STAMINA MILLS
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REGION I

RECORD OF DECISION

STAMINA MILLS SITE

NORTH SMITHFIELD, RHODE ISLAND

SEPTEMBER 28, 1990

8394

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

DECLARATION FOR THE RECORD OF DECISION

Stamina Mills
North Smithfield, Rhode Island

STATEMENT OF PURPOSE

This decision document represents the selected remedial action for the Stamina Mills Site (the Site) in North Smithfield, Rhode Island, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP), 40 CFR Part 300 et seq., as amended. The Region I Administrator has been delegated the authority to approve this Record of Decision.

The State of Rhode Island has concurred on the selected remedy.

STATEMENT OF BASIS

This decision is based on the Administrative Record which has been developed in accordance with Section 113 (k) of CERCLA and which is available for public review at the North Smithfield Public Library in Slatersville, Rhode Island and at the Region I Waste Management Division Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix E of the ROD) identifies each of the items comprising the Administrative Index upon which the selection of the remedial action is based.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to the public health or welfare or to the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy for the Stamina Mills Site includes both source control and management of migration components to obtain a comprehensive remedy.

The source control measures include:

* The in-situ vacuum extraction of soil contaminated with trichloroethylene (TCE) in the spill area. A number of shallow wells will be installed throughout the spill area and will be used to withdraw air containing TCE and other volatile organic compounds (VOCs) from the soils. The air containing

VOCs is then treated using activated carbon filters prior to being discharged to the atmosphere. Spent activated carbon filters will be transported off-site where they will be either regenerated or disposed of. Attaining the soil target cleanup levels will eliminate the potential migration of contaminants from the soils into the groundwater at levels exceeding groundwater cleanup goals.

* Excavation of approximately 550 cubic yards of a mixture of landfill wastes and sediments from within the 100-year floodplain of the Branch River. This material will be redeposited onto the landfill above the floodplain and incorporated under the new RCRA multi-layer cap to be installed. A leachate collection system will be installed along the base of the landfill's southern boundary and the leachate generated will be discharged into the on-site sewer system subject to the final approval of the Woonsocket Wastewater Treatment Authority.

* Institutional controls in the form of deed restrictions will be used at the Site to regulate land use. The institutional controls would be focused on preventing the disturbance of the physical integrity of many of the remedy's components. EPA has proposed, in a consent decree lodged in federal court, institutional controls with the current owner to protect the remedy.

* Confirmation of the septic tank location, testing and removal of its contents, and disposal of the contents of the tank and the tank itself. The contents of the septic tank will be disposed of off-site but the type of facility at which it will be disposed of will be contingent upon the testing results.

The management of migration remedial measures include:

* Active restoration of the groundwater aquifer contaminated with TCE and other VOCs using the innovative ultraviolet light and hydrogen peroxide (UV/hydrogen peroxide) technology. This component of the remedy will extract and treat groundwater contaminated by releases at the Site. The goal of this remedial action is to restore the groundwater to drinking water quality standards as rapidly as possible. The results of an on-site pilot test using the UV/hydrogen peroxide system will be conducted during the predesign phase to determine which of the three disposal options being considered for treated groundwater will be used. The disposal options being considered are on-site surface water discharge, on-site subsurface water discharge, and on-site discharge to the existing sewer line. The time frame for groundwater restoration has been estimated at 10 to 15 years. EPA will conduct an evaluation of the groundwater restoration remedy within 5 years of its implementation. If the evaluation

reveals that the remedy cannot achieve the cleanup levels within a reasonable time frame, consideration will be given to making changes in the remedy.

* Extraction of groundwater through on-site wells installed into the bedrock. Design details of the extraction system will be determined from the results of a predesign pump test. Groundwater extraction would act to halt the migration of contaminants and facilitate the removal of contaminants which have migrated off-site.

* Utilization of a pressure filtration system to remove suspended solids and suspended metals in the groundwater prior to treatment in the UV/hydrogen peroxide.

* Sealing of the entrances and exits of two raceways with impermeable barriers. The raceways were used to transport water to mill buildings. Sections of both raceways which have not collapsed will be collapsed and backfilled.

* Demolishing and removing partially standing buildings at the Site which include a deteriorating smokestack. It is believed that this activity will have to be one of the first to occur in order to allow workers to safely perform work at the Site. Solid waste of an earthen nature (i.e., bricks) will be disposed of on-site and all other solid wastes will be disposed of off-site in accordance with state solid waste regulations.

* Grading and vegetation of the Site at the conclusion of the remedial activities.

* Long-term environmental monitoring of the groundwater and Branch River to ensure the effectiveness of the remedy.

DECLARATION

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate for this remedial action and is cost-effective. This remedy satisfies the statutory preference for remedies that utilize treatment as a principal element to reduce the toxicity, mobility, or volume of hazardous substances. In addition, this remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

As this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide protection of human health and the environment.

9/28/90
Date

Julie Belaga
Julie Belaga
Regional Administrator

RECORD OF DECISION
STAMINA MILLS SITE

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September, 1990

I. SITE NAME, LOCATION AND DESCRIPTION

A. General Description

The Stamina Mills Superfund Site (the Site), a former textile weaving and finishing mill, is located in the Town of North Smithfield, Providence County, Rhode Island. The Site is located approximately one-half mile southwest of the intersection of Highway 146 and 146A and is approximately 14 miles northwest of Providence, Rhode Island (Appendix A, Figure 1).

The Site, comprising approximately 5 acres, is bounded to the south by the Branch River. A dam constructed immediately adjacent to the Site forms the Forestdale Pond. The pond forms the western boundary of the Site (Appendix A, Figure 2). The land to the north and east of the Site is largely residential with some commercial use. The Halliwell Memorial Elementary School is approximately four-tenths of a mile northwest of the Site. Areas directly east of the Site, which are in the floodplain of the Branch River, have been left undeveloped. The area to the south and southwest of the Site is occupied by industrial and commercial facilities. These include a fertilizer plant, a paper and tape coating manufacturer, an electronics and gauge producer, and a metal fabricator. The southeast section of the Site, which includes a small portion of the on-site landfill, is located within the 100-year floodplain of the Branch River. The Site is within 200 feet of the Branch River and is therefore a wetland under Rhode Island law.

In 1969, an unknown quantity of the solvent trichloroethylene (TCE) was spilled at the Site and has since migrated into the soil and the bedrock aquifer beneath the Site. The contaminated groundwater beneath the Site has been shown to be hydraulically connected to areas north of the Site and has affected these areas. The Site has remained vacant since a fire destroyed the mill in 1977 and currently rubble, piles of debris, and foundation remains (including a deteriorating smoke stack) cover the Site. A more complete description of the Site can be found in the "Remedial Investigation Report, Stamina Mills Site", January, 1990, (RI) in Section 2 of Volume I.

B. Geologic Characteristics

The bedrock underlying the Site is made up of schists, gneiss, and quartzite belonging to the Precambrian to lower Paleozoic age Blackstone Series. These rocks are exposed in outcrops over an area extending from 1.5 miles northwest of the Site to the southern side of Woonsocket Hill, approximately 2 miles to the south.

On-site drilling and geophysical work indicated that: the bedrock surface is irregular; the orientation of joints and fractures appear to be generally northeast-southwest and northwest-southeast; the fractures generally dip between 15 and 35 degrees and are parallel to the foliation planes in the rock. These discontinuities in the rock are important because they are the principal areas where groundwater is stored and transmitted.

Natural overburden soils encountered on the Site consist of thin glacial till, stratified ice contact deposits and local recent fluvial deposits. Glacial deposits found are generally thin, with relatively dense till deposited as a mantle overlying bedrock. Surficial soils have been significantly altered in the course of excavations and construction of structures at the Site. The overburden materials vary in thickness from 0 to 20 feet.

C. Hydrogeological Characteristics

The Site lies within the watershed of the Branch River, which is the recipient of most surface water runoff from the residential area north of the Site, the Stamina Mills property, and the area south of the Site. A dam constructed adjacent to the Site forms the eastern boundary of the Forestdale pond. Groundwater migrating beneath the Site occurs predominantly in the bedrock aquifer and to a lesser extent in the lower few feet of the overburden. With the exception of the landfill area at the east end of the Site, unconsolidated materials may lie completely above the saturated zone or may only be seasonally saturated and, therefore, do not play a major role in the storage and movement of groundwater through the Site.

Regional groundwater flow under natural conditions (i.e., non-pumping of residential wells north of the Site) is generally toward the Branch River from upland areas along the north and south banks, and then eastward parallel to the River. Residential and community pumping, occurring prior to the installation of public water supplies, altered the natural hydraulic system shown in Appendix A, Figure 3. EPA determined by the pump test conducted at the Forestdale Water Association Well that the pumping of individual bedrock wells to the north of the Site produced a reversal of the regional groundwater flow. As presented in Appendix A, Figure 4, the regional flow was reversed such that flow from beneath the

Site was induced toward the residential area north of the Site. Groundwater sampling data obtained in March 1988, indicates that the groundwater flow continues to follow the natural regional trend under non-pumping conditions.

Flow within the bedrock aquifer is controlled by hydraulic head and interconnected fractures and is affected locally at the Site by hydraulic gradients induced by the Forestdale Pond. The orientation of what are believed to be the principal water bearing features are to the northeast and northwest coinciding roughly with the location of the contaminant plume. Additional data, collected and described in Section 5 of the RI, indicated that locally across the Site the upper 15 feet of bedrock was significantly fractured providing available openings for groundwater flow while below this depth the bedrock exhibited a much tighter structure limiting the groundwater flow. Groundwater elevations indicated that hydraulic gradients at the Site are further effected by the local surface hydrology, specifically the Forestdale pond which borders the western section of the Site.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Land Use and Response History

Since the early 1800's the Site has been operated as a textile (cotton and wool) weaving and finishing facility. As part of the manufacturing process, various chemicals were used at the Site. These included detergents and solvents to clean the wool; acids, bases and dyes to color fabrics; pesticides and solvents for moth proofing; and plasticizers to coat fabrics. During the 1930's a fire at the Site destroyed one of the mill buildings. A portion of the burned-out foundation was used as a landfill for process wastes until approximately 1968. In 1968, the landfill was covered and used as a parking area.

In March 1969, a solvent-based scouring system was installed at the mill. The scouring system used TCE to remove oil and dirt from newly-woven fabrics. Shortly after the system was installed, an unknown quantity of TCE was spilled during the filling of an above-ground storage tank. The mill did not clean up the spill. Some of the spilled TCE infiltrated into the soil and entered the groundwater. The remainder of the TCE ran off into the Branch River. The mill continued to operate the scouring system until the mill closed in 1975.

In October 1977, a fire destroyed the mill complex. Since that time the property has remained vacant and unused. The Site is currently overgrown and contains rubble, piles of debris, and the remains of the building's foundation (including a deteriorating smokestack). A more detailed description of the Site history can be found in the RI, pages

1-4 through 1-7.

In 1979, TCE was detected off-site in the Forestdale Water Association well, a community water system located approximately 800 feet north of the Site. This sampling was conducted by the Rhode Island Department of Health (RIDOH) as part of a statewide groundwater survey. RIDOH then expanded the groundwater sampling program to include an additional 51 private residential wells in the Forestdale area. As a result RIDOH found elevated levels of TCE in 18 of these residential wells and advised area residents to boil water used for drinking and cooking.

In 1981, the State of Rhode Island Water Resources Board and the Town of North Smithfield financed the construction of a municipal water main to serve the residential area north of the Site that had been affected or had the potential to be affected by contamination from the Stamina Mills Site. Between 1981 and 1984, only seven of the approximately 50 affected or potentially affected residences had been connected to the new municipal water supply, reportedly because of the costs associated with connecting to the water main.

On September 8, 1983 the Site was placed on the final National Priorities List (NPL) and later that month EPA began to supply bottled water to residents not connected to the municipal water supply. During November 1984 EPA initiated an immediate removal action under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) §104(a), 42 U.S.C. §9604(a)(1984) to extend the existing water line as well as fund the residents' costs for connecting to the municipal water supply. In July 1988, EPA initiated a second removal action at the Site which dealt with two deteriorating underground storage tanks. The contents of both tanks were removed and then treated and disposed of off-site. The interiors of both tanks were decontaminated and the tanks were then decommissioned. In August 1990, EPA initiated a third removal action which removed the contents of an above-ground storage tank. The contents were treated and disposed of off-site. The interior of the tank was decontaminated and the tank shell was left on-site and will be disposed of during remedial activities. A more detailed description of the Site history can be found in the RI at pages 1-7 through 1-8.

B. Enforcement History

On September 19, 1984, EPA notified the owner of the Site at the time of the spill, Kayser-Roth Corporation, of its potential CERCLA liability with respect to the Site. In addition, on October 23, 1984, EPA notified the current owner of the Site, Hydro-Manufacturing Company, of its potential CERCLA liability with respect to the Site. In the absence of an offer by Kayser-Roth or Hydro-Manufacturing to reimburse the government for the costs of the removal actions and to fund the remediation of the Site, EPA filed suit against both companies in federal district court on May 23, 1988.

In July 1989, EPA entered into a partial consent decree with Hydro-Manufacturing in settlement of the company's liability. The consent decree, with subsequent modifications, has been lodged with the district court.

On October 11, 1989, the district court ruled that Kayser-Roth is liable under CERCLA for cleanup costs at the Site. The court entered a declaratory judgement on January 16, 1990, holding Kayser-Roth liable for all past and future costs consistent with the Act. Kayser-Roth filed an appeal on April 5, 1990. On August 2, 1990, the Court of Appeals for the First Circuit affirmed the district court's ruling.

Technical comments on the proposed plan were first presented by representatives of Kayser-Roth at the informal public hearing during the public comment period. A summary of the comments received during the meeting as well as the written comments are included in the Administrative Record.

III. COMMUNITY PARTICIPATION

Throughout the Site's history, community concern and involvement has been moderate to low. EPA has kept the community and other interested parties apprised of the Site activities through informational meetings, fact sheets, press releases and public meetings.

During December 1986, EPA released a community relations plan which outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. On March 10, 1986, EPA held an informational meeting in the Municipal Annex Building, North Smithfield, Rhode Island to describe the plans for the Remedial Investigation (RI) and Feasibility Study (FS). On February 21, 1990 EPA held an informational meeting in the Municipal Annex Building, North Smithfield, Rhode Island to discuss the results of the RI.

On March 22, 1989, EPA made the administrative record available for public review at EPA's offices in Boston and at the North Smithfield Public Library. Additional materials were added to the Administrative Record on February 12, 1990 with the release of the RI and on July 10, 1990 with the release of the FS and the Proposed Plan. EPA published a notice and brief analysis of the Proposed Plan in the Woonsocket Call on June 29, 1990 and made the plan available to the public at the North Smithfield Public Library.
On July 10, 1990, EPA held an informational meeting to discuss the cleanup alternatives presented in the Feasibility Study and to

present the Agency's Proposed Plan. Also during this meeting, the Agency answered questions from the public. From July 11 to August 9, the Agency held a 30-day public comment period to accept public comment on the alternatives presented in the Feasibility Study and the Proposed Plan and on any other documents previously released to the public. On July 31, 1990, the Agency held a public meeting to discuss the Proposed Plan and to accept any oral comments. A transcript of this meeting and the comments and the Agency's response to comments are included in the attached responsiveness summary found in Appendix C of this document.

IV. SCOPE AND ROLE OF RESPONSE ACTION

The selected remedy was developed by combining components of different source control and management of migration alternatives to obtain a comprehensive approach for Site remediation. In summary, the remedy provides for the treatment of contaminated soil in the TCE spill area, the excavation of landfill wastes within the 100-year floodplain of the Branch River and consolidation with landfill wastes above the floodplain, construction of a leachate collection system and an impermeable cap over the on-site landfill, and the confirmation of the Mills' septic tank location and disposal of its contents. These activities constitute the source control measures that will be undertaken to remediate areas which are acting as sources of contamination to the groundwater and surface water.

The remedy also includes the extraction and treatment of contaminated groundwater as well as the sealing and filling of the existing on-site raceways. These constitute the management of migration measures. They address the contaminated groundwater plume which has migrated beyond the Site boundaries and the migration of contaminants into the Branch River via the raceways. Prior to safely implementing either the source control or management of migration alternatives discussed above, it will be necessary to demolish the partially standing buildings at the Site and thereby ensure the safety and protection of on-site workers.

The remedial action will address the principal threats identified at the Site through treatment and will use engineering controls for areas of the Site which pose a relatively low long-term threat, consistent with the National Oil and Hazardous Substances Pollution Contingency Plan 40 CFR 300.5, Federal Register, Vol. 55, No. 46, March 8, 1990 (NCP). Areas of the Site which have been identified as the principal threats include the TCE spill area soils and the groundwater contaminant plume. The areas of the Site which are believed to pose a lower long-term threat include the landfill, raceways and septic tank. The remedial action will address the following threats to human health and the environment posed by the Site:

1. The off-site migration of contaminants;

2. The future ingestion of contaminated groundwater on-site and off-site;

3. The direct contact with and ingestion of contaminated soils, sediments, solid waste.

V. SUMMARY OF SITE CHARACTERISTICS

Chapter 1.0 of the FS contains an overview of the RI. The study area extends beyond the Site's boundaries and includes residential/commercial areas that are bounded to the north and east by Route 146, to the south by railroad tracks and to the west by Roselawn Avenue (See Appendix A, Figure 1). These areas were included to help delineate the extent of the contaminated groundwater plume resulting from the TCE spill at the Site. The significant findings of the RI are summarized below. A complete discussion of Site characteristics can be found in the RI at pages 6-1 through 6-59.

A. Soil

The discussion of the types and nature of contaminants found in the soil at the Site follows the format described in the RI and is broken up into the following three areas; 1) TCE spill area, 2) landfill area, and 3) remaining areas of the overall Site (Appendix A, Figure 5). These areas are described separately because of their different physical characteristics and chemical contaminants.

1. TCE Spill Area

Soil in the TCE spill area consists mainly of granular fill (e.g., sand and gravel), fragments of bedrock, and smaller amounts of miscellaneous construction debris (e.g., brick, concrete, and cinders). The thickness of this layer ranges from 10 to 18 feet, with groundwater seasonally occurring in the lower few feet.

Soils from the TCE spill area were found to contain the highest concentrations of volatile organic compounds (VOCs) detected at the Site. Smaller concentrations of base neutral compounds, pesticides, and metals were also detected in this area as well as over most of the Site. TCE (detected in 71 of 80 soil samples) and its degradation product 1,2-dichloroethylene (detected in 31 of 80 samples) were the principal VOCs detected in the spill area.

The following is a partial list of the volatile organic compounds detected in the spill area:

Compound	Concentration Range (ppb)
Trichloroethylene	less than 5 - 430,000
1,2-Dichloroethylene	less than 5 - 19,000
Methylene Chloride	less than 5 - 1,120
Tetrachloroethylene	less than 5 - 39

Other VOCs which were detected less frequently in the spill area and at much lower concentrations include toluene, chlorobenzene, ethylbenzene, total xylenes, chloroform, and 1,1,1-trichloroethane.

The following were the principal semi-volatile, base neutral compounds detected in the spill area soils:

Compound	Concentration Range (ppb)
Chrysene	37 - 2,700
Pyrene	96 - 4,300
Benzo(a)pyrene	110 - 3,600
Benzo(a)anthracene	120 - 2,800
Phenanthrene	52 - 2,200

Pesticide compounds identified above their detection limits and the range at which they were found include: dieldrin (1 - 200 ppb), endosulfan I (2 - 16 ppb), and endosulfan II (5 ppb). Three other pesticides (Alpha BHC, Beta BHC, and 4,4'-DDT) were detected in one soil sample each. No PCBs were observed above the contract required quantitation limit (CRQL). The CRQL is the amount of a compound which is necessary to produce a response that can be identified and reliably quantified and is part of the EPA contract laboratory program (CLP).

The following trace metals were among the ones that exceeded background levels and also typical ranges of trace metals found in soils:

Compound	Concentration Range (ppb)
Cadmium	7,000
Copper	45,000 - 139,000
Lead	78,000 - 880,000
Mercury	2,000 - 4,000
Vanadium	37,000 - 506,000
Zinc	90,000 - 542,000

The principal route of off-site migration of these contaminants from the spill area is through leaching from the soil into the bedrock aquifer located beneath it. Soil sampling indicated that the highest concentrations of TCE were found adjacent to where the TCE tank was reported to have been and where the spill occurred. In addition, sampling results indicated that the TCE concentration increases with soil depth in this area. The higher concentrations of TCE in the deeper soils are most likely due to two mechanisms: 1) TCE near the surface of the soil was able to volatilize easily into the ambient air, and 2) spilled TCE migrated through the coarser fill material near the surface and its progress was impeded when it encountered the finer grained material at the bedrock surface. Further contaminant migration through volatilization, wind, and water erosion is not likely to be significant because the concentrations of TCE and other VOCs in the upper soil layers have decreased to low levels as a result of these processes.

2. Landfill Area

The landfill wastes consist of a mixture of various fabric wastes, plastic, paper, felt, wood, metal, brick, cinders, glass, and rock interbedded with layers of sandy fill. The material ranges in thickness from 2 feet to more than 19 feet.

The most prevalent contaminant types detected in the landfill wastes were semi-volatile compounds, both base neutral and acid extractable compounds. These compounds were found distributed throughout the landfill material but the areas of highest concentrations of total semi-volatile compounds were found to correspond to sections of the landfill with depths greater than 10 feet of landfill material (Appendix A, Figure 6). Concentrations of individual base neutral semi-volatile compounds, primarily consisting of polycyclic aromatic hydrocarbons (PAHs), ranged between 40 ppb and 10,000 ppb. The PAHs detected with the greatest frequency include:

Compound	Concentration Range (ppb)
Benzo(b)fluoranthene	41 - 8,300
Fluoranthene	41 - 9,100
Phenanthrene	48 - 8,700
Chrysene	66 - 5,100
Benzo(k)fluoranthene	43 - 8,300
Pyrene	48 - 8,700
Benzo(a)pyrene	40 - 4,900
Benzo(a)anthracene	40 - 5,000
Phenanthrene	52 - 2,200

Among the seven acid extractable compounds detected in the landfill material only 4-methylphenol and benzoic acid were found at concentrations above 8,000 ppb. The 4-methylphenol and benzoic acid were detected as high as 100,000 ppb and 70,000 ppb, respectively.

TCE and other VOCs were detected in some of the landfill samples, but at much lower concentrations and frequencies than the semi-volatile compounds. The concentrations of VOCs detected in the landfill wastes did not exceed 2,500 ppb with the exception of one sample in which 51,000 ppb of TCE was detected. This sample was taken at a depth of 13 feet below the ground surface and at the time of sampling this was immediately above the water table. The other VOCs detected in the landfill in order of decreasing frequency are 1,2-dichloroethylene (2 - 980 ppb), toluene (5 - 81 ppb), and chlorobenzene (31 - 97 ppb).

Of the pesticides tested for, dieldrin was detected the most frequently (in 32 of 54 soil samples) and at the highest concentrations (33 ppb to 17,000 ppb). Two other pesticides, 4,4'-DDD and 4,4'-DDT, were detected less frequently and at concentrations below 100 ppb. No PCBs were observed at levels above the CRQL.

The following trace metals, among others, were detected in the landfill wastes at concentrations in excess of both background levels and published ranges typical of soils:

Compound	Concentration Range (ppb)
Cadmium	3,000 - 17,000
Copper	45,000 - 2,130,000
Lead	70,000 - 1,380,000
Arsenic	18,000 - 71,000
Vanadium	24,000 - 427,000
Zinc	91,000 - 1,900,000
Antimony	120,000

The presence of some of the semi-volatile compounds, pesticides, and metals in the groundwater beneath the landfill is believed to be the result of the leaching of these contaminants from landfill wastes. In addition, there is evidence based upon the erosional patterns shown in the steep side slope of the landfill adjacent to the Branch River, and the similarity of compounds detected in the sediment of the river, that erosion is playing a part in the migration of contaminants from the landfill into the Branch River.

The concentrations and locations at which TCE was detected in samples obtained from landfill wastes do not indicate that the TCE migrated from a source within the landfill. Test pit activities carried out during the RI did not detect the reported disposal of TCE still bottoms in the landfill. Rather, it appears that the TCE found in landfill wastes is the result of TCE contaminated groundwater migrating from the spill area through the raceway and sewer line into the landfill area and then volatilizing into the landfill wastes.

3. Overall Site

The overall Site refers to the remaining areas of the five acre Site. These areas are primarily covered with piles of rubble, partially collapsed buildings, or overgrown with weeds and small trees. No laboratory analyses were performed on the on-site debris and building remains. A sample of sludge from the on-site septic systems drain pipe was screened in the field during the RI and the results indicated the presence of TCE. The septic tank itself is believed to be buried under one of the piles of debris and therefore its contents could not be tested during the RI to determine if TCE-contaminated sludge were present. Based upon the results of the RI, contaminants detected in soil samples from the overall Site area were not acting as a significant migration source to either the groundwater or surface water.

The types of compounds detected in soil samples from the overall Site are similar to those already described in the TCE spill area and landfill area. Primarily low levels of the compound TCE, PAHs, and metals were found throughout this area. The low levels of these contaminants found in the soils of the overall Site are believed to be associated with residues produced during normal operations at the Mill. There were no pesticides or PCBs found above their CRQLs in this area.

TCE was detected in 12 of 45 soil samples in the overall Site area and ranged from 2 ppb (estimated value below the CRQL) to a high of 63 ppb. The sample with the highest TCE concentration (63 ppb) was collected from within the ruins of the former mill building. In addition to TCE, the following VOCs were detected above their detection limits (in only two or fewer soil samples out of 45): chloroform (1 - 27 ppb), 1,1,1-trichloroethane (19 ppb), methylene chloride (11 ppb), and benzene (5 ppb).

Seventeen semi-volatile, base neutral compounds were detected in soil samples from this area. The principal ones detected include:

Compound	Concentration Range (ppb)
Benzo(b)fluoranthene	68 - 7,500
Fluoranthene	90 - 5,700
Phenanthrene	40 - 3,300
Chrysene	99 - 3,200
Benzo(k)fluoranthene	730 - 7,500
Pyrene	33 - 6,000
Benzo(a)pyrene	120 - 2,900
Benzo(a)anthracene	71 - 4,500
Bis(2-ethylhexyl)phthalate	130 - 1,300

All of the base neutral compounds shown above with the exception of the last are PAHs. Although low levels of PAHs were found throughout the overall Site, the highest concentrations outside of the landfill area were confined to one small area referred to as the "hot spot" which is located just west of the partially standing mill building (Appendix A, Figure 5). The PAHs detected in the "hot spot" may be the result of some former mill operation, the 1977 fire that took place (the burning of wood produces PAHs), or the location of a nearby asphalt pad. Although this area of elvevated PAHs is referred to as a "hot spot" in the RI and FS, the levels of PAHs found in this area do not pose a risk to public health and the environment.

The following trace metals were among those detected in samples obtained from the overall Site which exceeded published ranges typically found in soils:

Compound	Concentration Range (ppb)
Cadmium	1,000 - 3,000
Lead	4,000 - 2,340,000
Mercury	100 - 2,000
Selenium	3,000 - 4,000

The highest concentration of lead in a soil sample from the overall Site (2,340,000 ppb) appears to be an anomaly, since the second highest concentration is 65,000 ppb. The ranges of metals detected in these samples from the overall Site also served as "background levels" for the comparison of samples from the landfill area and TCE spill area.

B. Groundwater

The majority of groundwater at the Site is stored in and transmitted through the bedrock aquifer located approximately 10 to 20 feet beneath the surface. To a lesser extent, the lower few feet of the soil layer above this is seasonally saturated. Under current conditions, with the residential wells and the community well directly north of the Site not pumping, the natural regional groundwater flow is generally toward the Branch River. The natural regional flow has been shown to be affected by previous groundwater pumping activity directly north of the Site. During the pump test conducted as part of the RI, pumping of a the Forestdale Water Association Well, a community well located north of the Site, produced a reversal of the regional hydraulic gradient. Reversal of the groundwater flow is believed to be the mechanism by which contaminants migrated from the Site to residential wells north of the Site.

In 1988, the groundwater contaminant plume extended approximately 500 feet northwest of the TCE spill area and then southeast towards the Branch River. The contaminant plume appears to be slowly reversing the previous trend of northward migration based upon 1986 and 1988 groundwater sampling results (Appendix A, Figure 7). TCE and its breakdown products were found to be the major compounds present in the contaminated groundwater. The highest concentrations were found in the groundwater beneath the spill area. The concentration of TCE in the groundwater in this area had ranged as high as 850,000 ppb but during the most recent sampling round (March, 1988) the highest concentration detected was 290,000 ppb (Appendix A, Figure 8). The following volatile organic compounds were the principal ones detected in the March, 1988 groundwater sampling round:

Compound	Concentration Range (ppb)
Trichloroethylene	less than 5 - 290,000
1,2-Dichloroethylene	32 - 31,000
Toluene	9 - 16
1,1-Dichloroethylene	12 - 36
Chloroethane	2,200
Vinyl Chloride	129

TCE contamination is found to a depth of at least 175 feet in the spill area as evidenced by the concentrations of 190,000 ppb detected in MW-10 in March 1988. Based on the high concentrations of TCE detected in the groundwater, there is a strong likelihood that a separate Dense Non-Aqueous Phase Liquid (DNAPL) exits within the contaminant plume. If DNAPL does exist, the higher specific gravity of TCE (when compared to water) may increase its downward migration through vertical joints present in the fractured bedrock thereby extending the contaminant plume. The presence of DNAPL in fractured bedrock conditions such as those found beneath the Site will increase the difficulty of extracting the contaminant plume and may extend the time frame needed to meet groundwater cleanup levels.

To a lesser extent, some semi-volatile organic compounds, trace metals, and pesticides have been found in the groundwater beneath the Site. These compounds have been primarily detected in the vicinity of the landfill. The principal semi-volatile base neutral compounds detected in March 1988, include:

Compound	Concentration Range (ppb)
Bis(2-ethylhexyl)phthalate	less than 180 - 230
1,2,4-Trichlorobenzene	less than 10 - 300
1,2-Dichlorobenzene	less than 10 - 14
1,4-Dichlorobenzene	less than 10 - 110
1,3-Dichlorobenzene	18 - 130

Two semi-volatile acid extractable compounds, benzoic acid and 2-methylphenol were found at concentrations below the CRQL in the August 1986, sampling round. These compounds were not detected in any subsequent groundwater sampling rounds.

The pesticides detected in the March 1988, sampling included dieldrin (4 ppb), 4,4'-DDE (0.48 ppb), and 4,4'-DDD (0.54 ppb). One other pesticide, endosulfan I, was detected below the CRQL. The metals that exceeded drinking water standards in groundwater samples in March 1988, and the range of detected values above the standard are: chromium (128 ppb - 190 ppb), iron (567 ppb - 14,100 ppb), manganese (76 ppb - 18,200 ppb) and zinc (710 ppb). There were no PCBs found above the CRQL in this area.

The semi-volatile compounds, pesticides, and metals detected in the groundwater in the vicinity of the landfill were found primarily in two shallow wells. These two wells, MW-4A and MW-6A, were screened over intervals located in saturated sections of landfill wastes (3 to 8 feet, and 11.5 to 21.5 feet, respectively) and which are located above the bedrock aquifer. As part of the RI activities, two additional deeper wells were placed into the bedrock aquifer, adjacent to the shallow wells. These wells, MW-4 and MW-6, were screened over intervals below all landfill wastes and unconsolidated materials.

The results of the sampling and analysis during the RI shows that the contaminants detected in the groundwater beneath the landfill were found primarily in the shallow wells. Based on the depths over which both shallow wells were screened and the physical description and characteristics of the wastes encountered over these screened intervals (See RI, Appendix A), EPA believes the water sampled in the shallow wells is representative of landfill leachate rather than groundwater found in the bedrock aquifer.

C. Surface Water

The Branch River located just south of the Site flows from west to east in this vicinity. A dam constructed adjacent to the Site forms the eastern-most boundary of the Forestdale Pond. The pond was historically used as a source of hydromechanical power for mill operations. Two "raceways" or rock tunnels were constructed to lead water away from the pond to the mill buildings (Appendix A, Figure 5).

The "old" raceway originates at the Forestdale Pond, directly west of the dam and loops in an easterly direction through the Site exiting to the river just east of the landfill. The inlet is still visible; however, the outlet has collapsed and sections of the raceway in the landfill are also believed to be collapsed. Based on test pit excavations during the RI and evidence of water seepage in the area where the outlet is believed to be located, water continues to travel through the tunnel.

The "new" raceway also originates just west of the dam and exits into the river just southwest of the landfill. The raceway inlet and outlet are still intact and there is visible evidence of water flowing through it.

Surface water and sediment samples were obtained from ten locations along the Branch River during two sampling rounds in the summer of 1986 and one during June 1988. Sampling locations included those adjacent to the Site immediately upstream and downstream, as well as a background location approximately one-quarter of a mile upstream, and a sampling location approximately one-half mile downstream to identify any contaminant transport. In addition, surface water samples were taken at the entrance and exits of both raceways to determine their impacts on the River.

The results of the surface water sampling indicate that upstream of the dam there were no detectable levels of TCE or other site-related contaminants such as the pesticide dieldrin. Downstream of the dam, TCE and its breakdown product 1,2-dichloroethylene were found approaching the CRQL (i.e., concentrations at or below 5 ppb). Higher concentrations of TCE and its breakdown products were found in surface water samples obtained from within or near the raceway exits as described below.

Concentrations of TCE and 1,2-dichloroethylene ranged as high as 59 ppb and 48 ppb, respectively, outside the exit of the new raceway. In addition, vinyl chloride was detected at this location at approximately 5 ppb. No semi-volatile compounds (base neutrals and acid extractables) were detected in any of the surface water samples collected in July and August 1986 and only one compound, diethylphthalate, was found below its CRQL in 1988. The only pesticide detected in the surface water sampling was 4,4'-DDT which was detected at a concentration of 0.13 ppb outside the new raceway exit in June 1988. The surface water sampling results for metals indicated that a limited number of metals were found both upstream and downstream of the dam and the concentrations found did not indicate any discernable site-related trends. There were no PCBs found above their CRQLs in samples from this area.

Although the exact mechanism by which the contaminants from the Site are entering the raceways is unknown (i.e., whether from groundwater migration or transport of soil particles through water erosion), both raceways were shown to be preferential pathways for the migration of contaminants from the Site into the Branch River. The evidence for this preferential pathway is the elevated levels of site-specific compounds found during the RI at the exit of the new raceway and where the exit to the old raceway is thought to be located.

D. Air

Ambient air monitoring completed during the RI to quantify air emissions at the Site under existing conditions did not detect any volatile compounds. Three of the principal volatile compounds detected in the soils at the Site, TCE, trans-1,2-dichloroethylene, and tetrachloroethylene, were used as target compounds for this air sampling effort. Other contaminants detected at the Site, which include PAHs, pesticides, and metals were not analyzed for at the time. These compounds were not tested for because their airborne release is primarily associated with particulate or fugitive dust emissions from bare soil areas. Since the Site is heavily vegetated, dust emissions and airborne releases would be limited and therefore these compounds would not be expected to pose a risk to public health and the environment. Any future activities at the Site which would potentially generate dust or particulate matter, would require ambient air monitoring to protect public health and the environment.

E. Sediment

As described in Section C above, sediment and surface water samples were obtained from ten sampling locations along the Branch River and three locations at or inside the raceway entrances or exits. Because the dam is located adjacent to the Site, sediment samples were easily obtained upstream of the Site. Downstream of the Site there was very little sediment to collect due to the velocity and scouring action of the water flowing over the dam. The one exception to this was a quiescent area located adjacent to the new raceway exit and extending downstream to approximately the eastern boundary of the landfill. Because the quiescent area is protected somewhat from the main flow of the river, sediment and soil have accumulated there.

The trends shown for the sediment sampling results are similar to those described for the surface water sampling. Upstream of the dam, levels of TCE or other site-related contaminants such as the pesticide dieldrin were not detected above the CRQL. Downstream of the dam, elevated levels of TCE and its breakdown product 1,2-dichloroethylene were found, with the highest concentrations between the new raceway exit and the eastern boundary of the landfill (e.g., the quiescent area). The concentrations of TCE and 1,2-dichloroethylene ranged between 6 to 240 ppb and 110 to 140 ppb, respectively, during the June 1988 sediment sampling round in the quiescent area.

A number of semi-volatile base neutral compounds were detected in the sediments obtained both upstream and downstream of the dam. Of those compounds detected in June 1988, six were detected only downstream of the dam and most of these were detected in the vicinity of the collapsed old raceway exit. These compounds and the range of concentrations found downstream of the Site are:

Compound	Concentration Range (ppb)
1,2,4-Trichlorobenzene	130
Naphthalene	100
Acenaphthylene	170 - 180
Dibenzofuran	200
Fluorene	140 - 250
Dibenz(a,h)anthracene	110 - 130

All other base neutral compounds detected downstream of the dam were also detected in sediment collected upstream. However, many of these compounds found downstream were detected in samples at concentrations an order of magnitude greater which indicates that the Site is potentially contributing to the presence of base neutral compounds in the sediment of the Branch River.

The pesticides dieldrin and 4,4'-DDT were identified in several sediment samples. Five sediment samples contained 4,4'-DDT at concentrations ranging from 35 ppb to 200 ppb. The highest concentration of 4,4'-DDT was detected in the sediment sample furthest upstream of the dam and the Site. Dieldrin was detected only downstream of the dam and ranged as high as 1,700 ppb in a sediment sample taken 40 feet downstream of the landfill. In June 1986, PCB aroclor-1254 was detected at 980 ppb at the same sampling location as the 1,700 ppb dieldrin.

Therefore, based on these findings, the presence of pesticides in Branch River sediments cannot be linked specifically to the Site with the exception of dieldrin. The trend seen for metals in the sediments was similar to that of the surface water. Elevated levels of metals were seen both upstream and downstream and no discernable impacts on the sediment could be linked specifically to the Site. The presence of PCB aroclor-1254 in the one sample downstream of the landfill is not believed to be Site-related because the presence of PCBs were not confirmed in any other soil samples taken at the Site. A more detailed discussion of the impacts of the contaminants from the Site on the Branch River can be found in the Ecological Assessment which is included in Appendix E of the FS.

VI. SUMMARY OF SITE RISKS

A risk assessment (RA) for the Stamina Mills Site was performed to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Site. The public health risk assessment followed a four step process: 1) contaminant identification, which identified those hazardous substances which, given the specifics of the Site were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of the exposure; 3) toxicity assessment, which considered the types and magnitude of adverse human and environmental effects associated with exposure to hazardous substances, and 4) risk characterization, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the Site, including carcinogenic, noncarcinogenic, and environmental risks. The results of the public health risk assessment for the Stamina Mills Site are discussed below.

Twenty-three contaminants of concern, listed in Tables 1 through 8 found in Appendix B of this Record of Decision, were selected for evaluation in the RA. These contaminants constitute a representative subset of the more than 90 contaminants identified at the Site during the RI. The twenty-three contaminants of concern were selected to represent potential Site related hazards based on toxicity, concentration, frequency of detection, and mobility and persistence in the environment. Toxicity profiles describing the health effects of each of the contaminants of concern can be found in Appendix J, Volume 2 of the RI.

Potential human health effects associated with exposure to the contaminants of concern were estimated quantitatively through the development of several hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to hazardous substances based on the present uses, potential future uses, and location of the Site. The current exposure pathways for the Site, which is presently abandoned and fenced, are through contact with contaminated soil and indirectly through the consumption of fish from the Branch River. There is no current risk posed by ingesting groundwater from the Site since it is not being used as a drinking water supply. Potential future exposure pathways include contact with contaminated soil, ingestion of groundwater and consumption of fish from the Branch River and are based upon the assumption that the Site would not be cleaned up and would be developed for residential use. Although the Site is currently zoned for manufacturing, a conservative assumption was made based upon the current residential nature of the area surrounding the Site, that it might be developed for residential use sometime in the future.

The following is a brief summary of the exposure pathways evaluated. A more thorough discussion can be found in Section 7.3 through 7.4 of the risk assessment which is located in the RI. For incidental ingestion and direct contact with contaminated soil, the health risk was evaluated for a child between the ages of 2 and 6 who may be exposed on average 60 times a year and at a maximum of 120 times a year for two hours per visit. During that time the child might ingest 50 mg of contaminated soil and absorb contaminants from soil covering the childs forearms, hands, legs and feet. For ingestion of groundwater used as a drinking water supply, the health risk was evaluated for an adult who may consume two liters per day for seventy years. For incidental ingestion and dermal absorption of surface water, the health risk was evaluated for a child between the ages of five and eighteen who may accidently ingest and swim in contaminated surface water once each year. For incidental ingestion of sediments via the consumption of fish (it was assumed that the fish tissues are contaminated to a level in equilibrium with the sediments), the health risk was evaluated for an adult consuming 6.5 grams of fish per day over seventy years. For each pathway evaluated, an average and a reasonable maximum exposure estimate was generated corresponding to exposure to the average and the maximum concentration detected in that particular medium.

Excess lifetime cancer risks were determined for each exposure pathway by multiplying the exposure level with the chemical specific cancer potency factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is very unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} for one in a million) and indicate (using this example), that an individual is not likely to have greater than a one in a million chance of developing cancer over 70 years as a result of site-related exposure as defined to the compound at the stated concentration. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances. The hazard index was also calculated for each pathway as EPA's measure of the potential for noncarcinogenic health effects. The hazard index is calculated by dividing the exposure level by the reference dose (RfD) or other suitable benchmark for noncarcinogenic health effects. Reference doses have been developed by EPA to protect sensitive individuals over the course of a lifetime and they reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. The hazard index is often expressed as a single value (e.g. 0.3) indicating the ratio of the stated exposure as compared to the reference dose value (In this example, the exposure as characterized is approximately one third of the acceptable exposure level for the given compound). The hazard index is only considered additive for compounds that have the same or similar toxic endpoints. As an example, conversely, the hazard index for a compound known to produce liver damage should not be added to a second whose toxic endpoint is kidney damage.

Table 1 depicts the cumulative risk summary for the carcinogenic and noncarcinogenic contaminants of concern for each pathway analyzed. The hazard indices for the individual contaminants of concern and their target endpoints can be found in Appendix B of this ROD. For a more detailed analysis on the risk for each contaminant of concern, see Tables J-44A through J-66A of the RI.

Cumulative potential cancer risks associated with ingestion of groundwater from off-site active wells, incidental ingestion of soils from the spill area, incidental ingestion of shallow soils (0-5') from the landfill area, and incidental ingestion of soils from the site proper did not exceed EPA's acceptable cancer risk range of 10^{-4} to 10^{-6}. The cumulative hazard indices as a measure of the potential for non-carcinogenic effects for ingestion of groundwater from off-site active wells and incidental ingestion of soils from the spill area, did not exceed unity. All off-site wells that are no longer being used as a drinking water source, as a result of the construction of the public water supply, are considered inactive and were not included in the off-site active well category.

Based on the findings in the Baseline RA, EPA has concluded that the risk posed by the future ingestion of groundwater from the Site will exceed the acceptable risk range of 10^{-4} to 10^{-6}. The principle contributors to carcinogenic risk from the ingestion of groundwater are trichloroethylene and 1,2-dichloroethylene. The maximum concentration of trichloroethylene detected on-site, 850,000 ppb, exceeded the Maximum Contaminant Level of 5 ppb promulgated in the Safe Drinking Water Act. Total 1,2-dichloroethylene was also found at high concentrations with a maximum concentration of 31,000 ppb. The Maximum Contaminant Level established in the Safe Drinking Water Act for 1,2-dichloroethylene is 7 ppb.

The hazard index exceeds unity for the future ingestion of groundwater from the Site for both the average and maximum cases. Total 1,2-dichloroethylene is the major contributor for the noncarcinogenic effects with a hazard index of 50. In addition, under a potential future scenario in which the landfill area would be developed, and deeper soils from within the landfill would be brought to the surface, the hazard index for these exposed soils would exceed unity. The principle contributor to the hazard index for the deeper soils from within the landfill is dieldrin, having The excess lifetime carcinogenic risk posed by eating the fish from the Branch River have been predicted to exceed the acceptable risk

TABLE 1
Cumulative Carcinogenic Risk Estimates and Cumulative Hazard Indices by Exposure Pathway

Exposure Pathway	Cancer Risk		Hazard Index	
	Average	Maximum	Average	Maximum
Present				
Ingestion of Groundwater, Off-site Active Wells	$3X10^{-6}$	$3X10^{-6}$	$1X10^{-1}$	$3X10^{-1}$
Incidental Ingestion of Soil, TCE Spill Area	$2X10^{-6}$	$8X10^{-6}$	$1X10^{-1}$	$6X10^{-1}$
Incidental Ingestion of Soil (0 - 5'), Landfill Area	$2X10^{-6}$	$2X10^{-5}$	$6X10^{-1}$	$3X10^{0}$
Incidental Ingestion of Soil (0 - 5'), Soil Outside of Landfill and Spill Area	$1X10^{-6}$	$1X10^{-5}$	$7X10^{-2}$	$1X10^{0}$
Ingestion of Sediments via Fish, Downstream of Site	$8X10^{-3}$	$3X10^{-2}$	$6X10^{-1}$	$2X10^{0}$
Ingestion of Sediments via Fish, Upstream of Site	$4X10^{-3}$	$4X10^{-3}$	$2X10^{-3}$	$2X10^{-3}$
Incidental ingestion of Surface Water	$5x10^{-7}$	$6x10^{-7}$	$2x10^{-2}$	$4x10^{-2}$
Future				
Ingestion of Groundwater, Tce Spill Area	$8x10^{-2}$	$4x10^{-1}$	$5x10^{1}$	$2x10^{2}$
Ingestion of Groundwater, Landfill Area	$2x10^{-2}$	$7x10^{-2}$	$3x10^{1}$	$6x10^{1}$
Ingestion of Groundwater, Off-site Active Wells	$3x10^{-6}$	$3x10^{-6}$	$1x10^{-1}$	$3x10^{-1}$
Incidental Ingestion of Soil (5 - 20'), Landfill Area a hazard index of 5.	$2x10^{-6}$	$3x10^{-6}$	$5x10^{-1}$	$6x10^{0}$

range of 10^{-4} to 10^{-6}. This is based on the assumption that contaminant levels in fish tissue are in equilibrium with contaminant levels found in sediment from the river. The principle contributors to the predicted carcinogenic risk are the PAHs and the pesticide dieldrin. The total hazard index for the most probable (average) case for the noncarcinogenic risk posed by eating fish tissue is less than one. However for the maximum case the hazard index is 2. Dieldrin is the compound of particular concern, having a hazard index of 2.

An ecological assessment was also completed for the Site. The ecological assessment found in Appendix E of the FS is a qualitative appraisal of the potential effects and risks of hazardous substances found at the Site on the environment (specifically target species of the fish population found in the Branch River). Using the quantitative information generated from the RI, the assessment compares the concentrations of contaminants reported at the Site, to those reported in available literature, and subsequently, attempts to define more clearly the potential ecological impacts from the Site. The main conclusion of the ecological assessment is that there is some potential for adverse impacts on the fish population in the Branch river due to contaminants being released from the Stamina Mills Site. Specifically, the elevated concentrations of dieldrin detected in the sediments of the Branch River, which are being released from the Site, pose a threat to the environment. The higher concentrations of some contaminants found in the furthest upstream sample, which is located well above where contaminants could be attributed to the Site, indicates that sources besides the Site may be effecting the environment.

Consequently, the Stamina Mills Site remediation shall strive to achieve cleanup levels for soil and groundwater that are protective of public health and the environment. Actual or threatened releases of hazardous substances in groundwater from the Site, if not addressed by implementing the response action selected in this ROD may present an imminent and substantial endangerment to public health, welfare or the environment.

VII. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria or limitations, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed to be consistent with these Congressional mandates.

Based on preliminary information relating to types of contaminants, environmental media of concern, prior and present use of groundwater as a drinking water source, and potential exposure pathways, remedial action objectives were developed to aid in the development and screening of alternatives. These remedial action objectives were developed to mitigate existing and future potential threats to public health and the environment. These response objectives were:

1. Restore the groundwater to Federal and State drinking water standards (or criteria when drinking water standards are not available) as quickly as possible because the aquifer is a drinking water source.

2. Prevent the public from direct contact with contaminated soils, sediments, and solid wastes which may present health risks.

3. Eliminate or minimize the migration of contaminants from the soil into the groundwater.

4. Prevent the off-site migration of contaminants to the surface water above levels protective of public health and the environment.

5. Reduce risks to human health associated with the physical hazards while implementing remedial actions at the Site.

B. Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives was developed for the Site.

With respect to source control, a range of alternatives was developed in the RI/FS, in which treatment reducing the toxicity, mobility, or volume of the hazardous substances was a principal element. This range included an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing to the degree possible the need for long term management. This range also included alternatives that treat the principal threats posed by the Site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed; alternatives that involve little or no treatment but provide protection through engineering or institutional controls; and a no action alternative.

With respect to groundwater response action, the RI/FS developed a limited number of remedial alternatives that attain site specific remediation levels using different technologies; and a no action alternative.

Section 3 of the FS identified, assessed and screened technologies based on implementability, effectiveness, and cost. These technologies were combined into source control (SC) and management of migration (MM) alternatives. Section 3 of the FS also presented the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories identified in Section 300.430(e) (3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated and screened in Section 4 of the FS.

In summary, of the nine source control and ten management of migration remedial alternatives screened in Section 4, thirteen were retained for detailed analysis. It should be noted that among the ten remedial alternatives being classified under the category of management of migration, five specifically address existing physical conditions at the Site. Because these five also address the remediation of the on-site raceways which have been shown to be a pathway for the preferential migration of contaminants, they are also being classified as management of migration alternatives. Table 4-2 in Section 4 of the FS identifies the thirteen alternatives that were retained through the screening process, as well as those that were eliminated from further consideration.

VIII. DESCRIPTION OF ALTERNATIVES

This Section provides a narrative summary of each alternative evaluated.

A. Source Control (SC) Alternatives Analyzed

As described in Section V of this document and Section 4 of the FS, the Site consists of a number of areas with different physical characteristics and chemical contaminants (Appendix A, Figure 9). As a result, separate source control measures have been developed for both the TCE spill area (identified as TSA alternatives) and landfill area (identified as LA alternatives). The source control alternatives analyzed for each of these areas include the following:

<u>TCE Spill Area (TSA)</u>

TSA-1: Excavation and On-site Incineration;

TSA-3: Soil Vacuum Extraction;

TSA-4: No-action Alternative;

Landfill Area (LA)

LA-1: Excavation and On-site Incineration;

LA-3: Capping Including Consolidation;

LA-5: No-action Alternative.

1. TCE Spill Area

TSA-1
Excavation and On-site Incineration

This alternative would involve the excavation and incineration of approximately 6,000 cubic yards of TCE contaminated soils. TCE contaminated soils would be excavated to the groundwater table and then processed and separated as necessary to prepare them for incineration in a mobile rotary kiln. The soils in the TCE spill area have been identified as one of the principal threats found at the Site and therefore the use of treatment to remediate this area is preferred by EPA.

The efficiency of rotary kiln incinerators for destroying organic hazardous materials is well proven and a destruction and/or removal efficiency (DRE) of 99.99% or greater is anticipated for TCE and other VOCs in soils from the TCE spill area. During the excavation of contaminated soils a foaming agent or other synthetic material would be employed to suppress dust and vapor emissions. Stockpiled soil would be stored in a lined containment area and will remain covered with polyethylene sheeting.

Materials excavated from the spill area which are not suitable for incineration would be disposed of in accordance with Rhode Island Solid Waste and Hazardous Waste Regulations. Because the TCE contaminated soil is considered a listed hazardous waste under the Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. 6901 et seq. (RCRA), and the excavation, treatment, or disposal of contaminated soils is considered placement, RCRA, Land Disposal Restrictions (LDRs), and Rhode Island Hazardous Waste Regulations are all important applicable or relevant and appropriate requirements (ARARs) for this alternative. A brief discussion of ARARs can be found on page 69 of this document. Both state and federal air emission standards are ARARs for any type of incineration.

Before implementing this alternative, site preparation activities including grading, staging pad construction, security fence construction, and utility hookup will have to be completed. Prior to the full-time operation of the incinerator, a series of test burns would be required to determine the optimum operating parameters of the rotary kiln. The principal residue expected to be produced during the operation of the incinerator is bottom ash; smaller quantities of scrubber liquor and fly ash are expected to be produced. The bottom ash, which is composed primarily of the inert inorganic elements of the soil, would require testing to determine whether it exhibits a RCRA hazardous waste characteristic. In the event that the bottom ash is a hazardous waste, it would be treated consistent with the appropriate federal and state hazardous waste regulations and LDR requirements and disposed of at an off-site RCRA facility. The scrubber liquor and fly ash are residues from the pollution control equipment used for treating air emissions. The fly ash and scrubber liquor will also require testing and, based upon the results, would be disposed of appropriately. The options being considered for the scrubber liquor include: disposal into a municipal sewer with or without treatment and on-site or off-site treatment.

ESTIMATED TIME FOR CONSTRUCTION:	3 Months
ESTIMATED TIME FOR OPERATION:	2.5 Years
ESTIMATED CAPITAL COST:	$ 9,994,150
ESTIMATED O & M (Cost/Year):	$ 100,000
ESTIMATED TOTAL COST (Present worth):	$10,690,620

TSA-3
Soil Vacuum Extraction

This alternative would use in-situ soil vacuum extraction to actively remove TCE and other volatile organic compounds from the soil. Contaminant laden air would be treated using vapor phase granular activated carbon (GAC). Shallow wells would be installed to a depth of ten feet, or far enough above the water table to avoid the extraction of excess moisture. A plastic ground cover may be required to be installed over the surface of the TCE spill area soils to minimize the infiltration of air and precipitation. This will be decided during the design phase or during the start up phase of the operational period. Vacuum extraction has been shown to remove as much as 99.99 percent of similar VOCs from soils. A removal efficiency of 97 percent for TCE would result in residual levels below the cleanup levels. Soil sampling would be done to confirm that the technology reduced contaminants to protective levels.

The technology, although proven for the type of contaminants found at the Site, does have some uncertainties which may affect the exact time frame required for cleanup. The physical properties of the chemicals being removed (e.g., Henry's Constant) and the soil being cleaned up (e.g., permeability) both play an important role in affecting the cleanup time frame. These physical properties can be estimated using calculated or laboratory derived values to obtain a rough estimation of the cleanup time frame. Because the values being used for the physical properties are not necessarily site-specific, the accuracy of the estimated cleanup time would only be known once the system is operational. Therefore, until the system is operational and field data is available a more refined cleanup time frame cannot be estimated.

The vapor phase GAC system that would be used to meet air emission standards would require the off-site transport of spent activated carbon for treatment and regeneration. It is also possible that a liquid residue associated with condensate from the vapor stream may be produced; this would be either combined with extracted groundwater for treatment on-site or be shipped off-site for treatment. Because the soils from the TCE spill area are considered a listed RCRA hazardous waste, any residues derived from the treatment of the soil would also be considered a hazardous waste. Therefore, state and federal Hazardous Waste Regulations, and state and federal air emission standards are the major ARARs for this alternative. Soil vacuum extraction is considered an in-situ activity, and as such, there is no excavation or placement of a RCRA waste. Therefore, LDRs are not considered an ARAR.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	1 Year
ESTIMATED CAPITAL COST:	$266,465
ESTIMATED 0 & M (Cost/Year):	$ 1,500
ESTIMATED TOTAL COST (Present worth):	$280,605

TSA-4
No-Action

This alternative is included in the FS, as required by CERCLA, to serve as a basis for comparison with the other source control alternatives being considered for the TCE spill area.

The no-action alternative for the TCE spill area would not involve any treatment of the contaminated soils. However, in order to provide minimal protection of human health and the environment, the no-action option would require the placement of a vegetative soil cover over the spill area. The soil in the spill area would be cleared and graded to provide surface runoff, and then covered with clean fill and vegetated with a low maintenance growth cover. Institutional controls would be implemented to limit future use of the area. A long-term groundwater monitoring program, which would be implemented along with the groundwater extraction and treatment alternative selected, would provide further information on the migration of contaminants from spill area soils if the no-action alternative were to be chosen. The no-action alternative does not help meet any identified ARARs. Indeed, the no-action alternative would impede the restoration of the groundwater to federal and state drinking water standards because the TCE spill area soils would continue to serve as a source of contamination of the groundwater.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	2 Months
ESTIMATED CAPITAL COST:	$40,140
ESTIMATED 0 & M (Cost/Year):	$ 1,500
ESTIMATED TOTAL COST (Present worth):	$54,280

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