Groundwater

A total of eight groundwater monitoring wells were installed and sampled several times during the RI. No contaminants at levels of concern were detected.

Sediment and Surface Water

Analytical results from sediment samples taken at the Site indicate the presence of asbestos, VOCs, SVOCs, pesticides, and PCBs in the sediments of the Schuylkill River and the Unnamed Tributary, the primary surface water drainage outlet from the Site. The data indicate that upstream sources are larger contributors to sediment contamination in the Schuylkill River than discharges from the Unnamed Tributary. Results of sediment macroinvertebrate community analyses performed during the RI indicated no significant adverse effects to the macroinvertebrate community from contaminants in the sediments. Contaminated sediments in the Unnamed Tributary, however, were found to be a potential source of human health risk.

No contaminants at levels of concern were detected in surface water samples from the Schuylkill River or the Unnamed Tributary.

Conceptual Site Model

Conceptual site and pathway analysis models were developed to evaluate exposure of potential Park users and ecological receptors to Site contaminants in the human health and ecological risk assessments (see Section VII). The human health risk assessment identified four types of current or future Park users:

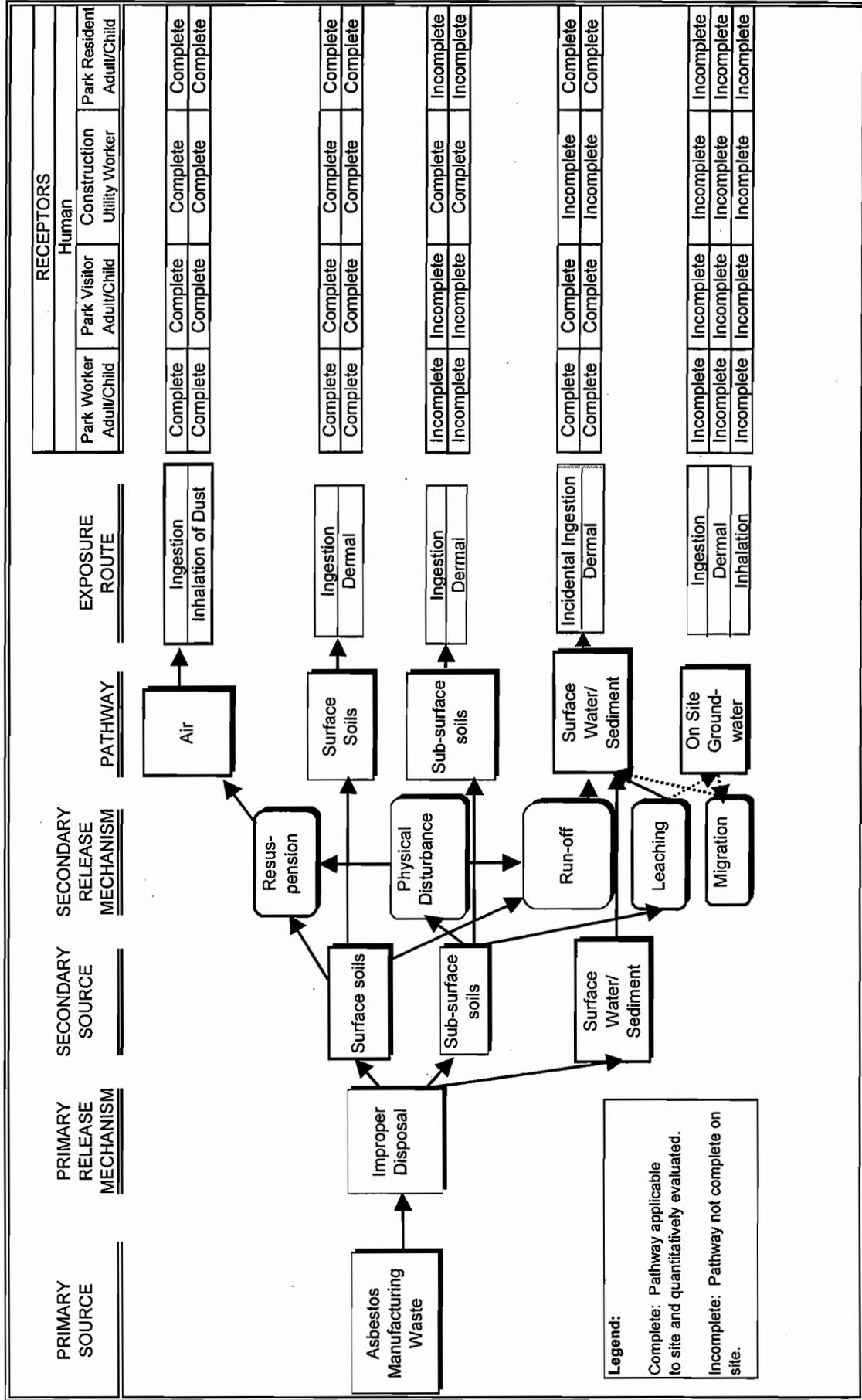
- Adult on-site Park worker;
- Adult construction worker;
- Adult and child recreational users; and
- Adult and child residents.

The exposure points and media evaluated were: surface soil, subsurface soil, sediment, and surface water; and exposure routes were: inhalation, dermal absorption, and incidental ingestion. Complete exposure pathways were evaluated for human health risk. The conceptual site model for human exposure to site contaminants is presented in Figure 3.

The ecological risk assessment identified terrestrial and aquatic receptor groups and constructed a simplified food chain model. The terrestrial receptors evaluated as representative were:

- Plants;
- Soil invertebrates;
- Insectivorous small mammal (short-tailed shrew);
- Insectivorous bird (American robin);
- Omnivorous bird (mallard duck);
- Piscivorous mammal (mink);

Figure 3
Valley Forge National Historical Park Asbestos Release Site (VFNHP-ARS)
Baseline Human Health Risk Evaluation Conceptual Site Exposure Model



- Carnivorous mammal (red fox);
- Carnivorous bird (red-tailed hawk);
- Herbivorous small mammal (eastern cottontail); and
- Herbivorous large mammal (white-tailed deer);

The following aquatic receptor groups were evaluated:

- Plankton;
- Freshwater fish; and
- Benthic macroinvertebrates.

The exposure pathways evaluated were: direct contact with soil or sediment, inhalation, dietary ingestion of contaminated prey, and incidental ingestion of soil or sediment. The conceptual site exposure model for ecological receptors is presented in Figure 4.

VI. CURRENT AND FUTURE SITE AND RESOURCE USES

Current On-Site Land Uses

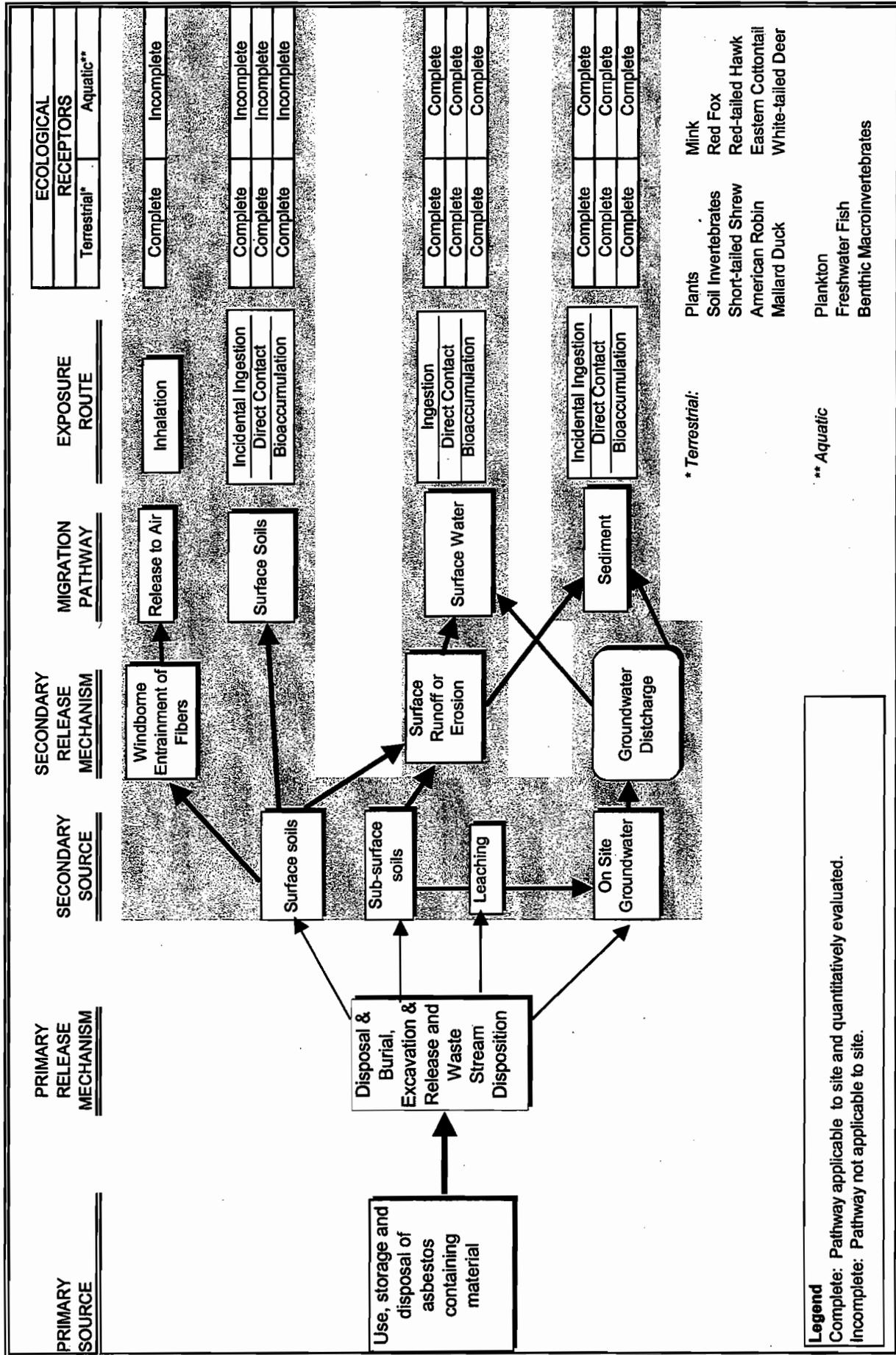
AOCs within the Site currently are fenced and posted to discourage use of the contaminated areas, thereby preventing exposure. If this were not the case, the Site would be used fully for all appropriate park uses, including public use and enjoyment. The AOCs within the Site have not been improved, for example, for historic interpretation or recreational facilities such as trails or picnic areas due to the current presence of contamination. The Waste Channel and Railbed AOC provides drainage for precipitation. The AOCs provide habitat for terrestrial plants and animals.

Current Land Use of Surrounding Properties

The Site is within and surrounded by VFNHP-managed property. County Line Road passes through the Site (see Figure 2). The surrounding uses within VFNHP include the Park Headquarters, Park Maintenance facilities, and residences that are occupied by NPS employees. Thus, recreation, park maintenance, residences, and transportation are land uses on surrounding VFNHP property.

VFNHP is immediately surrounded by residences to the southeast, southwest, and west; Route 422 and King of Prussia (population 18,511) to the east; fields, woodlands, a railroad line and the Schuylkill River to the north; and fields and woodlands to the west and southwest. Other cities and towns within a five mile radius of VFNHP include Norristown (31,282) to the northeast; Audubon (6,549) to the North; Phoenixville (14,788) to the northwest; Devon-Berwyn (5,067) to the south; and Paoli (5,425) to the southwest. To the east is Upper Merion Township, population approximately 26,863, which includes King of Prussia and is a major center for economic activity. Upper Merion Township includes office and retail developments that employ more people than any other municipality in Montgomery County. Tredyffrin Township is located to the south of VFNHP and has a population of approximately 29,062. This township is mainly agricultural with some residential and industrial areas. Schuylkill Township, located to the west of VFNHP in Chester County, has a population of approximately 6,960 and is more rural than the other surrounding townships. To the north of VFNHP is Lower Providence Township,

Figure 4
Valley Forge National Historical Park Asbestos Release Site (VFNHP-ARS)
Ecological Conceptual Site Model



population approximately 22,390, which includes residential, commercial, industrial, and open space land uses. Sections of Lower Providence Township include the communities of Trooper, Eagleville, Evansburg, and Audubon. To the northeast of VFNHP is West Norristown Township with a population of approximately 14,901. Areas within West Norristown Township, which is mainly residential with light industrial and recreational areas, include the communities of Jeffersonville, Trooper, and Port Indian.

Future On-Site Land Uses

The future on-site land uses will include recreation and historic preservation because the Site is within the VFNHP. The development of additional recreational facilities and historic interpretive areas are likely future land uses. Also, some areas may remain undeveloped and thus provide wildlife habitat in an otherwise urban area. The NPS Organic Act, which governs uses of Park Service lands, requires the conservation of the Park and its resources for the unimpaired enjoyment of future generations, so future use as parkland is assured.

Future Use of Surrounding Properties

The VFNHP property surrounding the Site will continue in park use as described above. In addition to the public areas, the maintenance area and residences for Park employees are likely future uses. The Organic Act controls use of this property as described above.

The surrounding areas outside the park will likely remain in commercial and residential use as they are currently; with the likelihood that population will increase in the region over time.

Current and Future Natural Resource Uses

Natural resources at the Site include groundwater and woodland. The groundwater is not used for water supply. The woodland is maintained for ecological health and Park use and enjoyment. Future use of the resources is expected to remain the same as current use.

VII. SUMMARY OF SITE RISKS

Summary of Human Health Risk

The baseline human health risk assessment (HHRA) (TtFWI, 2005b) estimates what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the Remedial Action. This section of the ROD summarizes the results of the HHRA for the Site.

The Contaminants of Concern (COCs) at the Site are asbestos, PAHs, lead, and arsenic in soil and sediment. The risk characterization process quantitatively examined potential exposures to the COCs along specific pathways and routes of exposure as described in the conceptual site model discussed above. Exposure scenarios based on current and future use were developed for complete exposure pathways, and quantitative risk assessment was performed for those scenarios. Receptor groups evaluated were child and adult Park visitors, child and adult Park residents, Park maintenance workers, and construction workers.

AOCs were identified during the Remedial Investigation (RI) based on former on-site activities, known waste disposal practices, and topographic boundaries (see Figure 2). Human health risk was evaluated for all AOCs. Residential exposure was only evaluated for the Waste Channel and Railbed-North AOC, the AOC nearest park residences.

Residential exposure was based on concentrations of contaminants in surface soil and sediment (0-2 ft below ground surface) and surface water in the Waste Channel and Railbed-North AOC. For all other receptor groups, exposure to COCs in surface soil and sediments was evaluated in all AOCs. Exposure to sub-surface soil was also evaluated for the construction worker scenario. The exposure point concentration was based on the Reasonable Maximum Exposure (RME) concentration in surface soil and sediments (and in subsurface soil for the construction worker exposure scenario). The routes of exposure evaluated for all receptor groups were incidental ingestion, dermal absorption, and inhalation of particulates.

Risk from carcinogenic COCs was described in terms of excess lifetime cancer risk. The HHRA was based on exposure in each AOC proportional to the surface area of the AOC to the total area of the Site, an assumption representing equal visitation to all areas of the Site. However, the exposure assumption for a construction worker also included an assumed 6-month duration exposure within single AOCs to represent a construction project scenario. For non-carcinogenic COCs, except lead, risk was described in terms of a Hazard Index (HI) expressed as the sum of quotients of the exposure dose divided by the reference dose for adverse effects. Lead risk evaluation was based on predicted lead levels in blood using the adult and child models approved by USEPA.

Tables 1 and 2 summarize the findings of the HHRA for all receptor groups and for construction workers, respectively.

Receptor Group	Excess Lifetime Cancer Risk (ELCR)¹	Hazard Index (HI)
	<i>RME</i>	<i>RME</i>
Recreational User – Adult	1.4×10^{-5}	1.5×10^{-2}
Recreational User – Child	2.2×10^{-5}	1.3×10^{-1}
Resident – Adult	7.4×10^{-5}	8.1×10^{-2}
Resident – Child	8.3×10^{-5}	7.2×10^{-1}
Park Maintenance Worker	4.3×10^{-5}	4.9×10^{-2}
Construction Worker	5.9×10^{-5}	3.8×10^{-1}

¹ Based on exposure in each AOC proportional to surface area of AOC to total surface Area of Site. Excess risk determined from exposure to asbestos, arsenic and PAHs

Location	Excess Lifetime Cancer Risk (RME)
Sitewide exposure proportional to area of AOCs	5.9×10^{-5}
Exposure During 6 Months Within a Single AOC	
Amphitheater Quarry AOC	2.9×10^{-4}
Waste Channel and Railbed South AOC	1.4×10^{-4}
Former Keene Plant – Upper Quarry AOC	1.7×10^{-4}

The assumptions used in the HHRA process were conservative so that the final results tended to overestimate rather than underestimate risk from exposure to COCs. The assumed levels of activity in the AOCs that were used to develop the exposure scenarios were higher than what occurs at the present time or would likely occur in the future. According to the NCP, the lifetime excess cancer risk should fall within or below the range of one excess cancer case in 10,000 individuals (1×10^{-4}) to one excess cancer case in 1,000,000 individuals (1×10^{-6}). Only the construction worker scenarios within individual AOCs (see Table 2) resulted in excess risk greater than one in 10,000. The other exposures were between one in 10,000 and one in 1,000,000 excess risk. All of the HIs were less than one, indicating that non-carcinogenic risk was unlikely. Modeled blood lead levels for the child and adult resident and the construction worker, however, were found to exceed USEPA recommended levels. Based on these results, the NPS has determined that further response action is necessary and that the Selected Remedy will reduce risk from carcinogens and lead to acceptable levels.

Summary of Ecological Risk

The Screening Level Ecological Risk Assessment identified the following Contaminants of Potential Ecological Concern (CPECs): asbestos, metals, pesticides, PCBs, PAHs, other SVOCs, and a limited number of VOCs. These contaminants were evaluated in the Baseline Ecological Risk Assessment (BERA) (TtFWI, 2005c) to determine if they were Contaminants of Ecological Concern (CECs). Aquatic and terrestrial communities were evaluated as shown in the conceptual site model discussed above. The results of the BERA are summarized in Table 3.

Receptor Group	Area of Concern (AOC)	Contaminants of Ecological Concern (CECs)	Principle Exposure Route Identified	Toxicological Endpoint
Benthic Community	--	--	--	--
Pelagic Aquatic Community	--	--	--	--
Terrestrial Plants	--	--	--	--
Soil Invertebrates and Microbial Process	Amphitheater Quarry & Historic Bridge	Asbestos	NA	Moisture Reduction
Insectivorous Mammals	Maintenance Area Ruins, Pennsylvania Department of Transportation Quarry & Waste Channel and Railbed	Mercury	Ingestion of Terrestrial Invertebrates	Mortality + weight loss
Insectivorous Birds	Waste Channel and Railbed & Small Additional Quarry Maintenance Quarry 3 Maintenance Area Ruins	Lead 4,4'-DDT 4,4'-DDE	Ingestion of Terrestrial Invertebrates Ingestion of Terrestrial Invertebrates Ingestion of Terrestrial Invertebrates	Reproductive Impairment Reproductive Impairment Reproductive Impairment
Omnivorous Birds	--	--	--	--
Piscivorous Mammals	--	--	--	--
Carnivorous Mammals	--	Asbestos	Incidental Ingestion of Surface Soil	Gastrointestinal Inflammation ¹
Carnivorous Birds	--	--	--	--
Small Herbivorous Mammals	Amphitheater Quarry & Historic Bridge	Asbestos	Incidental Ingestion of Surface Soil	Gastrointestinal Inflammation ¹
Large Herbivorous Mammals	--	--	--	--

Notes:
 NA: Not Applicable
 -- No COCs identified in any of the AOCs
¹ End point not a population level effect

The aquatic communities were evaluated by direct methods: a direct community assessment in the case of benthic macroinvertebrates; and aquatic toxicity tests for the pelagic community. The BERA determined that there were no significant risks for the aquatic communities.

The terrestrial plant community was evaluated based on a comparison of surface soil contaminant data to screening level benchmarks for phytotoxicity and direct observations of vegetation. While soil concentrations of some metals greater than benchmark values were found in some AOCs, the lime-rich soil reduces the bioavailability of metals, and no observations of stressed vegetation or areas devoid of vegetative cover were noted. The BERA determined that there were no significant risks for the terrestrial plant communities.

The terrestrial soil invertebrate and microbial process assessment endpoint relied upon two lines of evidence: 1) comparison of analytical data to screening level benchmarks deemed protective of soil invertebrates and microbial processes; and, 2) comparison of analytical data to background concentrations. Results of the evaluation indicated that soil invertebrates (i.e., earthworms) may be at risk of moisture reduction from exposure to asbestos in the Amphitheater Quarry and Historic Bridge AOCs, and therefore asbestos was retained as a CEC.

For insectivorous small mammals (short-tailed shrew), exposure to CECs in surface soil in the Maintenance Area Ruins, Pennsylvania Department of Transportation Quarry, and Waste Channel and Railbed AOCs was identified as posing potential risk from mercury and vanadium in soil. Evaluation of these risks indicated that exposure was comparable to background exposure dosages for both metals; however, mercury was retained as a CEC due to its high potential for bioaccumulation.

For insectivorous small birds (American robin), exposure to one CPEC, lead, in surface soil indicated potential risk of reproductive impairment. Lead was therefore retained as a CEC (and is also a COC for human receptors). Potential risks of reproductive impairment were determined for 4,4'-DDT concentrations in Maintenance Quarry 3 AOC surface soil and 4,4'-DDE concentrations in the Maintenance Area Ruins AOC due to exceedence of the no observed adverse effects level (NOAEL), although the calculated effects levels from Site data did not exceed the lowest observed adverse effects level (LOAEL). These pesticides were retained as CECs due to their high potential for bioaccumulation.

For omnivorous birds (mallard duck), a low risk from magnesium exposure was identified from the near-shore Schuylkill River and Unnamed Tributary. However, comparison to the background concentration of magnesium revealed similar concentrations, and magnesium was not retained as a CEC. No other CECs were identified for omnivorous birds.

For piscivorous mammals (mink), the risk assessment and background evaluations did not identify significant risk from exposure to heavy metals, PCBs, pesticides, SVOCs, and VOCs for the near-shore Schuylkill River and Unnamed Tributary. Therefore, no CECs were identified for piscivorous mammals.

Carnivorous mammals (red fox) were found to be exposed to asbestos fibers via incidental ingestion of soil on a site-wide basis, based on evaluation of exposure pathways and modeling results. The toxicological endpoint for this exposure was potential risk of minor gastrointestinal inflammation. This endpoint did not produce a population level effect. A finding of low/no risk associated with exposure to heavy metals, PCBs, pesticides, SVOCs, or VOCs was determined for carnivorous mammals. Therefore, no CECs were identified for carnivorous mammals.

No risks from exposure to heavy metals, PCBs, pesticides, SVOCs, and VOCs were identified for carnivorous birds (red-tailed hawk) utilizing the habitats of the Site. Therefore, no CECs were identified for carnivorous birds.

Potential risk of reduced growth from exposure to magnesium was identified for small herbivorous mammals (eastern cottontail) in some AOCs. However, because magnesium is an essential nutrient, it was not considered a CEC. No other CECs were identified for herbivorous mammals.

No risks from exposure to heavy metals, PCBs, pesticides, SVOCs, and VOCs were identified for large herbivorous mammals (white-tailed deer) utilizing the habitats of the VFNHP ARS, therefore no CECs were identified for herbivorous mammals.

In summary, the Baseline Ecological Risk Assessment identified the following CECs for the Site: asbestos, lead, mercury, 4,4'-DDE, and 4,4'-DDT as summarized in Table 3. During risk management, it was determined that further action to reduce risk from 4,4'-DDE and 4,4'-DDT was not warranted because exposure point concentrations based on the RME concentrations were between the NOAEL and LOAEL for the American robin, uncertainties in the food chain model assumptions overestimated the effect, and the BERA did not result in an HI >1 for other potential receptors. Therefore, the need for Remedial Action to address risks to ecological receptors was based on the other CECs: asbestos, lead, and mercury.

Basis for Taking Action

Based on the findings of the human health and ecological risk assessments, which identified asbestos, arsenic, lead and PAHs as presenting unacceptable human health risks, and asbestos, mercury and lead as presenting unacceptable ecological risks, the Remedial Action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

VIII. REMEDIAL ACTION OBJECTIVES

The following Remedial Action Objectives (RAOs) were formulated to guide the development of remedial alternatives for the Site:

- Prevent direct contact (i.e., incidental ingestion, inhalation, and dermal absorption) by human and ecological receptors with contaminated soil above acceptable risk levels;
- Eliminate or minimize contaminant-related constraints to the full utilization of Park resources for all appropriate purposes consistent with NPS mandates; and
- Attain federal and state ARARs.

The following is a description of the development of Site-specific human health and ecological risk-based RGs for the Site. If the calculated human health or ecological-based RGs were less than Site-specific background concentrations, the Site-specific background concentrations were used as the RGs. All three metals identified as COCs or CECs are naturally-occurring and present in Site background soil samples. Site-specific background concentrations are presented in Table 4.

COC or CEC	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)
Arsenic	12.8	12.4
Lead	64.7	38.6
Mercury	0.15	0.17

Human Health Risk-Based Remediation Goals

Selection of Human Health Target Risk Levels

USEPA's *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (USEPA, 1991) indicates that response action is generally warranted at a site when the cumulative excess cancer risk is greater than 10^{-4} or the HI exceeds 1.0 based on RME assumptions. It is generally appropriate to develop risk-based RGs for media where RGs are not clearly defined by ARARs. Generally, risk-based RGs are not needed for any chemicals in a medium with a cumulative excess cancer risk of less than 1 in 10^{-6} and/or a HI less than or equal to 1.0, or where the RGs are clearly defined by ARARs.

Two primary factors have been considered for the Site in setting carcinogenic risk management-based RGs within the NCP-prescribed range of 1×10^{-4} to 1×10^{-6} :

- Key uncertainties identified in the HHRA process tended to over-estimate site risks; and
- The Site is located within a unit of the National Park System.

Assumptions introduced into the HHRA process were conservative in nature such that the final risk and hazard results tended to overestimate, rather than underestimate, the potential impacts of exposure to Site COCs. Therefore, a target risk level of 1×10^{-5} is considered protective and has been selected for the Site as the basis for the RGs. Consequently, risk-based RGs were calculated for combinations of AOC, media, receptors, and COCs where risks greater than 10^{-5} or HIs greater than 1.0 were determined to be present. Attainment of these risk-based RGs assumes that there will be no permanent or long-term impairment of the use and enjoyment of the resources at the Site, as required by the NPS Organic Act.

Development of Human Health Remediation Goals

As discussed above, COCs presenting human health risks greater than the target risk level of 10^{-5} are asbestos, arsenic, and potentially carcinogenic PAHs.

Because of the very limited number of locations where lead was identified as a COC, Site-specific cleanup goals were not developed. Instead, the USEPA-recommended screening values were used as risk-based RGs. USEPA recommends 400 mg/kg as a lead screening level for surface soil and 1,000 mg/kg as a lead screening level for subsurface soil under residential land use (USEPA, 1994). For commercial/industrial sites the lead screening level is 710 mg/kg (USEPA, 2001).

Risk-based RGs for asbestos, arsenic, and PAHs were conservatively calculated by assuming that the entire duration of exposure is spent within a single AOC (rather than proportionate to the surface area of the AOC to the total surface area of all AOCs as was assumed in the HHRA). This assumption is particularly conservative for recreational visitors to the Park as it is unlikely that a Park visitor would spend significant amounts of time within a single AOC (an hour a day, 3 days a week, 50 weeks a year for 30 years was the assumed exposure duration). Furthermore, it is the NPS' intent that all AOCs will be readily accessible to park visitors consistent with the requirements of the Organic Act. It is conceivable, however, that a significant portion of a construction worker's time could be spent within a single AOC for the duration of a particular construction project. Under these circumstances, and based on the results of the HHRA, risks may exceed 10^{-4} for a construction worker in the Upper Quarry portion of the Former Keene Plant AOC, the southern portion of the Waste Channel and Railbed AOC, and the Amphitheater Quarry AOC (see Table 2). These construction worker risk estimates and corresponding RGs are conservative in that they do not take into account the use of dust suppressants or personal protective equipment that would likely be used by construction workers to reduce exposure to asbestos during road or other construction.

The Human Health-based RGs are summarized in Table 5.

TABLE 5 SITE-SPECIFIC HUMAN HEALTH REMEDIATION GOALS FOR CONTAMINANTS OF CONCERN (COCs)					
COC	Units	Resident Remediation Goal	Construction Worker Remediation Goal ¹	Park Maintenance Worker Remediation Goal ¹	Site Visitor Remediation Goal
		Target Risk level 10^{-5}	Target Risk level 10^{-5}	Target Risk level 10^{-5}	Target Risk level 10^{-5}
Asbestos	%	0.7 TEM 2.7 PLM	0.4 TEM 1.5 PLM	1.9 TEM 7.6 PLM	49 TEM 190 PLM
Arsenic	mg/kg	12.8 ²	232	17.7	16.7
Benzo(a)anthracene	mg/kg	6.5	435	24.4	23.4
Benzo(a)pyrene	mg/kg	0.6	41.0	2.3	2.2
Benzo(b)fluoranthene	mg/kg	6.5	429	24.4	23.4
Dibenzo(a,h)anthracene	mg/kg	0.6	41.2	2.3	2.2
Indeno(1,2,3-cd)pyrene	mg/kg	6.5	NA	24.4	23.4
Lead	mg/kg	400 ³	710 ³	710 ³	NA

¹ Worker exposure to surface soil only, calculated carcinogenic risk for subsurface soil exposure was less than 1×10^{-6}
² Site-specific background
³ Based on USEPA recommended risk based screening criteria
TEM = analyzed by Transmission Election Microscopy
PLM = analyzed by Polarized Light Microscopy
NA = Not Available

Ecological Risk-Based Remediation Goals

Selection of Target Risk Levels for Ecological Receptors

USEPA's *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (USEPA, 1991) indicates that, in assessing the potential for unacceptable risk to ecological receptors, a critical question to be answered is "At what level of ecological organization should risk be evaluated?" or "What is ecologically significant?" The National Park System, including the ecological systems within the Park System, is considered to be among the most highly valued of all public land resources. As a result, a conservative approach is appropriate in evaluating if identified risks in units of the National Park System are ecologically significant and should therefore be remediated. Given the degree of assessment uncertainty at the Site and the sensitivity of estimating risk to ecological resources within a unit of the National Park System, the ecological RGs are based on contaminant concentrations that would yield HQ values of 1. These RGs are shown in Table 6 below. In some cases contaminant concentrations would have to be reduced to below background to achieve an HQ of 1. For these situations, background (for naturally-occurring analytes) is identified as the remediation goal.

The following AOCs were identified as presenting a risk based on the ecological assessment endpoints in the BERA:

- Waste Channel and Railbed AOC: Lead bioaccumulation within the food chain resulting in the excess risk of reproductive impairment in insectivorous birds (American robin).
- Maintenance Area Ruins, Pennsylvania Department of Transportation Quarry, and Waste Channel and Railbed AOCs: Mercury bioaccumulation within the food chain resulting in the excess risk of premature mortality and weight loss in insectivorous small mammals.
- Amphitheater Quarry and Historic Bridge AOCs: Excess risk from moisture loss due to direct contact with asbestos in soil to soil invertebrates (earthworm).

Ecological risk is managed to protect populations, not individuals, unless threatened or endangered species are involved. The BERA did not identify any threatened or endangered species potentially impacted by Site contaminants.

The ecological risk-based RGs for CECs are presented in Table 6.

CEC	Units	Soil Invertebrates (Earthworm)	Insectivorous Mammal (Short-tailed Shrew)	Insectivorous Bird (American Robin)
Asbestos	%	0.45 ¹	HQ<1 ²	NA ³
Mercury	mg/kg	0.15 ⁴	0.15 ⁴	0.15 ⁴
Lead	mg/kg	500 ¹	HQ<1 ²	64.7 ⁴

¹ Benchmark value (Efroymson, *et al.*, 1997)
² HQ<1 Calculated hazard quotient was less than 1 indicating insignificant risk
³ NA = Not a CEC for the receptor group
⁴ Site Specific Background

Remediation Goal Verification

Consistent with the requirements in Appendix F to this ROD, a remediation goal verification program will be adopted that provides assurance that when determinations are made under the verification program that the Site remediation goals are met, such determinations are correct. The number of verification samples taken will be sufficient to provide assurance that the relevant human and ecological receptors can safely use the Site, consistent with the analyses provided in the Site human health and ecological risk assessments.

Summary

The overall risk management-based remediation goals (human health and ecological risk) for the Site are presented in Table 7.

COC/CEC	Units	Waste Channel Railbed –North AOC		All other AOCs	
		Remediation Goal	Basis	Remediation Goal	Basis
Asbestos	%	0.4 TEM 1.5 PLM	Construction Worker Risk 10 ⁻⁵	0.4 TEM 1.5 PLM	Construction Worker Risk 10 ⁻⁵
Arsenic	mg/kg	12.8	Site-Specific Background ¹	12.8	Site-Specific Background ¹
Benzo(a)anthracene	mg/kg	6.5	Resident Child/Adult Risk 10 ⁻⁵	23.4	Site Visitor Risk 10 ⁻⁵
Benzo(a)pyrene	mg/kg	0.6	Resident Child/Adult Risk 10 ⁻⁵	2.2	Site Visitor Risk 10 ⁻⁵
Benzo(b)fluoranthene	mg/kg	6.5	Resident Child/Adult Risk 10 ⁻⁵	23.4	Site Visitor Risk 10 ⁻⁵
Dibenzo(a,h)anthracene	mg/kg	0.6	Resident Child/Adult Risk 10 ⁻⁵	2.2	Site Visitor Risk 10 ⁻⁵
Indeno(1,2,3-cd)pyrene	mg/kg	6.5	Resident Child/Adult Risk 10 ⁻⁵	23.4	Site Visitor Risk 10 ⁻⁵
Lead – Surface 0-0.5'	mg/kg	64.7	Site-Specific Background ²	64.7	Site-Specific Background ²
Lead – Sub-surface >0.5'	mg/kg	400	USEPA Screening Criteria Residential	710	USEPA Screening Criteria Worker
Mercury	mg/kg	0.15	Site-Specific Background ³	0.15	Site-Specific Background ³

¹ Calculated human health risk-based exposure point concentration at 1 x 10⁻⁵ risk level was less than site-specific background concentration, so site specific background concentration was set as the RG.

² Calculated ecological exposure point concentration for lead that resulted in an HQ>1 for insectivorous bird was less than the site specific background concentration. Therefore, the RG was set at the site-specific background concentration.

³ Calculated ecological exposure point concentration for mercury that resulted in an HQ>1 for insectivorous small mammal was less than the site-specific background concentration. Therefore, the RG was set at the site-specific background concentration.

TEM = analyzed by Transmission Election Microscopy
PLM = analyzed by Polarized Light Microscopy

IX. DESCRIPTION OF ALTERNATIVES

The following comprehensive remedial alternatives were developed and evaluated in the FS:

- FS Alternative 1: No Action
 - FS Alternative 2: Capping with Limited Excavation and Off-site Disposal
 - FS Alternative 3a: Soil Stabilization with Limited Capping and Excavation
 - FS Alternative 3b: Soil Stabilization with Limited Excavation
 - FS Alternative 4: Shallow Excavation with Off-Site Disposal
 - FS Alternative 5: Complete Excavation with Off-site Disposal
- FS Alternative 4 is the Selected Remedy. Each of the alternatives is further described below.

Overview of Alternatives Considered

FS Alternative 1: No Action

The No Action alternative provides a baseline for evaluation of the alternatives and is required for inclusion in the FS by the NCP. Under this alternative, no cleanup or containment measures regarding Site contamination would be taken.

FS Alternative 2: Capping with Limited Excavation and Off-site Disposal

The Capping alternative involves containment/isolation of contaminated soil through placement of a 1.5 foot thick soil cap covered with 0.5 feet of topsoil. Following cap construction, the area would be planted similar to surrounding areas.

Capping would not be feasible in portions of the Waste Channel and Railbed AOC due to the presence of wetlands, the need to maintain flow capacity of the existing drainage channel, and being in a floodplain; therefore, in those areas excavation of the contaminated soil (and replacement with clean soil) and disposal at a permitted off-site facility was assumed.

FS Alternative 3a: Soil Stabilization with Limited Capping and Excavation

Soil stabilization involves injection and mixing of reagents in the contaminated soil to create a stable, cement-like matrix in which the contaminants are bound and become immobilized. The stabilized soil is then covered with 0.5 feet of topsoil and revegetated.

Stabilization is not feasible where steep slopes are present in portions of the Former Keene Plant and Amphitheatre Quarry AOCs due to implementation difficulties. It is also not appropriate where there are numerous mature trees, such as in portions of the Waste Channel and Railbed and Historic Bridge AOCs, since much of the contaminated soil to be stabilized would come out with the stumps of the trees that must be removed prior to stabilization. Capping, however, would be feasible in these areas and is assumed there under this alternative instead of stabilization.

As with capping, stabilization is not feasible in portions of the Waste Channel and Railbed AOC due to wetlands and floodplain issues, and the need to maintain the flow capacity of the channel (the soil volume increases when the soil is stabilized). Therefore, excavation of the

contaminated soil in the drainage channel, wetlands, and floodplain portions of this AOC (and off-site disposal at a permitted facility) is assumed instead of stabilization.

FS Alternative 3b: Soil Stabilization with Limited Excavation

As with FS Alternative 3a, this alternative relies on soil stabilization in most AOCs to bind and immobilize the contaminants. However, in all AOCs where stabilization is not feasible (as described under Alternative 3a above), excavation with off-site disposal is assumed rather than utilizing capping in selected areas as in Alternative 3a.

FS Alternative 4: Shallow Excavation with Off-Site Disposal (the Selected Remedy)

Shallow excavation with off-site disposal involves excavation of between 1.5 and 3 feet of soil where clean-up standards are exceeded (only the shallow soil, i.e., between 0 and 24 inches, poses unacceptable risks to visitors and residents). Excavated soil will be transported and disposed in an appropriately permitted landfill. Clean soil covered with topsoil will be used as backfill, and disturbed surfaces will be restored through seeding and replacement of shrubs and trees, replacement of pavement, etc.

The variability of the proposed depths of excavation under this alternative (i.e., 1.5 to 3 feet as described in the FS) is due to the differences in the depths of contamination among the AOCs as measured during the RI. In some areas, the proposed excavation depths will remove all of the contaminated soil in those locations since the RI data indicate that contaminants are only present in the shallow soil there. For example, where contaminants were only detected in the top 6 inches, excavation up to a depth of 1.5 feet will be implemented (an additional 12 inches of excavation depth (over-excavation) was added in the FS to be conservative), which will result in the removal of all of the contaminated soil at that location. Similarly, in areas where contaminants were detected up to a depth of 24 inches, a 30 to 36 inch depth of excavation will be implemented to confidently remove all the contaminants. The allowance for over-excavation may be reduced during final design (e.g., to 6 inches) from the 12 inches assumed in the FS if a higher degree of confidence in contaminant distribution is achieved through pre-design sampling.

In other locations, contaminants were detected at depths greater than 24 inches. For example, in the Amphitheater AOC asbestos was detected at depths up to 35 feet as a result of historical dumping of waste materials that were subsequently covered with clean soil. The RI demonstrated that the contamination at these depths is not leaching or migrating and does not pose a risk unless excavated. In such locations, the excavation depth will be 24 inches. Because this alternative will leave in place deep contamination, institutional controls will be implemented to ensure the protection of Park maintenance and construction workers if temporary construction or utility-related excavations in this soil are required in the future. To alert construction or maintenance workers to the presence of contaminated soil at depth, a warning layer will be installed at the lowest point of remedial excavation to serve as an indicator of potential contamination beneath that layer for future construction or utility activities. Such activities will conform to Site Institutional Controls.

FS Alternative 5: Complete Excavation with Off-site Disposal

FS Alternative 5 includes removal of all contaminated material and disposal at a permitted off-site facility and represents the opposite end of the spectrum from No Action. It includes excavation of all detected contaminants (i.e., metals, VOCs, SVOCs, pesticides, PCBs, and/or asbestos) regardless of concentration. This alternative involves excavation in more areas of the Park and in many places to much greater depths than in FS Alternative 4 (Shallow Excavation).

Common Elements and Distinguishing Features of Each Alternative

With the exception of FS Alternative 1 (No Action), all of the alternatives would involve excavation of contaminated soil/sediment in wetlands and flood plains and replacement with clean soil/sediments to achieve compliance with ARARs specific to those areas. In addition, FS Alternatives 2 (Capping) and 3a/3b (Stabilization) would include excavation of a portion of the Waste Channel to maintain its function as a storm water conveyance channel. FS Alternatives 3a/3b (stabilization) are not feasible in areas of mature trees and steep slopes. In those areas, the contaminated soil would be excavated or capped (FS Alternative 3a) or excavated with off-site disposal (FS Alternative 3b).

In FS Alternative 2, all soil that presents unacceptable risk would be capped except in flood plains, wetlands, and a portion of the Waste Channel (to maintain a flow channel). Approximately 37,500 yd³ of contaminated soil would be capped over discrete remediation areas totaling approximately 10.2 acres, and approximately 14,200 yd³ of soil would be excavated over a total area of 3.7 acres in the Waste Channel and Railbed AOC.

In FS Alternative 3a, soil in most areas to be remediated would be stabilized. However, remediation areas with mature trees and/or steep slopes would be capped and the soil in flood plains, wetlands and a portion of the Waste Channel would be excavated and disposed off-site. Approximately 14,600 yd³ of soil would be stabilized over discrete remediation areas totaling approximately 5.4 acres, approximately 22,900 yd³ of soil would be capped over approximately 4.7 acres, and approximately 14,200 yd³ of soil would be excavated over a total area of 3.7 acres in the Waste Channel and Railbed AOC.

As with FS Alternative 3a, soil in most areas to be remediated would be stabilized in FS Alternative 3b. However, remediation areas with mature trees and/or steep slopes and the soil in flood plains, wetlands and a portion of the Waste Channel and Railbed AOC would be excavated and disposed off-site. Approximately 14,600 yd³ of soil would be stabilized over discrete remediation areas totaling approximately 5.4 acres, and approximately 37,100 yd³ of soil would be excavated over a total area of 8.5 acres.

In FS Alternative 4 (the Selected Remedy), all shallow soil that presents unacceptable risk would be excavated to a depth of up to 3 feet (which includes up to 12 inches over-excavation to account for uncertainty) and disposed off-site. Approximately 51,700 yd³ would be excavated from 29 discrete remediation areas totaling approximately 13.9 acres.

In FS Alternative 5, all soil containing any detected contaminants would be excavated, resulting in approximately 2,150,000 yd³ being excavated from 48 discrete remediation areas totaling approximately 56 acres. Implementation of Alternative 5 would meet all ARARs and obviate the need for Institutional Controls and 5-year reviews. Nevertheless, this alternative is considered cost prohibitive, with an estimated cost nearly 30 times that of the Selected Remedy. Complete Excavation also would require more than 10 years to implement, as compared to an estimated 3 to 4 years for the Selected Remedy. Such a lengthy construction period increases the short and medium-term disruption of Park operations, visitor access, and local traffic patterns, as well as increasing the risk of accident or injury associated with prolonged construction activity.

In FS Alternatives 2 and 3a/3b, contaminated soil would be left in place and contained via capping or stabilization. In FS Alternative 4, some contaminated soil below the depth of excavation will be left in place in certain AOCs. Because all four of these alternatives (2, 3a, 3b, and 4) would leave some contaminated soil on-site, Section 121(c) of CERCLA requires that five-year reviews be performed to evaluate the effectiveness of the remedial action over time. In addition, because of the deep contamination being left in place, institutional controls would be required to control and manage potential risks associated with future excavation activities performed by Park maintenance or construction workers.

In FS Alternative 5, no contaminated soil would be left in-place and no institutional controls would be needed. Therefore, five-year reviews of the effectiveness of the remedial action would not be required.

FS Alternative 2 is estimated to require two to three years to implement. FS Alternatives 3a/3b and 4 are estimated to require a slightly longer time frame to implement (three to four years). FS Alternative 5 is estimated to require over 10 years for implementation.

Expected Outcomes of Each Alternative

FS Alternative 1 (No Action): the long-term risk to human health and environment would not be reduced and much of the Site would continue to be unavailable for desired Park uses.

FS Alternatives 2 and 3a/3b (capping and soil stabilization): the risks associated with the contaminants remaining at the Site under these alternatives would not be eliminated, but the containment barrier (cap) or stabilized soil (soil stabilization) would effectively break the exposure pathway between the contamination and potential receptors thereby managing the risk appropriately. While access to the Site would not be restricted under FS Alternatives 2 and 3a/3b, maintenance of the cap or stabilized soil would need to be performed over time to maintain the integrity of these remedies. FS Alternatives 2 and 3a/3b would limit potential Park development and certain uses in the remediation areas to ensure that the integrity of the cap or stabilized soil matrix is not compromised. Placement of the cap and soil stabilization would also result in increases in the ground surface elevation altering the topography of the remediation areas from the surrounding areas. Revegetation of stabilized areas (FS Alternatives 3a/3b) with shrubs and trees may not be possible due to the solid soil matrix immediately beneath the topsoil cover.

FS Alternative 4 (shallow excavation and off-site disposal): all soil in the zone of potential exposure (top 24 inches) containing levels of contaminants that pose unacceptable risk to humans and the environment would be excavated, essentially eliminating the risk posed. With the exception of institutional controls to limit exposure to contaminated soil greater than two feet in depth, Park use of the remediation areas would not be restricted. Following excavation of the contaminated soil, the remediation areas would be backfilled to the original ground surface and revegetated with grasses, shrubs and trees.

FS Alternative 5 (complete excavation and off-site disposal): since all soil, regardless of contaminant concentration or depth, would be removed under this alternative, there would be no restrictions on future access or use of the Site. Following excavation of the contaminated soil the remediation areas would be backfilled to the original ground surface and revegetated.

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP prescribes the use of nine criteria to evaluate remedial alternatives in order to identify a preferred alternative. The nine criteria are summarized in Table 8. The first two criteria, Overall Protection of Human Health and the Environment, and Compliance with ARARs, are considered “threshold criteria.” An alternative must satisfy these threshold criteria in order to be eligible for selection.

A summary of the comparative analysis of alternatives using the nine NCP criteria that was presented in the FS is provided below. A summary table presenting the results of this comparative analysis is provided in Appendix B. FS Alternatives 1 and 5 are not included in the Appendix B summary table, or in the summary of the comparative analysis below, for the following reasons. FS Alternative 1, No Action, did not satisfy the threshold criteria and therefore cannot be considered for the Selected Remedy. FS Alternative 5, although meeting the threshold criteria, was not considered cost effective and greatly prolongs the construction period, thereby increasing disturbance to Park activities, local traffic patterns, and risks related to construction traffic.

TABLE 8 NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES	
1.	Overall Protection of Human Health and the Environment evaluates whether the alternative adequately protects human health and the environment from unacceptable risks posed by hazardous substances.
2.	Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets Federal, and more stringent State, environmental statutes, regulations, and other requirements identified for the Site, or whether a waiver of such requirements is justified.
3.	Long-Term Effectiveness and Permanence assesses the alternative in terms of the magnitude of residual risk remaining at the conclusion of remedial action and the reliability of long-term controls to permanently protect human health and the environment.
4.	Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment evaluates the alternative’s effectiveness in the reduction of the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

TABLE 8 (continued)
NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

5. Short-Term Effectiveness considers the length of time needed to implement the alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
8. State Acceptance assesses the State's position and key concerns related to the preferred alternative and other alternatives including comments on ARARs and the proposed use of ARAR waivers.
9. Community Acceptance assesses which components of the alternatives received support, reservations, or opposition from members of the community. Comments received on the Proposed Plan are an important indicator of community acceptance.

Overall Protection of Human Health and the Environment

FS Alternatives 2, 3a & 3b, and 4 would all provide a high degree of overall protectiveness of human health and the environment.

Compliance with Applicable or Relevant and Appropriate Requirements

FS Alternatives 2, 3a & 3b, and 4 are all expected to meet all identified ARARs.

Long-term Effectiveness and Permanence

Capping and Soil Stabilization (FS Alternatives 2 and 3a/3b) rely on maintenance and institutional controls to ensure long-term integrity and effectiveness of the remedy, while shallow excavation (FS Alternative 4) does not. Additionally, shallow excavation with off-site disposal permanently removes contaminated shallow soil that poses unacceptable risk to human or ecological receptors. Consequently, FS Alternative 4 is ranked higher than the other alternatives under this criterion.

Reduction of Toxicity, Mobility, or Volume through Treatment

Shallow Excavation with Off-Site Disposal (FS Alternative 4) would remove the contaminants in the top several feet of the remediation areas, thereby achieving reduction of volume of the waste present at the VFNHP. Capping (FS Alternative 2) would indirectly reduce toxicity by eliminating the exposure pathway. Soil Stabilization (FS Alternatives 3a & 3b) immobilizes the contaminants (making them less bioavailable), thereby reducing the toxicity of the contaminants. Since each alternative satisfies this criterion in different ways, they are ranked equally.

Short-term Effectiveness

Short-term impacts associated with Capping, Soil Stabilization, or Shallow Excavation could be readily controlled and/or restored in a reasonable period of time. Therefore, FS Alternatives 2, 3a, 3b, & 4 are ranked equally under this criterion.

Implementability

There are no implementability issues associated with Shallow Excavation or Capping. Soil Stabilization requires some specialized mixing equipment and will require bench/pilot testing to determine the effectiveness of stabilization, the best additives, and the optimum doses. Therefore, FS Alternatives 3a/3b (stabilization) are ranked lower than the other alternatives under this criterion.

Cost

The estimated present worth for each of the FS Alternatives evaluated is presented in Table 9. Capping (FS Alternative 2) has the lowest cost (of which about 35% is associated with long-term Operation and Maintenance (O&M), shallow excavation (FS Alternative 4) is in the middle of the cost range (with most of its cost (96%) being capital costs for construction), and stabilization (FS Alternatives 3a/3b) has the highest cost (with the O&M portion ranging from 33% for FS Alternative 3a to 17% for FS Alternative 3b). However, within the limits of the accuracy of FS-level cost estimating (+50%/-30% per the USEPA FS Guidance) these alternatives are all relatively similar in cost.

A 30-year O&M performance period was used in the present worth analysis in the FS as recommended by EPA guidance. As the effectiveness of the remedies in FS Alternatives 2 and 3a/3b is dependent on the long-term integrity of the cap or stabilized soil, O&M costs beyond the 30-year period would almost certainly be incurred. Therefore, if one were to extend the O&M beyond 30 years, the estimated present worth for these two alternatives would be higher than these presented in Table 9.

State Agency Acceptance

The Commonwealth of Pennsylvania has concurred with the Selected Remedy for reasons including protectiveness of human health and the environment, implementability, cost effectiveness, and consistency with NPS long-term management goals for the Site.

Community Acceptance

In general, the Selected Remedy received significant support from the community. There was no opposition to the Selected Remedy expressed during the Proposed Plan public meeting. Among the written comments, two supported the Selected Remedy, one preferred total removal (Alternative 5), and one preferred no action (Alternative 1). Specific responses by NPS to public comments are found in the Responsiveness Summary provided at the end of this ROD (page RS-1).

**TABLE 9
REMEDIAL ALTERNATIVES COST ESTIMATE SUMMARY**

AOC	FS Alternative 2 Capping with Limited Excavation		FS Alternative 3a Stabilization with Limited Capping		FS Alternative 3b Stabilization with Limited Excavation		FS Alternative 4 Shallow Excavation and Off-site Disposal	
	Total PW	O&M PW	Total PW	CAPITAL	Total PW	CAPITAL	Total PW	CAPITAL
MAR	\$399,918	\$221,455	\$742,095	\$457,955	\$742,095	\$284,140	\$362,785	\$362,785
FKP	\$1,380,974	\$764,716	\$2,863,905	\$1,752,420	\$2,815,697	\$1,063,101	\$1,825,408	\$44,796
WCRN	\$3,706,932	\$505,992	\$3,706,932	\$3,200,940	\$3,573,866	\$0	\$3,573,866	\$0
WCRS	\$2,405,006	\$952,825	\$2,405,006	\$1,452,181	\$3,658,929	\$0	\$3,658,929	\$0
HIB	\$280,461	\$155,306	\$280,461	\$125,155	\$212,769	\$0	\$212,769	\$0
AMQ	\$174,709	\$96,745	\$174,709	\$77,964	\$97,897	\$0	\$97,897	\$0
SIB	\$138,838	\$76,882	\$238,027	\$146,889	\$238,027	\$91,138	\$77,585	\$0
CVQ	\$307,606	\$170,337	\$529,159	\$326,550	\$529,159	\$202,609	\$265,285	\$0
SAQ	\$145,764	\$80,717	\$211,702	\$130,644	\$211,702	\$81,058	\$71,115	\$0
PDQ	\$291,859	\$161,618	\$647,728	\$399,721	\$647,728	\$248,007	\$1,103,518	\$190,259
Site Wide	\$9,562,065	\$3,459,593¹	\$12,129,724	\$8,127,417	\$13,057,868	\$2,243,052³	\$11,579,154	\$508,053⁴

PW = Present worth based on 30 years and a 7% discount rate.

Note: Site Wide Costs includes capital costs associated with institutional controls plus 20% contingency (\$57,000), and the present worth of costs associated with five-year reviews and legal/technical support (\$273,000).

FS Alternative 1, No Action, has no capital cost and \$10,000 annual O&M cost for 5-year reviews resulting in a present worth of \$124,090 (30 years, 7%).

FS Alternative 5, Complete excavation with off-site disposal, has a capital cost of \$350M and no O&M cost.

¹ FS Alternative 2 Site-wide annual O&M = \$278,796

² FS Alternative 3a Site-wide annual O&M = \$318,632

³ FS Alternative 3b Site-wide annual O&M = \$180,759

⁴ FS Alternative 4 Site-wide annual O&M = \$40,942

XI. PRINCIPAL THREAT WASTE

The NCP establishes an expectation that treatment to address principal threats posed by a site will be considered and used where practicable (NCP § 300.430(a)(1)(iii)(A)). In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile and which generally cannot be reliably contained or would present significant risk to human health or the environment should exposure occur. NPS has determined that the Site does not contain principal threat wastes.

XII. SELECTED REMEDY

Summary of the Rationale for the Selected Remedy

The following are the principal factors upon which the selection of FS Alternative 4 as the Selected Remedy is based:

- FS Alternative 4 provides a high degree of overall protectiveness to human health and the environment and maximizes long-term protectiveness
- FS Alternative 4 complies with all ARARs
- On-Site risk to Park visitors and residents is permanently eliminated by FS Alternative 4 by removing all contaminated soil containing levels of contaminants that pose unacceptable risk to humans and the environment
- FS Alternative 4 can be readily implemented with existing technologies that can be provided by a large number of vendors
- FS Alternative 4 is cost effective when compared to the other alternatives
- FS Alternative 4 is the most consistent with the management and goals of a unit of the National Park System.
- The Commonwealth of Pennsylvania agrees with the selection of FS Alternative 4 as the Selected Remedy
- The public did not express any reservations regarding the choice of FS Alternative 4 as the Selected Remedy

Detailed Description of the Selected Remedy

Active Remediation

The Selected Remedy includes excavation of shallow contaminated soil posing an unacceptable risk to human health and/or the environment and disposal at a permitted off-site facility. Only contaminants in the top two feet of soil pose a risk to park visitors or residents or ecological receptors. Therefore, the Selected Remedy only requires excavation of shallow soil, with an over-excavation of up to one foot as a measure of added protectiveness. Excavated contaminated soil will be characterized for off-site disposal to determine if the soil/waste being excavated is considered Subtitle C Hazardous Waste under RCRA which will require disposal at a landfill permitted for such waste. Soil determined not to be Subtitle C waste will be sent off-site for disposal at a permitted solid waste landfill. Once excavation activities have been completed, clean soil will be used as backfill to achieve pre-remediation grades, and the remediated areas will be restored to their original conditions through seeding and replacement of shrubs, trees,

pavement, and any other disturbed surfaces, and installation of erosion protection. All active remediation components shall be completed in accordance with Performance Standards developed during final design, which shall be developed in accordance with the basis for Performance Standards presented in Appendix C.

The imported backfill, common fill and topsoil, must comply with the NPS Clean Fill Criteria and the Commonwealth's Management of Fill policy (as further described in Appendix C), and must also meet the RGs for COCs/CECs. Compliance with these requirements will assure that no contaminated soil will be used as backfill.

The areas delineated in the FS for remediation under FS Alternative 4, and the associated estimated volumes of soil to be excavated from each remedial area, are provided in Appendix D. The areas and depths of soil to be excavated will be refined based on pre-design testing done prior to finalization of the Remedial Design.

Excavation in wetlands and flood-plain areas will be restored to pre-remediation topography and hydrology and be designed to provide the original wetlands functions, therefore will be compliant with wetlands and floodplains ARARs. Wetland restoration plans will be developed for the implementation of the Selected Remedy in wetland areas. Additionally, remedial design plans will include appropriate measures to protect nesting habitat of the red-bellied turtle (*Pseudemys rubriventris*), a Pennsylvania-listed threatened species known to exist along the shoreline of the Schuylkill River.

During excavation and truck loading activities, control methods and monitoring will be used to address potential risks of exposure to construction workers and the public due to contact and inhalation of contaminants. Other potential safety concerns include physical hazards related to construction. There will also be an increase in truck traffic and associated noise, and a potential increase in dust levels during construction. During construction, dust suppression techniques will be used and appropriate containers/covers utilized during transportation to minimize fugitive dust emissions. Appropriate personal protective equipment (PPE) will be utilized to protect site workers from direct contact and inhalation risks, and adherence to OSHA construction safety requirements will protect site workers from construction hazards.

Public access to construction areas will be restricted with appropriate site controls (e.g. construction fencing, road barricades, etc.), and on-going air monitoring performed to ensure that workers and the public are not exposed to unacceptable contaminant levels during remediation. Upon confirmation that the Selected Remedy has been completely and effectively implemented such that no Site COCs or CECs remain in surface soil or sediment above RGs, all Site-specific warning signs and fencing will be removed.

Potential adverse environmental impacts during construction will be addressed by erosion control measures to minimize soil transport during precipitation events. Additional measures to protect surface water quality, such as bypassing the perennial stream in the Unnamed Tributary during construction in that area, will be developed during Remedial Design. Construction

activities may result in the temporary displacement of resident species. Following restoration of the area, however, displaced species are expected to return in a relatively short period of time (i.e., a year or two).

Coordination with Park officials will be necessary during the planning and implementation of the Selected Remedy regarding construction staging, phasing, hours and routes of truck traffic, management of existing Park traffic, and access control. Coordination with the PADOT may be necessary to integrate the Selected Remedy with the Betzwood Bridge project in their common areas. Coordination with the Norfolk-Southern Railroad will also need to occur for activities adjacent to the Norfolk-Southern tracks.

Remedial Action is proposed in the following four of the five archeologically sensitive areas within the Site identified in the RI:

- The Northern Building Area within the Former Keene Plant AOC;
- The Historic Bridge AOC;
- The Maintenance Area Ruins AOC; and
- Portions of the Waste Channel Railbed AOC.

To properly identify historic and cultural resources, additional archeological surveys will be required prior to remedial construction in those archeologically sensitive areas that may be disturbed during construction. Final Remedial Design will identify methods to be utilized to avoid (or otherwise mitigate) impacts to these sensitive resources during construction.

Institutional Controls

The Selected Remedy leaves contaminated soil at depths greater than 3 feet (2 feet of excavation to remove contaminated shallow soils, plus up to one foot of over-excavation as a measure of added protectiveness) in several of the AOCs. In some of these areas an extensive amount of historic waste has been placed and subsequently covered with clean fill and, therefore, this waste is present at substantial depths below the existing ground surface. This subsurface contamination poses no human health risks for Park visitors or residents or ecological exposure risks if left undisturbed. However, this waste potentially poses a risk to construction workers who may encounter this material during future construction projects or to Park maintenance workers during future maintenance of subsurface utilities. Therefore, institutional controls are included in the Selected Remedy to manage these potential future risks. The form of the institutional controls will be determined during the design and implementation of the Selected Remedy.

Institutional controls may include development and implementation of Park policies that set forth procedures for characterization and management of potential risks associated with excavation and other intrusive activities in the Site or limit future use of these areas.

Summary of the Estimated Remedy Costs

The estimated costs of the Selected Remedy as developed in the FS are summarized in Table 10 and are presented in more detail in Appendix E to this ROD. The cost analysis is based on U.S. USEPA guidance documents that define the accuracy for an FS-level cost estimate as +50 percent to -30 percent. Present worth cost analysis was used in the FS to provide a common basis from which to compare the different alternatives that have expenditures that occur over different time periods. For the present worth analysis, a period of performance of 30 years and a discount rate of 7 percent were assumed.

The information in Table 10 (and in the more detailed cost summary provided in Appendix E to this ROD) is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the estimated costs are likely to occur as a result of new information and data collected during the pre-design and design phases for the Selected Remedy.

TABLE 10	
Estimated Costs for the Selected Remedy	
Item	Estimated Cost
Pre-design, Design and Oversight	
Pre-Design Sampling and Design	\$756,000
Oversight, Air monitoring, and Confirmatory sampling	\$413,000
Legal and Technical Support Related to IC Development	\$48,000
Total Indirect Capital Costs	\$1,217,000
Construction	
Excavation – mob/demob, clearing and grubbing, excavation	\$453,000
Clean fill, Topsoil, Compaction and Vegetation	\$1,244,000
Waste characterization and Off-site Disposal	\$6,312,000
Total Direct Capital Cost	\$8,009,000
Total Capital Costs	\$9,226,000
Contingency	
20 % of Total Construction Costs	\$1,845,000
Total Capital Costs plus Contingency	\$11,071,000
Operation and Maintenance	
Annual Operation and Maintenance Cost	\$41,000
Present Worth (30 years, 7%) of O&M Cost	\$508,000
TOTAL PRESENT WORTH	\$11, 579,000

Expected Outcome of the Selected Remedy

Upon completion of the Selected Remedy, the NPS will immediately be able to allow unrestricted access by Park visitors and residents to areas of the Site that are currently restricted due to the potential for exposure to unacceptable levels of contaminants. In addition, ecological receptors currently at risk at the Site may populate and occupy the Site without harm. The Selected Remedy will allow the entire Site, excepting those areas developed to accommodate Park visitor, resident, maintenance and operation activities, to succeed to its ultimate habitat potential which is upland forest. This full succession is expected to take 50 to 80 years.

The purpose of the Selected Remedy is to control risks posed by direct contact, inhalation and ingestion of contaminated soil by receptors. The results of the HHRA indicate that existing conditions at the Site pose an unacceptable human health excess lifetime cancer risk of up to 2.9×10^{-4} from exposure to contaminated soil and sediment. In addition, the results of the BERA indicate that existing conditions at the Site pose an unacceptable risk to ecological receptors based on HQs greater than 1. The Selected Remedy will address all soil contaminated with COCs and CECs that exceed the remediation goals identified in Table 7. These soil cleanup levels are protective of human health at the aggregate 1×10^{-5} excess cancer risk level defined as the Site remediation goal, and at the Site human health-based remediation goals for lead. These soil cleanup levels are also protective of ecological receptors at the Site based on ecological risk-based remediation goals for all CECs except in instances where an ecological risk-based remediation goal is below background concentrations. For these situations, background is identified as the remediation goal because CERCLA does not provide for cleanup to concentrations below background for naturally-occurring analytes. Following remediation, verification sampling as specified in Appendix F to this ROD will be performed to ensure that the identified remediation goals are achieved.

XIII. STATUTORY DETERMINATIONS

Under CERCLA §121, a remedial action must: be protective of human health and the environment (one of the two threshold criteria); comply with ARARs unless a statutory waiver is justified (the second of the two threshold criteria); be cost-effective; and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA §121 includes a preference for remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element. This section discusses how the Selected Remedy meets these statutory requirements and preference.

Protection of Human Health and the Environment

The Selected Remedy will maximize long-term protection of human health and the environment on-site by removing all soil that contains contaminants exceeding remediation goals and which are accessible by Park visitors and residents and ecological receptors (the top 24 inches), and disposing those materials off-site. The Selected Remedy will also control the risks of exposure to contaminated soil greater than two feet through the use of institutional controls. The Selected Remedy will allow the entire Site to be fully utilized for all appropriate Park purposes, consistent with the management and goals of a National Park.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy will comply with all ARARs (see Appendix G to this ROD).

Cost Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. Under the NCP, a remedy is considered cost-effective “if its costs are proportional to its overall effectiveness.” 40 CFR § 300.430(f)(1)(ii)(D). This NCP provision also states that

overall effectiveness is evaluated by assessing three of the five balancing criteria (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness is then compared to costs to determine cost-effectiveness.

The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its costs. The Selected Remedy will provide a degree of protectiveness of human health and the environment equal to FS Alternative 5 but at a much lower cost, and will provide a higher degree of protectiveness of human health and the environment than FS Alternatives 2, 3a and 3b at a comparable cost. The Selected Remedy provides a significantly higher degree of protectiveness of human health and the environment than FS Alternative 1 (No Action) although the Selected Remedy is much more costly. However, FS Alternative 1 does not satisfy the threshold criteria; therefore it cannot be selected as the remedy for the Site.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be utilized in a practicable manner at the Site as discussed below.

The Selected Remedy partially satisfies the requirement for utilization of permanent solutions by permanently removing from Park lands the soil that contains contaminants exceeding remediation goals and which are accessible by Park visitors and residents and ecological receptors (the top 24 inches).

Deeper contaminated soil that may be accessed by Park maintenance or construction workers cannot be practically removed permanently without potentially creating unacceptable short-term risks to Park visitors, residents, maintenance and construction workers, and ecological receptors; and without creating construction hazards and safety concerns, and significant disruptions to Park operations during the many years of construction that would be required. Therefore, permanent removal of the deeper contaminated soil is not considered practicable.

There are no known alternative treatment or resource recovery technologies for the primary contaminant at the site (asbestos). The screening of technology types and process options during the FS process determined that asbestos fibers cannot be effectively treated or recovered using any known treatment process including thermal, physical/chemical, volatilization, or biological treatment. Asbestos fibers do not migrate in the subsurface, so disposal at a controlled, licensed off-site solid or hazardous waste facility (included in the Selected Remedy) is the most practical method of managing this type of waste. The only potentially effective alternative *in-situ* technologies available for the contaminants at this site, capping and stabilization, were evaluated in FS Alternatives 2 and 3a/3b, respectively. These alternatives were found to be less protective of human health and the environment and less permanent than the Selected Remedy.

Preference for Treatment as a Principal Element to Permanently and Significantly Reduce the Volume, Toxicity, or Mobility of Hazardous Substances

As described above, the screening of technology types and process options performed during the FS did not identify treatment technologies or process options that could effectively remediate the site hazardous substances, either *ex-situ* or *in-situ*.

Under the Selected Remedy, no treatment would be performed. However, all soil containing contaminants exceeding remediation goals and which are accessible by Park visitors and residents and ecological receptors (the top 24 inches) would be excavated for disposal at an appropriately permitted off-site landfill. By removal of this soil from the Park lands the Selected Remedy significantly reduces the volume of hazardous substances in the Park. Further, once capped in the landfill the contaminants would be permanently rendered immobile (i.e., there would no longer be any erosion or air borne transport potential), and made inaccessible to receptors (indirectly eliminating toxicity), thus reducing the toxicity and mobility of hazardous substances. Although FS Alternative 2 (capping) also reduces mobility and toxicity (indirectly by isolation), it does not reduce the volume of hazardous substances in the Park. Similarly, FS Alternative 3 (soil stabilization) reduces mobility and toxicity (but not the volume) of hazardous substances, but its permanence is questionable since it depends on the long-term integrity of the stabilized soil matrix.

The Selected Remedy therefore significantly reduces the volume, toxicity, and mobility of hazardous substances, and does so more effectively than the other alternatives.

Five-Year Review Requirements

Because some contamination will remain at the Site in the subsurface, CERCLA requires five-year reviews. These reviews will assess the on-going effectiveness of the Selected Remedy, the physical condition of the remediated areas, the adequacy of the revegetation, and the effectiveness of the institutional controls at preventing unacceptable exposure to the deep contamination.

XIV. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the ARS was released for public comment in September 2006. The Proposed Plan identified FS Alternative 4, Shallow Excavation and Off-site Disposal, as the Preferred Alternative for remediation of the Site. Four written comments were received during the public comment period. After careful analysis of these comments, NPS has determined that no significant changes to the remedy as originally identified in the Proposed Plan are necessary or appropriate.

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RESPONSIVENESS SUMMARY

Overview of Public Comment Process

In accordance with Section 117 of CERCLA and section 300.430(f) of the NCP, NPS published a notice of availability and opportunity to comment on the Proposed Plan on September 17, 2006. The formal comment period began on September 22, 2006 and, at the request of the Commonwealth of Pennsylvania, was extended to November 6, 2006.

On September 28, 2006, NPS held a public meeting at VFNHP to solicit oral comments on the Proposed Plan from interested parties. Twenty six people attended the public meeting, including eight representatives of contracting or consulting firms, five citizens, four representatives of the Pennsylvania Department of Environmental Protection, one local government representative, one representative of a non-profit organization, and seven representatives of NPS. During the public meeting, NPS received comments from eight individuals. In addition, by the close of the formal comment period, NPS received four written comments.

The oral and written comments submitted by the public on the Proposed Plan, and NPS' response to each, are summarized below.

Comments Received/NPS Responses

Written Comments

NPS received written comments from two citizens who reside near the Park. One resident supported FS Alternative 5 (Complete Excavation with Off-Site Disposal). The other resident supported FS Alternative 1 (No Action).

The National Parks Conservation Association (NPCA) submitted a letter, on behalf of its 325,000 members nationwide, offering its full support for NPS' efforts to clean up contaminated soils at the Site. In the letter, NPCA expressed its position that the Preferred Alternative "appears to be the best method for cleaning up this site ... Excavating and removing contaminated soil is preferred to capping as it allows the park to adhere to the Organic Act of 1916..."

The Commonwealth of Pennsylvania, through its Department of Environmental Protection, submitted a letter stating, in part, "(s)ubject to the comments set forth in this letter, the Department concurs with the NPS Preferred Alternative as set forth in the Proposed Plan." The Commonwealth also advised NPS that it had collected information to analyze potential cost savings that might be realized from consolidating waste materials for disposal within the boundaries of the Park in lieu of off-site disposal:

Based upon this information, the Department no longer submits that the consolidation remedy will provide for a more cost effective response within the meaning of Section 121 of CERCLA, and therefore the Department endorses the Preferred Alternative. However, the Department submits that extraordinary attention must be paid to addressing any potential adverse affects (sic) on the public health and the environment from excavation with off-site disposal and its consequential increase in truck traffic.

Response:

NPS respects and appreciates the concurrence and support of the Commonwealth and NPCA on the Selected Remedy. NPS agrees that potential adverse effects arising from truck traffic associated with off-site disposal of contaminated material must be addressed to protect public health and safety.

With respect to FS Alternative 5, NPS has determined that complete excavation would not be cost effective and would entail undue disruption of Park activities over the long time period (estimated at more than ten years) required for implementation. The estimated \$355 million cost of implementing FS Alternative 5 did not provide commensurate risk reduction in comparison to the Selected Remedy's estimated \$11.6 million cost and substantially similar risk reduction.

With respect to FS Alternative 1, NPS rejected the no action alternative because it did not satisfy the two threshold remedy selection criteria. Specifically, NPS found that the no action alternative would not protect human health and the environment from unacceptable risks and would not attain ARARs.

Comments from the Public Meeting

1. Implementation Issues

Depth of excavation:

One commenter requested clarification regarding how NPS would determine the depth of excavation that would be necessary in different areas. The commenter questioned whether testing would be performed or if all areas of contamination would be excavated to a depth of three feet in a "one-size fits all" approach.

Response:

The Selected Remedy requires excavation of contaminated soil posing an unacceptable risk to human health and/or the environment and disposal at a permitted off-site facility. The RI determined that contaminants in the top two feet of soil may pose a risk to Park visitors or residents or ecological receptors based on the potential for exposure to contaminants.

In areas where contaminants were detected no deeper than 24 inches, a maximum 30-36 inch depth of excavation will be implemented to ensure complete removal of the contaminants that pose a risk to Park visitors, residents, or ecological receptors (the extra 6-12 inches of excavation will be included to be conservative – the final determination of the over-excavation amount will depend upon the level of confidence achieved regarding contaminant distribution once pre-design testing is completed). In other areas where contaminants are limited to shallower soils, excavation depths will be shallower. For example, where contaminants were only detected in the top 6 inches, excavation to a depth of 12-18 inches will be implemented which will result in the removal of all of the contaminated soil at that location. In other areas where contaminants are known to be present deeper than 24 inches, the excavation will stop at 24 inches and the remaining deeper contamination will be left in place. In those areas, a synthetic warning layer will be placed at the bottom of the excavation prior to backfilling and institutional controls implemented (see a more detailed description in response to the next comment below). The variability of the depths of excavation will be based on the differences in the depths of contamination among the AOCs as measured during the RI and additionally measured during pre-design testing.

The areas delineated in the FS for excavation, and the associated estimated volumes of soil to be excavated from each remedial area, are provided in Appendix D. The areas and depths of soil to be excavated will be refined based on pre-design testing done prior to finalization of the Remedial Design.

Verification that Remediation Goals (RGs) will be achieved:

One commenter asked for information concerning how NPS will verify that RGs and other cleanup objectives are achieved and that the remedy has succeeded.

Response:

Appendix F of the ROD establishes detailed RG verification procedures. Initially, contaminated soils will be excavated at the locations and to the depths as specified in the ROD or at revised locations and depths determined during Remedial Design. A pre-design sampling plan will be developed and implemented to confirm that excavating at the locations and to the depths established in the FS will achieve the RGs, or provide the basis for a revised excavation plan to achieve the RGs.

In areas where pre-design sampling data indicate that contaminated soils exceeding RGs are present at depths greater than two feet (determined during the pre-design testing), excavation will be completed to two feet and a suitable synthetic warning layer will be installed at the bottom of the excavation prior to backfilling to alert future construction and utility workers to the presence of contamination beneath the warning layer, and institutional controls will be established to control and manage exposure to Site contamination by Park maintenance and/or construction workers.

For all areas where pre-design data indicate that RG exceedances are limited to the top two feet, post-excavation verification sampling will be performed to verify that soils remaining within two feet of the ground surface meet the RGs set forth in Table 7 of this ROD.

Vertical verification samples will be collected from the top six inches of the base of the excavation in each 2500 square foot area (but in no case less than three locations within a discrete remediation area), except in areas where RG exceedances are known to exist deeper than 24 inches in which case a warning layer will be installed without additional vertical verification sampling, and the area backfilled with clean soil and institutional controls implemented (see response to prior comment above). In addition, regardless of the excavation depth, horizontal verification samples will be collected around the perimeter of the excavation sidewalls from 0-6 inches and 12-18 inches below the original ground surface. Horizontal verification samples will be collected approximately every 200 lineal feet around the excavation perimeter at no fewer than three approximately equally spaced locations (six samples) per remediation area.

In addition to these prescribed vertical and horizontal sampling locations, additional representative samples will be taken for asbestos analysis from any area of the excavation bottom or sidewall that visually has the appearance indicating the potential presence of asbestos fibers. All post-excavation sampling will be fully documented and the locations determined in the field with a GPS and mapped for future reference.

If the results of post-excavation verification sampling reveal that a base or perimeter sidewall sample exceeds the RGs, those areas will be subject to additional characterization and/or further excavation.

In the case where a vertical verification sample from the base of the excavation exceeds the RGs, the excavation will be extended to a minimum depth of 24 inches (if not already at that depth), and a warning layer installed and institutional controls implemented if the previous or an additional round of verification data indicate RG exceedances at or beneath the 24 inch deep excavation.

In the case where a horizontal verification sample from the sidewall of the excavation exceeds the RGs, additional sampling will be performed to delineate the horizontal extent of the RG exceedance in that area. Additional samples will be collected at the same density as the vertical verification sampling of a minimum of one location per 2500 square feet from 0-6 and 12-18 inches below the original ground surface until sample results are reported below the RGs, which will be used to define the new horizontal limits of excavation. The depths of excavation within the expanded area of excavation will be dependent upon the results of the individual depth samples. In some instances anthropogenic features, such as County Line Road and quarry walls, may be utilized to define the horizontal limit of additional excavation.

Finally, in accordance with Section 121(c) of CERCLA, because some contamination will remain at the Site in the subsurface, NPS will review the effectiveness of the Selected Remedy no less often than every five years. These reviews will assess the on-going effectiveness of the

Selected Remedy, the physical condition of the remediated areas, the adequacy of the revegetation, and the effectiveness of the institutional controls at preventing unacceptable exposure to the deep contamination.

Timeline for implementation of the Selected Remedy:

One commenter asked what the projected timeline was for designing and implementing the Selected Remedy.

Response:

NPS expects that remedial design activities will take between one and two years and that implementation of the Remedial Action will take an additional year or two.

2. Potential Off-site Sources or Migration

Two commenters asked whether the results of the RI, other investigations, or any other information available to NPS suggested either (1) that disposal of waste material from the Keene facility occurred in quarries or other locations beyond the boundaries of VFNHP or (2) that sources other than the Keene facility may have contributed to releases of hazardous substances at the Site.

Response:

The Commonwealth of Pennsylvania, Department of Environmental Protection, conducted the RI subject to NPS oversight. The RI included an investigation into the historic waste disposal practices of Ehret and Keene as well as a comprehensive field investigation that revealed remnants of the mechanisms by which Ehret and Keene disposed of wastes.

Based on these investigations, the Commonwealth concluded, and NPS concurs, that Ehret and Keene utilized disposal locations (e.g., quarries) and methods (e.g., slurring waste down the Waste Channel and Railbed) that were the most readily available. Readily available quarries were those located within Valley Forge State Park, which Ehret and Keene were authorized by the Commonwealth to use for disposal, and the Keene Quarry located on the Ehret/Keene property. NPS has also concluded that the results of the RI demonstrate that the full geographical distribution of contamination emanating from the Ehret/Keene facility has been established.

In addition, based upon the commingling of asbestos waste with other hazardous substances detected at the Site, along with the fact that only Ehret and Keene were authorized to dispose of wastes within the Site, NPS has concluded that it is likely that all of these substances originated from the operations of Ehret and Keene.

3. Other Technical Issues

One commenter questioned the rationale for shallow soil excavation called for by the Selected Remedy instead of just stabilizing or capping contaminated soils in place as contemplated by FS Alternatives 2, 3a, and 3b.

Response:

Under the Selected Remedy, contaminants in the top two feet that pose unacceptable risks will be excavated, essentially eliminating risks associated with those materials. Under the capping and soil stabilization alternatives, risks posed by contaminants in the top two feet would not be eliminated even though the containment barrier (cap) or stabilized soil would effectively break the exposure pathway between the contamination and potential receptors thereby managing the risk appropriately. However, maintenance of the cap or stabilized soil would need to be performed over time to maintain the integrity of these remedies. The possibility that the integrity of the cap or stabilized soil could be compromised in the future would remain. Consequently, the Selected Remedy will achieve a higher level of long term effectiveness and permanence than the capping and soil stabilization alternatives.

FS Alternatives 2, 3a, and 3b would limit potential Park development and certain uses in the remediated areas as necessary to ensure that the integrity of the cap or stabilized soil matrix was not compromised. Under the Selected Remedy, with the exception of institutional controls to limit exposure to contaminated soil greater than two feet in depth, Park use of the remediated areas will not be restricted. In addition, capping and soil stabilization alternatives would result in increases in the ground surface elevation altering the topography of the remediated areas from the surrounding areas. Successful revegetation of stabilized areas (Alternatives 3a/3b) with shrubs and trees might not be possible due to the solid soil matrix immediately beneath the topsoil. For these reasons, the Selected Remedy is more consistent with the management and goals of a unit of the National Park System.

Finally, within the limits of the accuracy of FS-level cost estimating (+50%/-30%), FS Alternatives 2, 3a, 3b, and the Selected Remedy are all relatively similar in cost. Moreover, as the effectiveness of the remedies in FS Alternatives 2 and 3a/3b is dependent on the long-term integrity of the cap or stabilized soil, O&M costs beyond the 30-year period included in the FS cost estimate would almost certainly be incurred. Extending the O&M costs beyond 30 years would increase the estimated present worth for FS Alternatives 2, 3a, and 3b above that presented in the FS.

4. Liability Issues

Three commenters raised issues regarding whether, and how many, potentially responsible parties (PRPs) have been identified by NPS. In written comments submitted to NPS, the Commonwealth of Pennsylvania reiterated the comment made by one of its representatives on

this topic at the public meeting. In addition, one commenter inquired why the Commonwealth of Pennsylvania is a PRP at the Site.

Response:

NPS has conducted a comprehensive investigation to identify PRPs and to pursue the recovery of response costs from responsible parties. Because the number and identify of PRPs at the Site is not relevant to the evaluation of remedial alternatives and the selection of the Selected Remedy, NPS has determined that it is inappropriate to address these comments in this Responsiveness Summary.

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Appendix A
Contaminants of Concern and Concentration Ranges

Table A-1
SVOCs by AOC

AOC	Units	Benzo(a)anthracene			Benzo(b)fluoranthene			Benzo(a)pyrene		
		Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #
MQ-1	ug/kg	190J	1,200J	4/12	160J	1,600J	4/12	200J	1,300J	4/12
MQ-2	ug/kg	NA	NA	NA	37J	37J	1/9	36J	36J	1/9
MQ-3	ug/kg	30J	180J	5/9	48J	170J	5/9	48J	200J	5/9
MQ-4	ug/kg	100J	300J	3/6	110J	310J	3/6	94J	330J	3/6
MAR	ug/kg	NA	NA	NA	2002-120J 2004-65J	2002-8,700 2004-19,000	2002-5/8 2004-4/6	2002-140J 2004-38J	2002-9,600 2004-11,000	2002-5/8 2004-5/6
FKP-UQ	ug/kg	2002-41J 2004-48J	2002-130,000 2004-51,000	2002-9/10 2004-10/11	2002-36J 2004-98J	2002-83,000 2004-49,000	2002-9/10 2004-8/11	2002-41J 2004-51J	2002-100,000 2004-30,000	2002-8/10 2004-9/11
FKP-LQ	ug/kg	21J	2,200	11/14	33J	1,400J	10/14	31J	2,000	10/14
FKP-FOOT	ug/kg	29J	2,000J	7/18	22J	1,600J	8/18	23J	1,700J	7/18
FKP-I	ug/kg	21J	1,100	3/11	28J	990	3/11	27J	1,300	3/11
FKP-NB	ug/kg	36J	360J	4/6	23J	310J	4/6	28J	320J	4/6
FKP-CLRPD D	ug/kg	120J	2,500	5/9	96J	2,100	3/9	110J	2,400	3/9
FKP-MISC	ug/kg	200J	200J	1/1	31J	31J	1/1	NA	NA	NA
WCR-N	ug/kg	2002-38J 2004-39J	2002-3,600 2004-13,000	2002-14/19 2004-4/6	2002-160J 2004-61J	2002-4,000 2004-18,000	2002-13/19 2004-3/6	2002-24J 2004-39J	2002-4,200 2004-12,000	2002-4/19 2004-4/6
WCR-S	ug/kg	2002-62J 2004-390J	2002-10,000 2004-3,300	2002-18/20 2004-4/5	2002-30J 2004-510	2002-6,100 2004-4,600	2002-19/20 2004-4/5	2002-27J 2004-220J	2002-7,300 2004-2,700	2002-19/20 2004-4/5
HIB	ug/kg	19J	50J	4/5	20J	47J	4/5	21J	47J	4/5
AMQ	ug/kg	25J	410	3/9	29J	350J	3/9	34J	420	3/9
SIB	ug/kg	53J	600J	7/8	34J	570J	7/8	33J	650J	7/8
WAP	ug/kg	38J	57J	3/6	34J	61J	3/6	39J	68J	3/6
PDQ	ug/kg	19J	1,100J	5/9	22J	970J	5/9	46J	1,100J	4/9
LVQ	ug/kg	19J	550J	2/10	570J	570J	1/10	710J	710J	1/10
CVQ	ug/kg	57J	510	2/8	67J	600	2/8	65J	530	2/8
SAQ	ug/kg	710J	1,300J	2/2	840	1,200	2/2	630J	1,200J	2/2

**Table A-1 (continued)
SVOCs by AOC**

AOC	Units	Indeno(1,2,3-cd)pyrene			Dibenz(a,h)anthracene		
		Min.	Max.	Detection #	Min.	Max.	Detection #
MQ1	ug/kg	100J	870J	4/12	300J	300J	1/12
MQ2	ug/kg	NA	NA	NA	NA	NA	NA
MQ3	ug/kg	29J	110J	5/9	52J	52J	1/9
MQ4	ug/kg	64J	190J	3/6	28J	100J	3/6
MAR	ug/kg	2002-82J 2004-650	2002-6,700 2004-6,400	2002-5/8 2004-3/6	2002-33J 2004-94J	2002-2,500J 2004-1,200J	2002-5/8 2004-2/6
FKP-UQ	ug/kg	2002-25J 2004-290J	2002-54,000 2004-14,000	2002-9/10 2004-7/11	2002-67J 2004-830J	2002-21,000J 2004-3,000J	2002-4/10 2004-5/11
FKP-LQ	ug/kg	22J	950J	10/14	51J	210J	5/14
FKP-FOOT	ug/kg	26J	1,100J	6/18	27J	440J	5/18
FKP-I	ug/kg	26J	640	2/11	240J	240J	1/11
FKP-NB	ug/kg	21J	230J	3/6	44J	95J	2/6
FKP CLRPPDD	ug/kg	55J	1,600	3/9	25J	570J	3/9
FKP-MISC	ug/kg	NA	NA	NA	NA	NA	NA
WCR-N	ug/kg	2002-88J 2004-1,000	2002-2,500 2004-4,900	2002-13/19 2004-2/6	2002-65J 2004-160J	2002-1,000J 2004-1,000J	2002-4/19 2004-2/6
WCR-S	ug/kg	2002-36J 2004-110J	2002-4,100J 2004-950J	2002-18/20 2004-4/5	2002-45J 2004-150J	2002-1,800J 2004-150J	2002-11/20 2004-1/5
HIB	ug/kg	27J	29J	2/5	NA	NA	NA
AMQ	ug/kg	41J	190J	2/9	85J	85J	1/9
SIB	ug/kg	40J	390J	6/8	24J	200J	4/8
WAP	ug/kg	43J	43J	1/6	NA	NA	NA
PDQ	ug/kg	280J	670J	3/9	180J	180J	1/9
LVQ	ug/kg	440J	440J	1/10	NA	NA	NA
CVQ	ug/kg	38J	310J	2/8	170J	170J	1/8
SAQ	ug/kg	380J	670J	2/2	150J	380J	2/2

Notes: ug/kg = micrograms per kilogram; J - result estimated; K - result biased high; NA - not analyzed; Detection # = number of detections/total number of samples

**Table A-2
Metals by AOC**

Location	Units	Arsenic (As)				Lead (Pb)				Mercury (Hg)			
		Min.	Max.	Detection #	Units	Min.	Max.	Detection #	Units	Min.	Max.	Detection #	
Background Surface	mg/kg	12.77				64.69				0.15			
Background Subsurface	mg/kg	12.4				38.58				0.17			
AOC	Units	Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #
MQ 1	mg/kg	1.4	16.5	12/12	1.4	82.7	12/12	0.03	0.71	9/12			
MQ 2	mg/kg	0.74L	7.4	8/9	0.93J	42.2J	9/9	0.03J	0.09J	4/9			
MQ 3	mg/kg	4.3	10	9/9	8.8	61.8	9/9	0.03	0.08	8/9			
MQ 4	mg/kg	0.43	9	6/6	0.93K	58.3J	6/6	0.03	0.13	5/6			
MAR	mg/kg	3.2	12.3	8/8	12.9J	275J	8/8	0.04	0.35	8/8			
FKP-UQ	mg/kg	2.8	9	9/10	4.2	33.9K	10/10	0.02	0.38	9/10			
FKP-LQ	mg/kg	3.4L	13.2	14/14	12.6	140J	14/14	0.02	0.08	13/14			
FKP-FOOT	mg/kg	0.48	28.8	17/18	0.9	248	18/18	2002-0.02 2004-0.148	2002-65.1K 2004-13.4	2002-11/18 2004-7/7			
FKP-I	mg/kg	0.96	9.1L	11/11	4.6	105	11/11	0.03	0.07	6/11			
FKP-NB	mg/kg	2.9	7.3	6/6	14.7K	102K	6/6	0.03K	0.15K	4/6			
FKP-NWP	mg/kg	1.1	9L	6/6	1.9	16.9	6/6	0.02	0.06	4/6			
FKP-CLR PDD	mg/kg	2002-2.7 2004-3.5	2002-58.8 2004-9.1	2002-9/9 2004-5/6	2002-11.6 2004-9.4J	2002-2,010 2004-2,120J	2002-9/9 2004-12/12	0.02	0.32	9/9			
FKP-MISC	mg/kg	8	8	1/1	28K	28K	1/1	0.12K	0.12K	1/1			
WCR-N	mg/kg	2L	21.6	19/19	2002-16.6 2004-24.9	2002-2,080J 2004-317	2002-19/19 2004-7/7	0.05	3.2J	19/19			
WCR-S	mg/kg	2002-2.6 2004-3.4	2002-43.3 2004-72	2002-20/20 2004-6/6	7.6	150	20/20	0.03	0.3	18/20			
HIB	mg/kg	3K	10.8	5/5	103K	91.2K	5/5	0.03	0.09	4/5			
AMQ	mg/kg	1.1	11.5	9/9	2.3J	59J	9/9	0.03	12.2	2002-4/9			
SIB	mg/kg	2.1	8.1	8/8	2.2J	118K	8/8	0.102J	5.71	2004-6/9			
WAP	mg/kg	0.74	9.9	6/6	2.2	32.6	6/6	0.02L	0.09	5/8			
								0.02	0.15	5/6			

Table A-2 (continued)
Metals by AOC

Location	Units	Arsenic (As)			Lead (Pb)			Mercury (Hg)				
		Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #		
AOC	Units											
PDQ	mg/kg	1.1L	16.4	9/9	2002-1.9 2004-224J	2002-1,440 2004-1,100J	2002-9/9 2004-6/6	0.05	0.43	5/9		
LVQ	mg/kg	1.2L	5.7	10/10	1.6	47	10/10	0.04	0.08	8/10		
CVQ	mg/kg	0.88	6.5	7/8	1.2	37.3K	8/8	0.04	0.07	3/8		
SAQ	mg/kg	2002-51.5 2004-0.739B	2002-94.3 2004-74.2	2002-2/2 2004-7/7	117	122J	2/2	0.09	0.1	2/2		

Notes: ug/kg = micrograms per kilogram; J - result estimated; K - result biased high; NA - not analyzed; Detection # = number of detections/total number of samples

**Table A-3
Pesticides by AOC**

AOC	Units	4,4'-DDE			4,4-DDD			4,4-DDT		
		Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #
MQ3	ug/kg	26	58	2/9	22	22	1/9	31	390	2/9
MAR	ug/kg	31	110	2/8	NA	NA	NA	NA	NA	NA
FKP-UQ	ug/kg	4.7J	400	3/10	4.2J	4.2J	1/10	NA	NA	NA
FKP-LQ	ug/kg	NA	NA	NA	NA	NA	NA	23	23	1/14
FKP-FOOT	ug/kg	24K	32K	2/18	NA	NA	NA	19K	20K	2/18
FKP-I	ug/kg	4.1	4.2J	2/11	3.6J	3.6J	1/11	NA	NA	NA
WCR-N	ug/kg	34J	34J	1/19	NA	NA	NA	NA	NA	NA
WCR-S	ug/kg	13	13	1/20	NA	NA	NA	NA	NA	NA
PDQ	ug/kg	NA	NA	NA	NA	NA	NA	120	120	1/9
SAQ	ug/kg	18	24	2/2	NA	NA	NA	NA	NA	NA

Notes: ug/kg = micrograms per kilogram; J - result estimated; K - result biased high; NA - not analyzed; Detection # = number of detections/total number of samples

Table A-4
Asbestos by AOC

AOC	Units	Surface 0-2 ft bgs			Subsurface 2-6 ft bgs			Subsurface >6 ft bgs		
		Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #
MQ 1	%	0.00828 TEM <1 PLM	0.0802 TEM 3 PLM	3/51	1	2	2/20	2	20	3/13
MQ 2	%	<0.00005	0.00005	3/35	<0.00005	0.00006	2/20	--	--	0/14
MQ 3	%	0.00055	0.00688	2/28	--	--	0/5	--	--	0/9
MQ 4	%	<0.00005	0.0008	3/18	<0.00005	<0.00005	2/6	--	--	0/5
MAR	%	<0.00005	0.00212	6/37	<0.00005	<0.00005	1/7	--	--	0/3
FKP-UQ	%	<0.00005	4.96238 TEM 10 PLM	18/49	0.00906 TEM 3 PLM	5	3/9	3	10	5/8
FKP-LQ	%	<0.00005	0.00032	3/24	--	--	0/2	2	5	7/21
FKP-FOOT	%	<0.00005	20	17/84	2	5	4/18	2	10	3/17
FKP-I	%	<0.00005	0.820 TEM 3 PLM	9/40	2	2	1/11	--	--	0/18
FKP-NB	%	<0.00005	.0153 TEM <1 PLM	4/26	--	--	0/9	--	--	NA
FKP-NWP	%	<0.00005	5	10/49	--	--	0/7	--	--	0/2
FKP-CLRPDD	%	<0.00005	0.0401	3/20	--	--	0/9	--	--	0/2
FKP-MISC	%	--	--	0/39	--	--	0/10	--	--	NA
WCR-N	%	<0.00005	2.6623 TEM 3 PLM	22/124	2	2	4/29	--	--	NA

**Table A-4 (continued)
Asbestos by AOC**

AOC	Units	Surface 0-2 ft bgs			Subsurface 2-6 ft bgs			Subsurface >6 ft bgs		
		Min.	Max.	Detection #	Min.	Max.	Detection #	Min.	Max.	Detection #
WCR-S	%	0.00979 TEM	14.573 TEM	78/347	<0.00005	0.01223 TEM 3 PLM	3/26	--	--	NA
HIB	%	1.2317 TEM	2.3983 TEM 10 PLM	10/38	2	3.8333 TEM 5 PLM	2/4	--	--	NA
AMQ	%	<0.00005	10.82065 TEM 10 PLM	4/74	5.93866 TEM 3 PLM	5.93866 TEM 3 PLM	1/15	3	20	8/13
SIB	%	<0.00005	3	9/45	--	--	0/6	--	--	0/5
WAP	%	<0.00005	0.1342 TEM	7/57	--	--	0/10	--	--	0/7
PDQ	%	--	--	0/21	--	--	0/2	--	--	0/7
LVQ	%	<0.00005	<0.00005	1/44	--	--	0/6	2	5	3/11
CVQ	%	0.00355	3	7/44	2	2	2/10	--	--	0/7
SAQ	%	<0.00005	0.19013	4/11	--	--	NA	--	--	NA

Notes:

TEM – analyzed by Transmission Electron Microscopy

PLM – analyzed by Polarized Light Microscopy

NA Not analyzed

-- No detections

Appendix B
Summary of FS Alternatives Evaluation

**TABLE B-1
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES**

Remedial Alternative		Evaluation Criteria						
		Threshold Criteria		Long Term Effectiveness	Reduction of Toxicity, Mobility and/or Volume	Short Term Effectiveness	Implementability	Cost (Present Worth: 7% Discount Rate 30 Years)
Overall Protection of Human Health and the Environment	Compliance with ARARs and TBCs							
FS Alternative 1: No Action	Not protective Contaminated soils would be left in place with no treatment or controls to mitigate any exposure pathways.	Not compliant Does not comply with Chemical-specific ARARs since contaminated soils remain. Does not comply with NPS Organic Act because future park visitors would be restricted from areas of the Park and other park uses would be impaired.	Not effective Under this alternative remedial actions would be undertaken. No institutional or engineering controls would be implemented. This alternative would not be effective in achieving RAOs in the long-term.	No reduction Does not result in reduction of toxicity, mobility, or volume of contaminants as no active remedial measures would be employed.	Effective Does not increase risks to workers or the public as a result of remedial activities. However, protection from human health or ecological risks would not be achieved under this alternative in the short-term or long-term.	Easily implementable Requires coordination with regulatory agencies for review of five-year assessment data and making decisions regarding any future remedial activities, if necessary. Consulting services for five-year reviews are readily available.	Low (\$0.1M) There are no capital costs for this alternative. The cost for this alternative is approximately \$125,000, assuming five-year reviews for 30 years. Potential future remedial action costs under this alternative could be substantial.	
FS Alternative 2: Capping with Limited Excavation	Protective Protects human health and the environment by eliminating soil exposure pathways. On-going monitoring and periodic cap maintenance would be required to ensure an appropriate level of protection over the long term.	Compliant Complies with identified ARARs.	Moderately effective The long term effectiveness of this alternative would be moderate because it would require continued integrity of the cap, a long-term O&M plan, and five-year reviews.	Some reduction Significant reduction of future air borne releases. Minor reduction in mobility by infiltration and erosion. No reduction of toxicity or volume through treatment. Indirect reduction in toxicity by eliminating the exposure pathway.	Moderately effective Use of appropriate PPE, dust suppression, and access controls would prevent contact and inhalation. Construction workers and the public, minimizing short-term risk. Site restoration is feasible in short-term.	Reasonably implementable Technically feasible, but portions of several AOCs have steep slopes and may require extra effort to construct the cap and protect it against erosion during the establishment of new vegetation.	Moderate (\$9.6M) Capital costs - \$6.1M. O&M and five-year reviews - \$279,000/year. Potential future remedial action costs would be relatively low.	

B-1

Red = Lowest of the comparative rankings
Green = Top comparative ranking (top two rankings shown)

**TABLE B-1
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES**

Remedial Alternative		Evaluation Criteria					Short Term Effectiveness	Implementability	Cost (Present Worth: 7% Discount Rate 30 Years)
		Overall Protection of Human Health and the Environment	Threshold Criteria	Long Term Effectiveness	Reduction of Toxicity, Mobility and/or Volume	Compliance with ARARs and TBCs			
FS Alternative 3a: Stabilization with Limited Capping and Excavation		Protective Provides protection of the environment by eliminating the soil exposure pathways for human and ecological receptors.	Compliant Complies with identified ARARs.	Moderately effective Eliminates human health and ecological risks. Site specific long-term effects due to weathering are unknown, so potential for degradation of the stabilized mass is uncertain. Long-term O&M would be required in addition to five-year reviews. There is some redundancy in protectiveness with the overlying top soil layer.	Moderate reduction Immobilizes the contaminants in the stabilized matrix, which results in reduction of toxicity and mobility. This technology has been demonstrated to reduce the mobility of contaminated waste by greater than 95%. Volume of impacted material would likely increase as a result of additives necessary to facilitate stabilization.	Moderately effective Use of appropriate PPE, dust suppression, and access controls would prevent contact and inhalation. Construction workers and the public, minimizing short-term risk. Site restoration is feasible in short-term.	Some implementation issues Implementation would require specially adapted surface soil tilling or mixing equipment. AOCs with excessive slope or forested vegetation have not been included. The reagents for stabilization are fairly common and readily available.	Moderate (\$12.1M) Capital costs - \$8.1M. O&M and five-year reviews - \$319,000/year. Potential future remedial action costs associated with this alternative would be relatively low.	
FS Alternative 3b: Stabilization with Limited Excavation		Protective See Above	Compliant See Above	Moderately effective See Above	Moderate reduction See Above	Moderately effective See Above	Some Implementation Issues See Above	Moderate (\$13.1M) Capital costs - \$10.8M. O&M and five-year reviews - \$181,000/year.	

Red = Lowest of the comparative rankings
Green = Top comparative ranking (top two rankings shown)

**TABLE B-1
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES**

Remedial Alternative		Evaluation Criteria					Cost (Present Worth: 7% Discount Rate 30 Years)	
		Overall Protection of Human Health and the Environment	Threshold Criteria Compliance with ARARs and TBCs	Long Term Effectiveness	Reduction of Toxicity, Mobility and/or Volume	Short Term Effectiveness		Implementability
FS Alternative 4: Shallow Excavation with off-site Disposal		Protective Eliminates human health and ecological risks posed by exposure to contaminated soil. Permitted off-site facilities are designed and operated to be protective of human health and the environment.	Compliant Complies with identified ARARs.	Effective Eliminates human health and ecological risks. Long-term institutional controls used to prevent future intrusive maintenance or construction activities.	Moderate reduction Removes contaminants in top two feet of soil from the site, but does not reduce contaminant mass since it would be moved to disposal facility. Contaminants deeper than three feet would remain. Toxicity would not be reduced by treatment, but exposure eliminated.	Moderately effective Use of appropriate PPE, dust suppression, and access controls would prevent contact and inhalation. Construction workers and the public, minimizing short-term risk. Site restoration is feasible in short-term.	Reasonably implementable No concerns with respect to technical feasibility for the Shallow Excavation with Off-Site Disposal alternative.	Moderate (\$11.6M) Capital costs - \$11.1M. O&M costs and five-year reviews - \$41,000/year. Potential future remedial action costs associated with this alternative would be relatively low.
FS Alternative 5: Complete Excavation with off-site Disposal		Protective Eliminates all potential risks due to exposure to contaminated soil. Permitted off-site facilities are designed and operated to be protective of human health and the environment.	Compliant Complies with identified ARARs.	Very effective Eliminates human health and ecological risks. Permitted off-site disposal facilities are designed and operated to mitigate potential risks to human health and the environment so a transfer of risk to the off-site facility is not likely. No reliance on long-term institutional controls to manage future risks.	Significant reduction Reduces toxicity by removing exposure pathway, but contaminant mass not reduced. Mobility management of contaminated soils in off-site disposal facility.	Not effective Due to the large extent of construction associated with this alternative, significant adverse environmental impacts and erosion are possible which would present potential risks to park visitors, residents, and maintenance and construction workers.	Poor implementability Extent and depth of excavation would take 10 years, require extensive shoring, and cause damage to park facilities. Significant access and traffic controls would be required.	Very high (\$350M) Capital costs - \$350M. No O&M requirements and associated costs. There would be no potential future remedial action costs associated with this alternative.

Red = Lowest of the comparative rankings
Green = Top comparative ranking (top two rankings shown)

Appendix C
Basis for Performance Standards for the Selected Remedy

Basis for Performance Standards for the Selected Remedy

I. Remedy Overall

The Selected Remedy shall be designed, constructed, monitored, and maintained in compliance with all statutes and regulations identified in Appendix G of this ROD, and shall achieve the Performance Standards established in final design for the individual components of the remedy. The basis for the development of the individual Performance Standards for this Site is presented in the following sections.

II. Contaminated Soil Removal

All soil or sediment within the top 24 inches in the Site that exceeds the Remediation Goals (RGs) summarized in Table 7 of this ROD shall be excavated and disposed in an appropriate off-site licensed facility. A complete vertical and horizontal delineation of the soils or sediments that must be excavated will be established during final design based on the previously collected data (i.e., during the RI) and any pre-design data that may be collected as necessary to fill data gaps. Verification that the full extent of contaminated soils and sediments that exceed the RGs have been removed shall be performed following excavation in each area and prior to backfilling with clean soil. Verification procedures to be followed shall be as described in Appendix F of this ROD as further specified in the final design. Prior to disposal, a determination will be made regarding what type of disposal facility is appropriate for the excavated material (e.g., RCRA Subtitle C or Subtitle D waste disposal facilities), relying on RI and pre-design data and/or through post-excavation material characterization testing.

III. Clean Backfill

Demonstration of compliance with the NPS Clean Fill Criteria and the Commonwealth's Management of Fill policy will be required for all imported soil material, common backfill, and topsoil. Imported soil will also be required to meet the chemical concentration RGs for all COCs and CECs as summarized in Table 7 of the ROD. The Contractor will be required to completely decontaminate all tools and equipment that come into contact with the contaminated soils during excavation, transport and disposal prior to handling any imported clean soil.

Common fill shall have the structural and physical characteristics necessary to support the expected overlying land uses or habitats (e.g., wetlands, forested uplands, parking, structures, etc.). Topsoil shall be fertile, natural soil, typical of the locality; substantially free of stones, roots, sticks greater than 2 inches in diameter or length, clay, peat, weeds and sod; and obtained from upland areas or be treated to be free of exotic plant seeds. Topsoil shall contain organic matter content appropriate for the intended and desired revegetation and restoration scenario (e.g., wetlands, grasslands, forest, etc.). Detailed specifications for both common fill and topsoil for the different land use/restoration areas shall be specified in the final design.

IV. Site Restoration/Revegetation

A diverse, effective, and permanent vegetation cover of plants native to the Park region shall be established over all natural areas disturbed during the implementation of the Remedial Action. Seeding and planting of the disturbed areas will stabilize the soil surface to prevent erosion but

also provide a base level of desirable vegetation that can succeed to the ultimate desired habitat. A Planting and Restoration Plan to restore the landscape at the VFNHP will be part of the final design and will form the basis for the revegetation performance standard. The Planting and Restoration Plan shall contain soil amendment requirements, seed mix specifications (including seed types and the specific required mix, placement locations, application rates, and germination requirements), tree and shrub specifications (including species, numbers and locations of plantings, planting requirements, etc.), specific survival requirements, and monitoring and maintenance requirements. Restoration will be required in both wetland and upland areas and will include the replacement of trees and shrubs and reseeding. In wetland areas, a wetland seed mix and wetland shrubs appropriate to the wetland type and local flora will be used. In order to limit the spread of invasive species such as *Phragmites australis*, the final design or Remedial Action Work Plan shall include specific requirements such as washing construction equipment before it is brought on site, providing certification of *Phragmites*-free top soil, etc.

Details for the revegetation performance standards shall be specified in the Planting and Restoration Plan and shall include minimum allowed percent vegetation coverage for grasses, and percent survival for shrubs and trees as measured one year from the date of completion of the plantings. The final design or Remedial Action Work Plan shall specify responsibilities for maintaining plantings during the first year including watering and irrigation, protection from deer browsing, etc, and may also include requirements (if appropriate) regarding plantings survival after year one. Methods for quantifying percent coverage and survival shall be included in the Planting and Restoration Plan.

During the first year evaluation period, the revegetated areas will be visually inspected on a quarterly basis to detect the establishment of any erosion gullies. If any erosion gullies deeper than 4" are found, these gullies will be filled with the approved topsoil, the gully areas will be regraded, and the areas will be re-treated with seed and mulch.

A full inspection of the plantings will be conducted one full year after the restoration in a given AOC is complete. If any areas are determined to fail the revegetation performance standards at the one-year evaluation, the area shall be reseeded with the approved seed mix and dead, damaged, or diseased plants shall be replaced. A second evaluation of these areas will be conducted after one full additional growing season. If this second one-year evaluation period is required, erosion inspections and necessary repairs will continue as described for year one.

At the conclusion of the second one-year evaluation period, the revegetation of all areas failing to meet the revegetation performance standards will be deemed unacceptable, and such areas will be replanted in a manner determined by NPS. The revegetation obligations will continue until the revegetation performance standards are met.

Appendix D
Remediation Areas, Depths and Volumes for the Selected Remedy

TABLE D-1 REMEDIATION AREAS, DEPTHS AND VOLUMES FOR THE SELECTED REMEDY				
AOC DESIGNATION	Designation of Remedial Area	Area (acres)	Depth (ft) ¹	Volume (yd ³)
Maintenance Area Ruins (MAR)	MAR-A	0.67	1.5	1621
	MAR-B	0.13	1.5	315
Former Keene Plant Area (FKP)	FKP-A	0.07	1.5	169
	FKP-B	0.90	1.5	2178
	FKP-C	0.79	1.5	1,912
	FKP-D	0.45	1.5	1,089
	FKP-E	0.08	1.5	194
	FKP-F	0.02	2.5	81
	FKP-G	0.06	2.5	242
	FKP-H	0.04	1.5	97
	FKP-I	0.01	2.5	40
	FKP-J	0.35	2.5	1,412
	FKP-K	0.02	3.0	97
	FKP-L	0.24	2.0	774
	FKP-M	0.39	1.5	944
Waste Channel and Railbed - North (WCRN)	WCRN-A	0.09	1.5	218
	WCRN-B	0.29	3.0	1,404
	WCRN-C	3.04	2.5	12,261
Waste Channel and Railbed - South (WCRS)	WCRS-A	4.5	3.0	21,780
Historic Bridge (HIB)	HIB-A	0.16	1.5	387
	HIB-B	0.02	1.5	48
	HIB-C	0.24	1.5	581
Amphitheater Quarry (AMQ)	AMQ-A	None	0	0
	AMQ-B	0.08	2.0	258
	AMQ-C	0.02	1.5	48
	AMQ-D	None	0	0
Silicate Bank (SIB)	SIB-A	0.08	1.5	194
PADOT Quarry (PDQ)	PDQ-A	0.59	2.0	1,904
Cave Quarry (CVQ)	CVQ-A	0.10	1.5	242
	CVQ-B	0.46	1.5	1,113
Small Additional Quarry (SAQ)	SAQ	0.03	2.5	121
	TOTAL	13.92	1.5 - 3.0	51,723
Notes: ¹ Depth corresponds to 1' deeper than deepest exceedance of RGs except PDQ and FKP-L where only the top 2 feet of RG exceedance is remediated (the RG exceedances deeper than 2 feet at PDQ and FKP-L are below the exposure zone for the target receptors).				

Appendix E
Detailed Cost Estimate Spreadsheets for the Selected Remedy

FS Alternative 4: Shallow Excavation and Off-site Disposal

AL-4 MAR Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 2% of the design costs
- * All remediation areas will be excavated, totalling 1,936 cy over 0.8 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 100 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes - 1 sample per 900 sf base
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNIP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Design</i>												
Engineering	200	hours	\$125	\$25,000								\$25,000
Pre-design sampling	1	lump sum	\$1,250	\$1,250								\$1,250
<i>Excavation</i>												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000								\$25,000
Air Monitoring & Oversight	17	days	\$640	\$10,880								\$10,880
Clearing and Grubbing (non-forested)	0	days	\$0	\$0					136	samples	\$40	\$5,440
Clearing and Grubbing (forested)	3	days	\$4,700	\$14,100								\$14,100
Excavation	3	days	\$1,220	\$3,659								\$3,659
Clean Fill	2	days	\$454	\$909					1,420	cy	\$15	\$21,300
Top Soil	1	days	\$192	\$192					710	cy	\$19	\$13,490
Compaction	2	days	\$454	\$909								\$909
Vegetation (non-forested areas)	0	days	\$0	\$0					0	acre	\$1,370	\$0
Vegetation (forested areas)	8	days	\$0	\$0					0.8	acre	\$4,000	\$3,200
Confirmatory Samples (pals)									39	samples	\$158	\$6,162
Waste Characterization									4	samples	\$950	\$3,800
Off-Site Disposal (non-haz)									1,936	cy	\$83	\$160,688
Off-Site Disposal (haz)									0	cy	\$330	\$0
Total Direct Construction Costs (TDCC)												
Contingency at 20%												
Total Capital Cost												
\$302,321												
\$60,464												
\$362,785												
Five-Year Review (each)												
Legal/Technical Support (40 hours each per year)												
Total O&M Costs												
Present Worth O&M (30-year, 7%)												
\$0												
Total Present Worth												
\$362,785												

Alt. 4 WCR - North Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totaling 13,883 cy over 3.42 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 500 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 500 ft base
- * Only waste from WCRN-A and portions of WCRN-C is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using total concentrations to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Design</i>												
Engineering	1,600	hours	\$125	\$200,000								\$200,000
Pre-design sampling	1	lump sum	\$10,000	\$10,000								\$10,000
<i>Excavation</i>												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000								\$25,000
Air Monitoring & Oversight	88	days	\$640	\$56,320								\$56,320
Clearing and Grubbing (non-forested)	1	days	\$1,075	\$1,075					704	samples	\$40	\$28,160
Clearing and Grubbing (forested)	2	days	\$8,166	\$16,333								\$2,205
Excavation	20	days	\$481	\$9,621								\$34,264
Clean Fill	16	days	\$489	\$7,824								\$21,421
Top Soil	4	days	\$205	\$819					12,237	cy	\$15	\$183,555
Compaction	16	days	\$489	\$7,824					3,034	cy	\$19	\$57,646
Vegetation (non-forested areas)	1	days	\$248	\$248					0.64	acre	\$1,370	\$877
Vegetation (forested areas)	28	days	\$735	\$20,572					2.78	acre	\$4,000	\$11,170
Confirmatory Samples (PAH, arsenic, lead, mercury, & asbestos)									166	samples	\$236	\$39,176
Waste Characterization									28	samples	\$950	\$26,600
Off-Site Disposal (non-haz)									9,674	cy	\$83	\$802,942
Off-Site Disposal (haz)									4,209	cy	\$330	\$1,388,970
Total Direct Construction Costs (TDCC)											\$2,978,222	
Contingency at 20%											\$595,644	
Total Capital Cost											\$3,573,866	
Five-Year Review (each)											site-wide	
Legal/Technical Support (40 hours each per year)											site-wide	
Total O&M Costs											\$0	
Present Worth O&M (30-year, 7%)											\$0	
Total Present Worth											\$3,573,866	

Alt. 4 WCR - South Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totalling 21,780 cy over 4.5 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 6,000 sf/day is assumed
- * Waste characterization sampling assumes 1 sample per 500 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 900 sf base
- * Only waste from the vicinity of WCRHA42B is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using total concentrations to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the YFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs
	Estimated Quantities	Units	Unit Price	Estimated Quantities	Units	Unit Price	Estimated Quantities	Units	Unit Price	
<i>Design</i>										
Engineering	2,000	hours	\$125							\$250,000
Pre-design sampling	1	lump sum	\$12,500							\$12,500
<i>Excavation</i>										
Mobilization / Demobilization	1	lump sum	\$25,000							\$25,000
Air Monitoring & Oversight	112	days	\$640							\$71,680
Clearing and Grubbing (non-forested)	1	days	\$5,713	1	lump sum	\$2,400				\$2,400
Clearing and Grubbing (forested)	1	days	\$13,395	1	lump sum	\$3,901				\$3,901
Excavation	31	days	\$487	1	lump sum	\$14,706				\$14,706
Clean Fill	25	days	\$511	1	lump sum	\$18,513				\$18,513
Top Soil	4	days	\$270	1	lump sum	\$27,552				\$27,552
Compaction	25	days	\$511	1	lump sum	\$3,474				\$3,474
Vegetation (non-forested areas)	2	days	\$428	1	lump sum	\$27,552				\$27,552
Vegetation (forested areas)	23	days	\$734	1	lump sum	\$500				\$500
Confirmatory Samples (lead, mercury, & asbestos)										
Waste Characterization										
Off-Site Disposal (non-haz)										
Off-Site Disposal (haz)										
Total Direct Construction Costs (TDCC)										\$3,049,107
Contingency at 20%										\$609,821
Total Capital Cost										\$3,658,929
Five-Year Review (each)										site-wide
Legal/Technical Support (40 hours each per year)										site-wide
Total O&M Costs										\$0
Present Worth O&M (30-year, 7%)										\$0
Total Present Worth										\$3,658,929

AIL 4 AMO Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totaling 307 cy over 0.1 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per500 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per900 sf base
- * No waste from AMO is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using totals concentration to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Design</i>												
Engineering	100	hours	\$125	\$12,500								\$12,500
Pre-design sampling	1	lump sum	\$625	\$625								\$625
<i>Excavation</i>												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000				\$0				\$25,000
Air Monitoring & Oversight	8	days	\$640	\$5,120	1	lump sum	\$450	\$450	64	samples	\$40	\$2,560
Clearing and Grubbing (non-forested)	1	days	\$134	\$134	1	lump sum	\$141	\$141				\$8,130
Clearing and Grubbing (forested)	1	days	\$118	\$118	1	lump sum	\$129	\$129				\$276
Excavation	1	days	\$193	\$193	1	lump sum	\$261	\$261				\$247
Clean Fill	1	days	\$156	\$156	1	lump sum	\$342	\$342	248	cy	\$15	\$3,720
Top Soil	1	days	\$24	\$24	1	lump sum	\$77	\$77	89	cy	\$19	\$1,691
Compaction	1	days	\$156	\$156	1	lump sum	\$342	\$342				\$4,218
Vegetation (non-forested areas)	1	days	\$31	\$31	1	lump sum	\$250	\$250	0.08	acre	\$1,370	\$110
Vegetation (forested areas)	1	days	\$148	\$148	1	lump sum	\$500	\$500				\$60
Confirmatory Samples (mercury & asbestos)									5	samples	\$38	\$290
Waste Characterization									1	samples	\$950	\$950
Off-Site Disposal (non-haz)									307	cy	\$83	\$25,481
Off-Site Disposal (haz)									0	cy	\$330	\$0
Total Direct Construction Costs (TDCC)											\$81,580	
Contingency at 20%											\$16,316	
Total Capital Cost											\$97,897	
Five-Year Review (each)											site-wide	
Legal/Technical Support (40 hours each per year)											site-wide	
Total O&M Costs											\$0	
Present Worth O&M (30-year, 7%)											\$0	
Total Present Worth											\$97,897	

Att. 4 SIB Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totalling 194 cy over 0.08 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 100 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 900 sf base
- * No waste from SIB is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using totals concentration to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
Design	100	hours	\$125	\$12,500								\$12,500
Engineering	1	lump sum	\$625	\$625								\$625
Pre-design sampling	1	lump sum	\$625	\$625								\$625
Excavation	1	lump sum	\$25,000	\$25,000								\$25,000
Mobilization / Demobilization	6	days	\$640	\$3,840	1	lump sum	\$150	\$150	6	samples	\$40	\$240
Air Monitoring & Oversight	1	days	\$134	\$134	1	lump sum	\$141	\$141				\$4,230
Clearing and Grubbing (non-forested)	0	days	\$0	\$0	1	lump sum	\$0	\$0				\$276
Excavation	1	days	\$122	\$122	1	lump sum	\$165	\$165				\$287
Clean Fill	1	days	\$91	\$91	1	lump sum	\$196	\$196	142	cy	\$15	\$2,130
Top Soil	1	days	\$19	\$19	1	lump sum	\$62	\$62	71	cy	\$19	\$1,349
Compaction	1	days	\$91	\$91	1	lump sum	\$196	\$196				\$1,430
Vegetation (non-forested areas)	1	days	\$31	\$31	1	lump sum	\$250	\$250	0.08	acre	\$1,370	\$110
Vegetation (forested areas)	0	days	\$0	\$0	1	lump sum	\$0	\$0				\$0
Confirmatory Samples (asbestos)					4	samples	\$40	\$160				\$160
Waste Characterization					1	samples	\$950	\$950				\$950
Off-Site Disposal (non-haz)					194	cy	\$83	\$16,102				\$16,102
Off-Site Disposal (haz)					0	cy	\$330	\$0				\$0
												\$64,654
												Contingency at 20%
												\$12,931
												Total Capital Cost
												\$77,585
												Legal/Technical Support (40 hours each per year)
												site-wide
												site-wide
												Total O&M Costs
												\$0
												Present Worth O&M (30-year, 7%)
												\$0
												Total Present Worth
												\$77,585

Alt. 4 CVO Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totalling 1,355 cy over 0.56 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 100 cy and analysis for TCLP, RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 100 sf base
- * No waste from CVQ is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using total concentrations to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
Design												
Engineering	200	hours	\$125	\$25,000								\$25,000
Pre-design sampling	1	lump sum	\$1,250	\$1,250								\$1,250
Excavation												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000								\$25,000
Air Monitoring & Oversight	13	days	\$640	\$8,320	1	lump sum	\$400	\$400	104	samples	\$40	\$4,160
Clearing and Grubbing (non-forested)	1	days	\$504	\$504	1	lump sum	\$530	\$530				\$1,034
Clearing and Grubbing (forested)	2	days	\$1,528	\$3,056	1	lump sum	\$1,677	\$1,677				\$3,205
Excavation	2	days	\$470	\$939	1	lump sum	\$1,152	\$1,152				\$2,091
Clean Fill	2	days	\$318	\$636	1	lump sum	\$1,372	\$1,372	994	cy	\$15	\$14,910
Top Soil	1	days	\$134	\$134	1	lump sum	\$432	\$432	497	cy	\$19	\$9,443
Compaction	2	days	\$318	\$636	1	lump sum	\$1,372	\$1,372				\$2,008
Vegetation (non-forested areas)	1	days	\$116	\$116	1	lump sum	\$250	\$250	0.3	acre	\$1,370	\$411
Vegetation (forested areas)	3	days	\$641	\$1,924	1	lump sum	\$1,500	\$1,500	28	samples	\$40	\$1,120
Confirmatory Samples (asbestos)									3	samples	\$950	\$2,850
Waste Characterization									1,355	cy	\$83	\$112,465
Off-Site Disposal (non-haz)									0	cy	\$330	\$0
Off-Site Disposal (haz)												\$0
Total Direct Construction Costs (TDCC)											\$221,071	
Contingency at 20%											\$44,214	
Total Capital Cost											\$265,285	
Five-Year Review (each)											site-wide	
Legal/Technical Support (40 hours each per year)											site-wide	
Total O&M Costs											\$0	
Present Worth O&M (30-year, 7%)											\$0	
Total Present Worth											\$265,285	

Att. 4 SAO Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totalling 121 cy over 0.03 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 500 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 500 sf base
- * No waste from SAQ is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using total concentrations to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Design</i>												
Engineering	100	hours	\$125	\$12,500								\$12,500
Pre-design sampling	1	lump sum	\$625	\$625								\$625
<i>Excavation</i>												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000				\$0				\$25,000
Air Monitoring & Oversight	6	days	\$640	\$3,840	1	lump sum	\$400	\$400	48	samples	\$40	\$1,920
Clearing and Grubbing (non-forested)	0	days	\$0	\$0	1	lump sum	\$0	\$0				\$6,160
Clearing and Grubbing (forested)	1	days	\$176	\$176	1	lump sum	\$194	\$194				\$370
Excavation	1	days	\$84	\$84	1	lump sum	\$103	\$103				\$187
Clean Fill	1	days	\$68	\$68	1	lump sum	\$146	\$146	106	cy	\$15	\$1,590
Top Soil	1	days	\$7	\$7	1	lump sum	\$23	\$23	27	cy	\$19	\$513
Compaction	1	days	\$68	\$68	1	lump sum	\$146	\$146				\$544
Vegetation (non-forested areas)	0	days	\$0	\$0	1	lump sum	\$0	\$0	0.03	acre	\$1,370	\$0
Vegetation (forested areas)	1	days	\$222	\$222	1	lump sum	\$500	\$500	2	samples	\$12	\$24
Confirmatory Samples (as)									1	samples	\$950	\$950
Waste Characterization									121	cy	\$83	\$10,043
Off-Site Disposal (non-haz)									0	cy	\$350	\$0
Off-Site Disposal (haz)												\$0
Total Direct Construction Costs (TDCC)											\$59,262	
Contingency at 20%											\$11,852	
Total Capital Cost											\$71,115	
Legal/Technical Support (40 hours each per year)											site-wide	
Five-Year Review (each)											site-wide	
Total O&M Costs											\$0	
Present Worth O&M (30-year, 7%)											\$0	
Total Present Worth											\$71,115	

Att. 4 PDO Estimating Assumptions:

- * Excavation with Off-Site Disposal alternative costs are considered on an AOC-by-AOC basis
- * Capital costs include implementation of institutional controls (i.e. public awareness program and deed restrictions), excavation, off-site disposal, and site restoration
- * Engineering costs include the hours for design of the excavations - rate is a blended rate for junior level, senior level, and CAD staff
- * Pre-design sampling is assumed to be 5% of the design costs
- * All remediation areas will be excavated, totaling 1,904 cy over 0.59 acres
- * Clearing and grubbing rate of 2.3 acres per day is assumed
- * Excavation assumes conventional equipment only with no shoring or dewatering necessary
- * Excavation rate of 720 cy/day is assumed
- * Topsoil rate of 1,000 cy/day is assumed
- * Clean fill rate of 800 cy/day is assumed
- * Compaction rate of 800 cy/day is assumed
- * Waste characterization sampling assumes 1 sample per 500 cy and analysis for TCLP RCRA 8 Metals, TCLP Pesticides, TCLP Volatiles, and TCLP BNA
- * Confirmatory sampling assumes ~ 1 sample per 900 sf base
- * All waste from PDO is considered to be hazardous based on contaminant concentrations 20 times TCLP limits (rough estimation using totals concentration to anticipate TCLP results)
- * Air monitoring assumes 8 samples per day
- * Vegetation (non-forested) material cost based on \$10.96/lb and 125 lb/acre of the Valley Forge specified seed mix
- * Vegetation (non-forested) production rate assumes 1.84 acres/day
- * Vegetation (forested) material cost based on \$100/tree and 40 trees/acre
- * Vegetation (forested) production rate assumes 0.1 acres/day
- * O&M costs include consulting services and on-going costs associated with cap maintenance and institutional controls as well as Five-Year Review for the VFNHP ARS
- * Equipment and labor costs determined using Means database

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Design</i>												
Engineering	300	hours	\$125	\$37,500								\$37,500
Pre-design sampling	1	lump sum	\$1,875	\$1,875								\$1,875
<i>Excavation</i>												
Mobilization / Demobilization	1	lump sum	\$25,000	\$25,000								\$25,000
Air Monitoring & Oversight	9	days	\$640	\$5,760	1	lump sum	\$150	\$150	9	samples	\$40	\$360
Clearing and Grubbing (non-forested)	1	days	\$991	\$991	1	lump sum	\$1,041	\$1,041				\$6,270
Clearing and Grubbing (forested)	0	days	\$0	\$0	1	lump sum	\$0	\$0				\$2,033
Excavation	0	days	\$1,200	\$0	1	lump sum	\$1,618	\$1,618				\$0
Clean Fill	2	days	\$1,005	\$2,011	1	lump sum	\$2,168	\$2,168	1,371	cy	\$15	\$20,565
Top Soil	1	days	\$141	\$141	1	lump sum	\$456	\$456	524	cy	\$19	\$9,956
Connection	2	days	\$1,005	\$2,011	1	lump sum	\$2,168	\$2,168				\$10,553
Vegetation (non-forested areas)	0	days	\$229	\$0	1	lump sum	\$250	\$250	0.59	acre	\$1,370	\$808
Vegetation (forested areas)	1	days	\$0	\$0	1	lump sum	\$0	\$0	0	square feet	\$4,000	\$0
Warning Layer	2	days	\$500	\$1,000	1	lump sum	\$1,000	\$1,000	25,700	square feet	\$0.30	\$7,710
Confirmatory Samples (asbestos)									29	samples	\$40	\$1,160
Waste Characterization									4	samples	\$950	\$3,800
Off-Site Disposal (non-haz)									0	cy	\$83	\$0
Off-Site Disposal (haz)									1904	cy	\$330	\$628,320
												\$761,049
												\$152,210
												\$913,259
												\$127,769
												\$153,323

Total Direct Construction Costs (TDCC)	\$761,049
Contingency at 20%	\$152,210
Total Capital Cost	\$913,259
Total Cap Direct Construction Costs	\$127,769
Total Cap Direct Construction Costs plus 20%	\$153,323
Cap Maintenance (10% Capital Cost)	\$15,332
Five-Year Review (each site-wide)	\$127,769
Legal/Technical Support (40 hours each per year)	\$15,332
Total O&M Costs	\$150,259
Present Worth O&M (30-year, 7%)	\$103,518
Total Present Worth	\$1,035,318

Alt. 4 Shallow Excavation and Off-site Disposal Site-Wide Estimating Assumptions:

- * O&M costs include consulting services associated with institutional controls as well as Five-Year Review for the VFNHP ARS
- * Legal and technical support include hours for development and implementation of institutional controls (i.e. public awareness program and deed restrictions)
- * Assumes Excavation with Off-site disposal for all above AOCs

Line Item	Labor			Equipment			Material			Total Costs		
	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities	Units	Unit Price	Cost	Estimated Quantities		Units	Unit Price
<i>Institutional Controls</i>												
Legal Support	200	hours	\$175.00	\$35,000.00								\$35,000
Technical Support	100	hours	125	12500								\$12,500
											Total Direct Construction Costs (TDCC)	\$9,225,917
											Contingency at 20%	\$1,845,183
											Total Capital Cost	\$11,071,101
											Five-Year Review (\$50,000 over 5 years)	\$10,000
											Legal/Technical Support (40 hours each per year)	\$12,000
											Cap maintenance at FKP-L and PDQ	\$18,942
											Total O&M Costs	\$40,942
											Present Worth O&M (30-year, 7%)	\$508,053
											Total Present Worth	\$11,579,154

FS ALTERNATIVE 4 - TOTAL ESTIMATED COST SUMMARY

Design - Engineering and pre-design sampling	\$756,000
Excavation - mob/demob, clearing and grubbing, excavation	\$452,951
Oversight, Air monitoring, and Confirmatory sampling	\$413,310
Clean fill, topsoil, compaction, vegetation	\$1,244,238
Waste characterization and off-site disposal	\$6,311,918
Legal/Technical Support	\$47,500
Total Direct Construction Costs (TDCC)	\$9,225,917
Contingency at 20%	\$1,845,183
Total Capital Cost	\$11,071,101
Five-Year Review (\$50,000 over 5 years)	\$10,000
Legal/Technical Support (40 hours each per year)	\$12,000
Cap maintenance at FKP-L and PDQ	\$18,942
Total O&M Costs	\$40,942
Present Worth O&M (30-year, 7%)	\$508,053
Total Present Worth	\$11,579,154

Appendix F
Remediation Goal Verification Procedures for the Selected Remedy

Remediation Goal Verification Procedures for the Selected Remedy

To verify that the remediation goals defined for the Site have been achieved by the Remedial Action, the following procedures shall be followed as further specified in the Remedial Design based on pre-design testing results or other considerations.

Step 1. Initially, contaminated soils will be excavated at the locations and to the depths as specified for Alternative 4 in the FS or at revised locations and depths determined during Remedial Design and depending on the results of pre-design testing. A pre-design sampling plan will be developed and implemented to: 1) verify that excavating at the locations and to the depths established in the FS will achieve the Remediation Goals (RGs); or 2) provide the basis for a revised excavation plan to achieve the RGs. The pre-design sampling will fill data gaps in the RI data set as necessary to provide confidence that the remedial design areal and vertical extent of excavation will achieve the RGs. For example, where portions of the horizontal limits of excavation established during the FS were estimated due to limited data in that particular area, additional sampling and analysis will be done inside and outside of the previously estimated boundary, and the boundary modified based on the results of this additional testing. Similarly, where the vertical limits of excavation in certain areas as developed in the FS were based only on a single shallow sample result, additional deeper samples will be collected in that area and analyzed to confirm the vertical limits of excavation necessary to achieve the RGs. The pre-design samples will be analyzed for the contaminants present above RGs in the specific remedial action areas as previously identified in the RI/FS.

The zone of potential exposure to contaminants for the identified receptors at the Park is 0 to 24 inches below the ground surface. To be conservative, and recognizing the inherent tolerances associated with construction excavations, the vertical design depth of excavation is expected to be a minimum of six inches and a maximum of twelve inches deeper than the shallowest sample exhibiting an RG exceedance (depending on the confidence in the knowledge of contaminant distribution gained through pre-design testing). The maximum design excavation depth will therefore be between 30 and 36 inches. For cost estimating purposes the maximum depth of excavation was assumed to be 36 inches. Where only shallow data currently exist, vertical pre-design sampling may be extended beneath the maximum excavation depth to determine the areas where contamination exceeding RGs would remain beneath the exposure zone after excavation. In areas where data show RG exceedances below 24 inches, excavation will only extend to a depth of 24 inches and a suitable synthetic warning layer will be installed at the bottom of the excavation prior to backfilling, and institutional controls will be established to control and manage exposure to this deeper site contamination by Park maintenance and/or construction workers. Other evidence that may be used to determine the need for a warning layer and institutional controls include prior deep sampling laboratory results (e.g., from the RI), prior deep soil boring information (e.g., visual evidence of fibers in soil cores), and/or historical or anecdotal information related to past waste disposal practices.

The pre-design sampling program will also include the establishment of horizontal survey control points at each remedial action area to allow accurate layout of the excavation areas

preceding construction, and to enable field verification and documentation that the horizontal and vertical design limits of the excavation have been achieved.

Step 2. For all areas where pre-design data indicate that RG exceedances are limited to the top two feet, post-excavation verification sampling will be performed to verify that soils remaining within two feet of the ground surface meet the RGs set forth in Table 7 of this ROD. Vertical verification samples will be collected from the top six inches of the base of the excavation in each 2500 square foot area (but in no case less than three locations within a discrete remediation area), except in areas where RG exceedances are known to exist deeper than 24 inches, in which case a warning layer will be installed without additional vertical verification sampling, and the area backfilled with clean soil and institutional controls implemented (as described above). In addition, regardless of the excavation depth, horizontal verification samples will be collected around the perimeter of the excavation sidewalls from 0-6 inches and 12-18 inches below the original ground surface. Horizontal verification samples will be collected approximately every 200 lineal feet around the excavation perimeter at no fewer than three approximately equally spaced locations (six samples) per remediation area.

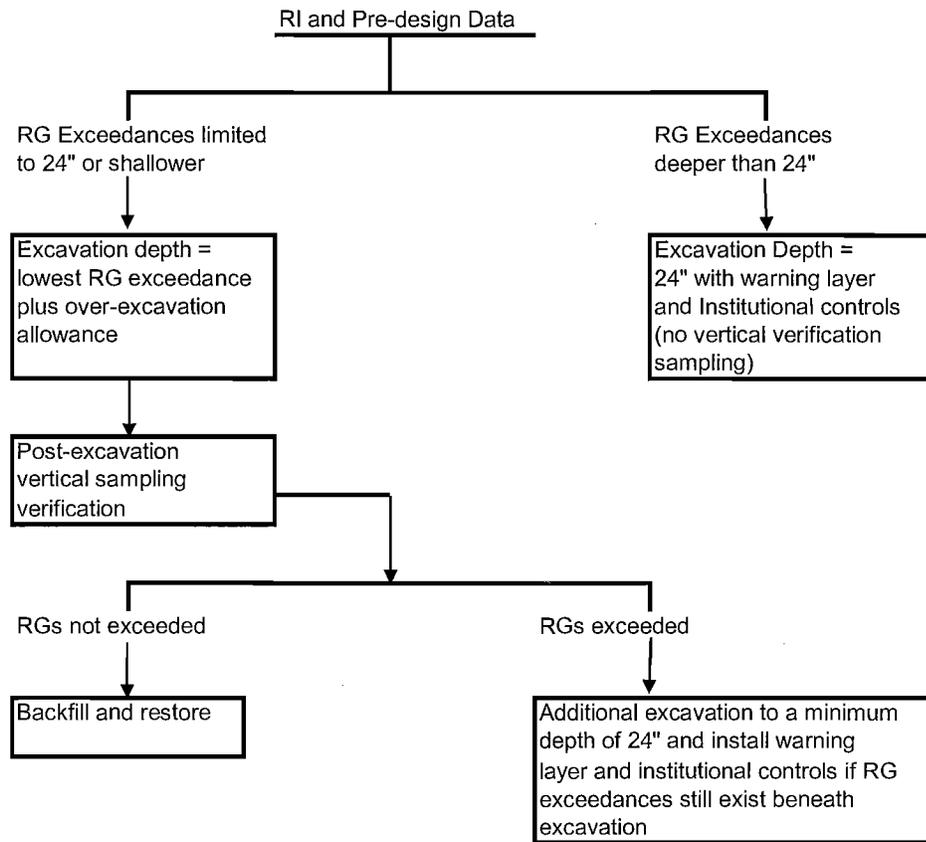
In addition to these prescribed vertical and horizontal sampling locations, additional representative samples will be taken for asbestos analysis from any area of the excavation bottom or sidewall that visually has the appearance indicating the potential presence of asbestos fibers. All post-excavation sampling will be fully documented and the locations determined in the field with a GPS and mapped for future reference.

The verification samples will be analyzed for the contaminants present above RGs in the specific remedial action areas as previously identified in the RI/FS.

Step 3. If the results of post-excavation verification sampling described in Step 2 reveal that a base or perimeter sidewall sample exceeds the RGs, those areas will be subject to additional characterization and/or further excavation described as follows.

Vertical Verification Sampling

In the case where a vertical verification sample from the base of the excavation exceeds the RGs, the excavation will be extended to a minimum depth of 24 inches (if not already at that depth), and a warning layer installed and institutional controls implemented if the previous or an additional round of verification data indicate RG exceedances at or beneath the 24 inch-deep excavation. These vertical verification procedures are illustrated in the following figure.



Institutional controls, where necessary as described above, will specify that precautions need to be taken when future excavations are proposed in those areas.

Horizontal Verification Sampling

In the case where a horizontal verification sample from the sidewall of the excavation exceeds the RGs, additional sampling will be performed to delineate the horizontal extent of the RG exceedance in that area. Additional samples will be collected at the same density as the vertical verification sampling of one location per 2500 square feet from 0-6 and 12-18 inches below the original ground surface until sample results are reported below the RGs, which will be used to define the new horizontal limits of excavation. The depths of excavation within the expanded area of excavation will be dependent upon the results of the individual depth samples. In some instances anthropogenic features, such as County Line Road and quarry walls, may be utilized to define the horizontal limit of additional excavation.

Appendix G
List and Summary of ARARs for the Selected Remedy

**TABLE G-1
 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC)
 COMPLIANCE EVALUATION OF THE SELECTED REMEDY**

<u>ARAR/TBC Type</u>	<u>Brief Description</u>	<u>Citation</u>	<u>Requirement¹</u>	<u>Compliance</u>
CHEMICAL	FEDERAL			
	National Emissions Standards for Hazardous Air Pollutants-Asbestos	40 CFR 61	Regulates the management of asbestos and asbestos containing waste	Compliance attained through air monitoring, dust suppression, and PPE.
	Region III Risk Based Concentrations	Guidance Criteria	Guidelines established for the protection of human health and/or aquatic organisms	Limited applicability because RGs were developed based on site-specific risk assessment and are equally or more protective.
	Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments	Guidance Criteria	Provides guidance in preparing Environmental Risk Assessments	Compliance attained during the preparation of earlier BERA.
	National Ambient Air Quality Standards	40 CFR 50	Sets national standards for levels of air quality deemed necessary for protection of public health	Compliance attained through air monitoring, dust suppression, and PPE.
	Ambient Water Quality Criteria	Guidance Criteria	Guidelines established for the protection of human health and/or aquatic organisms	Compliance in the area of the Unnamed Tributary and adjacent to the Schuylkill River will be attained through proper planning of excavation and backfill activities.

ARAR/TBC Type	Brief Description	Citation	Requirement¹	Compliance
	Aquatic Sediment Quality Guidelines (Ontario)	Guidance Criteria	Guidelines for screening contaminants in freshwater sediments	Limited applicability because RGs were developed based on site-specific risk assessment and are equally or more protective.
	Draft Soil Screening Guidance	Guidance Criteria	Establishes soil screening levels (SSLs) for specific contaminants and exposure pathways	Limited applicability because RGs were developed based on site-specific risk assessment and are equally or more protective.
CHEMICAL	STATE			
	PA Water Quality Criteria	25 PA Code Chapter 93	Water quality standards for various classes of surface waters	Compliance in the area of the Unnamed Tributary and adjacent to the Schuylkill River will be attained through proper planning of excavation and backfill activities.
	Act 2 Statewide Health Standards for Soil	25 PA Code Chapter 250	Medium specific concentrations for contaminants in soils based on land use	Limited applicability because RGs were developed based on site-specific risk assessment and are equally or more protective.
	Site Specific Ecological Risk Assessment Procedure	Guidance Criteria	Provides guidance in preparing Ecological Risk Assessments	Compliance attained during the preparation of earlier BERA.
	Act 2 Site specific Standards	25 PA Code Chapter 250	Allows development of site specific risk-based standards for soil and groundwater	Limited applicability because RGs were developed based on site-specific risk assessment and are equally or more protective.

ARAR/TBC Type	Brief Description	Citation	Requirement ²	Compliance
LOCATION	FEDERAL Solid Waste Disposal in National Parks	16 USC 4601 22(c) et seq. 36 CFR Part 6	Prohibits the operation of any solid waste disposal unit within the park boundaries, except as specifically provided for in the regulations, and governs the continued use of any existing solid waste disposal sites within park boundaries	Compliance attained as excavation with off-site disposal will not create or require the operation of new solid waste disposal sites or involve continued use of existing sites within VFNHP ARS.
	The National Park Service Organic Act	16 USC 1-3 36 CFR Parts 1-0 and P.L. 92-406	Regulates the management of national parks in order to conserve the scenery, natural and historic objects, and wildlife so as to provide for their enjoyment and leave them unimpaired for the enjoyment of future generations.	Compliance attained as excavation and off site disposal and restoration of the remediated areas will conserve the scenery, natural and historic objects and wildlife; and allow future generations to enjoy them in an unimpaired condition.
	Federal Cave Resources Protection Act of 1988		Protects and preserves significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people.	Compliance attained because identified caves are in locations that will not be affected by shallow excavation and off-site disposal.
	National Cave and Karst Research Institute Act of 1988		Promotes national and international cooperation in protecting the environment for the benefit of cave and karst formations.	Compliance will be attained because bedrock is more than 10 feet bgs, so karst geology will not be affected by shallow excavation and off-site disposal.
	Department of Interior Cave Management Regulations	43 CFR Subtitle A Part 37	Establishes policy that Federal lands be managed in a manner that, to the extent practical, protects and maintains significant caves and cave resources.	Compliance attained because identified caves are in locations that will not be affected by shallow excavation and off-site disposal and bedrock is more than 10 feet bgs in the remedial areas.

ARAR/TBC Type	Brief Description	Citation	Requirement ³	Compliance
	Protection of Wetlands Order	40 CFR Part 6, Appendix A, Executive Order No. 11990 Section 404(b)(1), 33 USC 1344(b)(1)	Requires consideration of impacts to wetlands in order to minimize their destruction, loss or degradation and to preserve/enhance wetland values	Compliance will be attained through proper wetland restoration activities following excavation.
	Protection of Floodplains	40 CFR Part 6, Appendix A, Executive Order No. 11988	Requires consideration of impacts to floodplain areas in order to reduce flood loss risks, minimize flood impacts on human health, safety and welfare and preserve and/or restore floodplain values	Compliance will be attained through proper grading following backfill to promote drainage and prevent flooding.
	Endangered Species Act	16 USC 1531	Establishes requirements for the protection of federally listed threatened and endangered species and their habitat	Compliance will be attained through proper identification of habitats and avoidance of identified habitats during remedial action.
	National Historic Preservation Act	16 USC 470	Establishes requirements for the identification and preservation of historic and cultural resources	Compliance will be attained through proper identification of historic and cultural resources and avoidance (or mitigation) of identified resources during excavation.
	Archeological Resources Protection Act	16 USC 470	Provides for the protection of archeological resources located on public lands	Compliance will be attained through proper identification of archeological resources and avoidance (or mitigation) of identified resources during excavation.
	Fish and Wildlife Coordination Act	16 USC 661 et seq. 40 CFR 6.302(g)	Requires consideration of impacts to wildlife resources resulting from the modification of waterways	Compliance in the area of the Unnamed Tributary and adjacent to the Schuylkill River will be attained through proper planning of excavation and backfill activities.

<u>ARAR/TBC Type</u>	<u>Brief Description</u>	<u>Citation</u>	<u>Requirement⁴</u>	<u>Compliance</u>
	Rivers and Harbors Act, Section 10 Regulations	33 CFR 320-330	Requirements for evaluating the placement of structures and/or excavation activities within navigable waters	Compliance in the area of the Unnamed Tributary and adjacent to the Schuylkill River will be attained through proper planning of excavation and backfill activities.
	Clean Water Act, Section 404(b)(1) Guidelines	40 CFR 230.10	Establishes criteria for evaluating impacts to waters of the US (including wetlands) and sets forth factors for considering mitigation measures	Compliance in the area of the Unnamed Tributary and adjacent to the Schuylkill River will be attained through proper planning of excavation and backfill activities.
	Archaeological and Historic Preservation Act	16 USC 469 et seq. 40 CFR 6.301(c)	Provides for the protection and preservation of archeological and historical resources that may be destroyed through the alteration of terrain as a result of federal construction projects	Compliance will be attained through proper identification of archaeological resources and avoidance (or mitigation) of identified resources during excavation.
	Historic Sites, Buildings, and Antiquities Act	16 USC 461 et seq. 40 CFR 6.310(a)	Requires the consideration of the existence and location of historic and prehistoric sites, buildings, objects, and properties of historical and archaeological significance when evaluating remedial alternatives	Compliance will be attained through proper identification of archaeological resources and avoidance (or mitigation) of identified resources during excavation.
	NPS Regulations	36 CFR Part 1 et seq. (including §5.13) and PL 92-406	Prescribes and governs activities within NPS units and prohibits the creation or maintenance of a nuisance.	Compliance will be attained through careful excavation and transportation to permitted off-site disposal facility so as not to create a "nuisance."
	Management Policies 2001	NPS D1416	Provides policies guidance for the management of natural and cultural resources by the NPS, including revegetation of disturbed land.	Compliance will be attained through restoration of remediation areas and surrounding areas following excavation.

ARAR/TBC Type	Brief Description	Citation	Requirement ^s	Compliance
	NPS Clean Fill Criteria	See Attachment 1 to Table G-1	Prescribes specific criteria for the determination of clean fill material with the VFNHP.	Compliance will be attained through proper identification and testing of backfill material sources.
LOCATION	STATE			
	PA Floodplain Management Act and Dam Safety and Encroachment Act	PL 851, No. 166 and PL 1375	Regulates the placement of fill, grading, excavation and other disturbances within the defined flood hazard area and/or floodplain of rivers and/or streams	Compliance will be attained through proper excavation and backfill within floodplains of the Schuylkill River and/or Unnamed Tributary.
	PA Wild Resource Conservation Act	PL 547 No. 170 32 PS 5301-5314	Conserves critical habitats for endangered or threatened species	Compliance will be attained through proper identification of habitats and avoidance of identified habitats during excavation. None have been identified by Federal and State Agencies
ACTION	FEDERAL			
	National Emission Standards for Hazardous Air Pollutants (NESHAPS)	40 CFR 61.150	Requirements for the collection, packaging, manifesting, and transportation of asbestos and asbestos containing waste	Compliance will be attained through proper waste classification, collection, packaging, manifesting, and transportation.
		40 CFR 61.151	Requirements for inactive asbestos waste disposal sites, including emissions, waste coverage and access restriction requirements	ARAR for in-situ remediation or excavation of asbestos and asbestos containing waste in all AOCs
		40 CFR 61.154	Requirements for active asbestos waste disposal sites	Not applicable as excavation with off-site disposal will eliminate the presence of areas that could be considered "active asbestos waste disposal sites."

<u>ARAR/TBC Type</u>	<u>Brief Description</u>	<u>Citation</u>	<u>Requirement⁶</u>	<u>Compliance</u>
	Hazardous Waste Generation	42 USC §6901 et seq. 40 CFR 262	Specifies requirements for hazardous waste packaging, labeling, manifesting, and storage	Compliance will be attained through proper waste classification, packaging, labeling, manifesting, and storage.
	Transportation of Hazardous Waste	42 USC §6901 et seq. 40 CFR 263	Specifies requirements for transporters of hazardous waste to obtain a USEPA identification number, compliance with manifest procedures and spill response	See above
	Treatment, Storage, and Disposal of Hazardous Waste	42 USC §6901 et seq. 40 CFR 264	Specifies requirements for the operation of hazardous waste treatment, storage, and disposal facilities	See above
	Land Disposal Restrictions	42 USC §6901 et seq. 40 CFR 268	Sets out prohibitions and establishes standards for the land disposal of hazardous wastes	See above
	National Ambient Air Quality Standards- Particulates	40 CFR 50	Establishes maximum concentrations for particulates and fugitive dust emissions	Compliance will be attained through air monitoring and dust suppression.
	Clean Water Act Stormwater Program	40 CFR 122	Regulates the discharge of stormwater from industrial and construction activities	Compliance will be attained through soil erosion and sediment control measures for stormwater.
	USDOT Hazardous Materials Transportation Regulations	49 CFR 171-180	Establishes classification, packaging and labeling requirements for shipments of hazardous materials	Compliance will be attained through proper waste classification, packaging, labeling, manifesting, and storage.
	USEPA Test Methods for Evaluation of Solid Waste	SW-846	Establishes analytical requirements for testing and evaluating solid and/or hazardous wastes	Compliance will be attained through proper waste classification sampling.

ARAR/TBC Type	Brief Description	Citation	Requirement ⁷	Compliance
ACTION	STATE			
	Hazardous Waste Management Regulations	25 PA Code Chapter 264	Provides requirements for the generation, accumulation, on-site management, and transportation of hazardous waste. Equivalent to Federal RCRA program	Compliance will be attained through proper waste classification, packaging, labeling, storage, and transportation.
	Residual Waste (asbestos) Disposal Requirements	25 PA Code Chapter 288.302	Provides operational requirements for disposal of asbestos wastes	Compliance will be attained through disposal of asbestos waste at a permitted facility (i.e., in compliance with regulations).
	Residual Waste (non-asbestos) Disposal Requirements	25 PA Code Chapter 287.132	Provides requirements for chemical analyses and classification of residual wastes	Compliance will be attained through disposal of asbestos waste at a permitted facility (i.e., in compliance with regulations).
	Transportation of Asbestos Containing Waste	25 PA Code Chapter 299.232	Requirements for the transportation of asbestos and asbestos containing waste	Compliance will be attained through proper waste classification, packaging, and labeling. A permitted transporter (i.e., in compliance with regulations) will be used.
	Air Quality Regulations	25 PA Code Chapters 121-143	Provides requirements applicable to air pollution sources	Compliance will be attained through air monitoring and dust suppression.
	Management of Fill	PADEP Doc.# 258-2182-773 25 PA Code Chapters 271-285 Chapters 287-299 (also see Attachment I to Table G-1)	Policy for evaluating whether a material qualifies as clean fill	Compliance will be attained through proper evaluation of fill material (i.e. in compliance with regulations).

⁷ Unless otherwise noted, all NPS authorities are applicable requirements

ATTACHMENT 1

Materials Specifications

1. Topsoil

Topsoil shall be fertile, natural soil, typical of the locality, substantially free of stones, roots, sticks greater than 2 inches in diameter or length, clay, peat, weeds and sod, and obtained from upland areas or be treated to be free of exotic plant seeds. It shall contain between 2 % and 10% organic matter as determined in accordance with AASHTO-194.

The Contractor must identify the topsoil source and certify the topsoil contains no CERCLA hazardous substances and meets the requirements of “clean fill” in accordance with the State of Pennsylvania Clean Fill Policy. The Pennsylvania Department of Transportation Form EDD-VI and the Pennsylvania Department of Environmental Protection Form FP-001 shall be completed and submitted by the Contractor to document that the topsoil meets the requirements for classification of clean fill.

The Contractor also will be required to collect one composite sample from a representative number of locations within the topsoil source and submit the sample to an approved analytical laboratory for the following analysis:

Volatile Compounds: EPA 8260B

Semi-Volatile Compounds: EPA 8270C

Pesticides/PCBs: EPA 608; EPA 8081A; EPA 8082

13 Priority Pollutant List Metals plus total cyanide and phenolics: methods as appropriate.

The Contractor must submit the topsoil sample analytical results to the NPS for approval prior to use.

A topsoil mixture, enriched or blended with organic compost, may be acceptable provided it meets the above defined specifications and it can be certified not to contain any waste materials (e.g., non-clean fill, sewage or other sludge).

2. Soil Amendments and Seed

Lime

Lime shall be pulverized agricultural limestone applied at a rate of 800 pounds per 1,000 square yard (SY).

Fertilizer

Fertilizer shall be complete commercial fertilizer, 10-20-20 grade, applied at a rate of 140 pounds per 1,000 SY.

Seed

Seed shall comply with the “VFNHP Meadow Mix” grass seed mixture, the specifications for which are provided in Table A below.

TABLE A: Specifications for VFNHP Meadow Mix					
Meadow Mix species	% by Weight	Minimum %		Max. % Weed Seed	Seeding Rate
		Purity	Germination		lbs. per 1,000 SY
Little Bluestem	30	98	85	0.15	6.75
Indian Grass	30	98	85	0.15	6.75
Switch Grass	20	98	85	0.15	4.5
Annual Ryegrass	20	98	85	0.15	4.5
					Total 22.5

Grass seed of the specified mixtures shall be furnished in fully labeled, standard, sealed containers.

Percentage and germination of each seed type on the mixture, purity, and weed seed content of the mixture shall be clearly stated on the label.



Valley Forge

National Historical Park
Pennsylvania