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RAYMARK
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RACI-EPA-2693

Contract No. 68-W6-0045

November 20, 2000

Mr. Ronald Jennings
U.S. Environmental Protection Agency
One Congress Street, Suite 1100, HBT
Boston, Massachusetts 02114-2023

Subject: Transmittal of the Draft Technical Memorandum - Remedial Alternatives Screening Report
Raymark – OU4 – Ballfield Site, Remedial Investigation/Feasibility Study
RAC I W.A. No. 030-RICO-01H3

Dear Mr. Jennings:

Enclosed are two copies (one bound and one unbound) of the Draft Technical Memorandum – Remedial Screening Alternatives Report for the Ballfield study area. As instructed by you, I have also transmitted, under separate cover, two copies of the report to Mr. Ronald Curran of the Connecticut Department of Environmental Protection (CTDEP), two copies of the report to Ms. Laureen Borachaner of the U.S. Army Corps of Engineers (ACOE), and one copy of the report to Ms. Kathleen Conway, Counsel for the Raymark Advisory Group. In addition, two copies of the report will be hand delivered to the Raymark Advisory Group on November 21, 2000.

If you have any questions regarding this transmittal, please contact me.

Very truly yours,

Heather M. Ford
Project Manager

PMO – @

HMF:rp

Enclosures

c: H. Horahan (EPA) w/o enc.
R. Curran (CTDEP) w/enc. (2)
L. Borachaner (ACOE) w/enc. (2)
K. Conway (RAC) w/enc. (1)
RAC – By Hand (2)
A. Ostrofsky (TtNUS) w/o enc.
File N0004 -1.0 w/o enc./N0004-3.4 (orig) w/enc.

18023

RI00588D

DRAFT
TECHNICAL MEMORANDUM

RAYMARK-OPERABLE UNIT 4
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 030-RICO-01H3
TtNUS Project No. N0004

November 2000

TETRA TECH NUS, INC.

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November 2000

Heather M. Ford
Project Manager

George D. Gardner, P.E.
Program Manager

TABLE OF CONTENTS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
RAYMARK – OU4
STRATFORD, CONNECTICUT

TABLE OF CONTENTS (cont.)
DRAFT TECHNICAL MEMORANDUM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
RAYMARK – OU4
STRATFORD, CONNECTICUT

TABLES

NUMBER

FIGURES

NUMBER

REFERENCES

ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Amended by SARA in 1986. Also called the Superfund Law.
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CT DEP	Connecticut Department of Environmental Protection
DNAPL	dense non-aqueous phase liquid
ELUR	Environmental Land Use Restrictions
EPA	U.S. Environmental Protection Agency
°F	degree Fahrenheit
FS	Feasibility Study
GB	State of Connecticut classification for non-drinking water sources
GRA	General Response Action
HNUS	Halliburton NUS Corporation
kg	kilogram
LDR	land disposal restriction
µg/kg	microgram per kilogram
mg	milligram
mg/kg	milligram per kilogram
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
No.	number
NPDES	National Pollutant Discharge Elimination System
OU	Operable Unit
PCB	polychlorinated biphenyl
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
Raymark Facility	Raymark Industries, Inc. Facility
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile Organic Compound
TBC	To Be Considered
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
TSD	(RCRA) Treatment, Storage, and Disposal
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This Draft Technical Memorandum, Remedial Alternatives Screening, was prepared by Tetra Tech NUS, Inc. (TtNUS) at the request of the U.S. Environmental Protection Agency (EPA) under Contract No. 68-W6-0045. This Technical Memorandum describes the remedial alternative screening process for the Raymark Operable Unit 4 (OU4) Ballfield study area under Work Assignment No. 030-RICO-01H3. The alternatives screening was performed in accordance with the Draft Work Plan dated May 1999 and the EPA guidance document, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA,* October 1988. The remedial alternatives screening was prepared based on the *Final Remedial Investigation Report, Raymark – OU4 – Ballfield* (TtNUS, 1999).

The objective of this memorandum is to evaluate the Ballfield Area for general site cleanup options and to present an estimate of the cost associated with each alternative considered.

This Technical Memorandum is presented in one volume. Section 1.0 presents the introduction, Section 2.0 identifies and screens remedial technologies and process options, and Section 3.0 briefly discusses the future assembly of alternatives.

1.1 <u>Background</u>

This section provides a summary of the history of the study area and vicinity (see Figure 1-1), a summary of past operations at the Raymark Facility, a description of the study area and setting, and a listing of other on-going activities associated with the Raymark Facility.

This report addresses the Raymark OU4 study area. OU4 is one of the eight operable units at the Raymark Industries, Inc. Superfund site. All eight of the Raymark Operable Units are in various stages of investigation (see Section 1.1.5 for details and Figure 1-2 for the locations).

1.1.1 History of Raymark Facility and Environs

The OU1-Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut. The Raymark Facility operated from 1919 until 1989, when the plant was shut down and permanently closed. Based on Stratford tax map information, the OU1-Raymark Facility occupied 33.4 acres and manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material, sheet packing, and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils and groundwater at the OU1-Raymark Facility became contaminated.

Between 1919 and 1984, low-lying portions of the OU1-Raymark Facility were filled with manufacturing waste materials from various plant operations. The filling of those areas occurred over the life of the facility operations, and progressed essentially from north to south, across the property. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded.

The OU1-Raymark Facility was underlain by an extensive, subsurface drainage system network. This network collected water and wastes from the manufacturing operations and diverted it into the facility drainage system. The system also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and discharged to Ferry Creek.

During peak operations at the OU1-Raymark Facility, approximately 2 million gallons of water were used for plant processes each day. Municipal water was used for both contact and non-contact cooling water. To supplement this source, an additional on-site supply well was installed. The well, located in the northeastern corner of the facility, was used for non-contact cooling water. Facility water was recirculated, with some percentage reinjected into the on-site well; the unused well water and municipal water were discharged through the facility drainage system. Wastewater from facility operations was collected and discharged to a series of four settling lagoons located in the southwestern corner of the facility, and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. The wastewater consisted of wastewater from the acid treatment plant, wet dust collection, paper making processes, non-contact cooling water, and wastewater from solvent recovery plant operations. The lagoons also received stormwater drainage and surface water runoff.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4, that in turn discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These three lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm sewer, which ultimately discharges to Ferry Creek. Lagoon No. 4 was closed in early 1995. Refer to Figure 2-1 for the locations of the former lagoons.

During the operation of the lagoons, the settled material in the lagoons was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as "fill" material (referred to as "Raymark soil-waste") both at the Raymark Facility and at various locations in Stratford.

A number of locations where Raymark soil-waste was disposed were found to be contaminated with levels of asbestos, lead, and polychlorinated biphenyls (PCBs) that posed a threat to public health. To abate the potential health threat to residential properties, residential locations were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The excavated material from these residential locations was stored and ultimately placed under the cap at the OU1-Raymark Facility. Waste from one municipal property, Wooster Middle School, was also excavated, stored, and ultimately placed under the cap at the OU1-Raymark Facility.

A substantial number of field investigations relating to soil, sediment, surface water, biota, and groundwater have been conducted at the Raymark Facility and its environs.

1.1.2 Facility Operating History

The following narrative presents a summary of plant operations and waste handling practices for Raymark's manufacturing operations; see the OU1 Remedial Investigation (RI) (HNUS, 1995) for further details.

1.1.2.1 Phenolic Resin Manufacturing

Solid and liquid phenolic resin was manufactured at the Raymark Facility. The resin was produced in five or six pressure vessels; companion tanks held the raw product. After production, the liquid resins were transferred to the plant floor to manufacture plant goods or to set in order for use in solid form. Prior to use, the solid resins were pulverized on site to meet product specifications, and then transferred to the plant floor for use.

1.1.2.2 Brake Lining Production

Brake lining production began by adding dry asbestos materials, liquid phenolic resins, and solvents (to thin the resins) to the mixers located on the plant floor. The mixers operated for approximately 1 hour until the liquid resin had penetrated and coated all the dry materials. This mixture, resembling a soft heavy mud, was formed into brake lining parts that were then baked in ovens for 6 hours. The end product, a hard material, was machined to the specifications of a finished brake lining. As necessary, materials that were trimmed and ground during the machining operations and not used in the finished product were disposed of on or off site as fill/soil-waste material; after 1984, these processed wastes were shipped off site in containers.

The waste from the machining operations was collected in a wet-type dust collection system. Particulates collected from the system were mixed with process water and pumped to the on-site lagoons as a 90/10 water/dust slurry mixture. The slurry mixture settled out in the lagoons and eventually filled them. When a lagoon was filled, the slurry mixture would be diverted to another lagoon, to allow time (several months) to dewater. The dewatered material in the lagoon was excavated and disposed of either on site or off site. After 1984, the waste particulates were collected in dry dust collectors and disposed of off site in one-cubic yard bags.

1.1.2.3 Standard Transmission Clutch Plates

The process of producing clutch plates began by creating a mixture of asbestos, other components, and water and forming a paper-like sheet of material. This sheet was rolled onto a machine roller, saturated with phenolic resin, and then oven dried and cured. The clutch plates were machined to specifications from these sheets and the finished clutch plate was bonded to a steel core. As in the brake lining production, the manufacturing process produced machining particulates that were collected in the dust collection system, mixed into a wet slurry, and pumped to the lagoons to settle. This system was replaced in 1984, by the dry dust collectors.

In the early 1980s, the process was modified to allow water to be reused and captured into the manufacturing process resulting in no discharge of water. In addition, the dry asbestos used in the original manufacturing of the paper-like material was replaced with a cotton-type material, so the product became asbestos-free.

The Raymark Facility also molded raw steel into a steel core onto which the clutch plate was mounted. After molding, the steel core was degreased, etched to specification, coated with a phenolic resin, and allowed to dry. The clutch plate was then mounted to the steel core.

A specialty heavy-duty clutch was also manufactured on the Raymark Facility. The process of mixing the asbestos, resins, and water to produce heavy-duty clutches was similar to that used to produce the standard transmission clutch plates.

1.1.2.4 Gasket Material Manufacturing

Gasket material was produced in large rubber sheets. The rubber was composed of naphtha, toluene, asbestos, phenolic resins, and various fillers. The process began by mixing asbestos, latex, rubber cement, and rubber together until the mix was homogeneous. The mix was then loaded onto a roller machine where it was flattened into a sheet. The sheet was removed and laid out on a large table for cutting. The gaskets were then cut to specification.

The trim from cutting was pulverized and re-used in the process. Vapors were collected and passed through the activated carbon solvent recovery plant. Prior to the mid-1980s, no vapor collection occurred.

1.1.2.5 Disc Brake Pad Manufacturing Operations

Asbestos, glass, and semi-metallic disc brakes were manufactured at the Raymark Facility. Asbestos disc brakes were composed of asbestos, phenolic resin, and fillers; glass disc brakes were composed of fiberglass, phenolic resin, and fillers; and semi-metallic disc brakes were composed of steel wool, phenolic resin, and fillers. The operations to process these disc brake pads involved mixing components in plant mixers until a homogenous mixture was coated completely with phenolic saturate, pouring the mixture into electronically heated molds to form a hard part, and machining this part into the needed specified product size.

Waste generated from the machining process was collected in the dust collector system, and transported as described above, as a water/waste slurry mixture to the on-site lagoons. After 1984, dry dust collectors collected the particulate matter and the material was disposed of off site in 1-cubic yard bags. The trim and off-specification material, if not pulverized for reuse, was disposed of as fill.

1.1.2.6 Miscellaneous Activities

The following activities also occurred at the Raymark Facility:

- Coal-fired Steam Generation – The Raymark Facility generated steam from August 1919, until the early 1940s. Steam was generated from coal-fired steam boilers. The coal was delivered by rail directly onto the facility by a railroad spur that has since been removed. The coal was stored in the area surrounding the boiler house and transported by heavy equipment around the plant. No figures are available on the quantities of coal used.

- Steam Boilers – The coal-fired steam boilers were converted to oil in the early 1940s. Number six fuel oil was stored in two 50,000 gallons tanks. No figures are available on quantities of oil used.

- Material Storage – Numerous tanks located throughout the plant stored raw product, manufactured goods not yet turned into a product, and waste products remaining from the various manufacturing processes.

- Dry Trim Reclamation – The materials that were trimmed from the baked products (dry trim) were stored outside under a roof on the asphalt pavement. The trim re-use process consisted of using hammer mills to pulverize the waste trim. As dry trim re-use occurred more frequently during later years of facility operations, particulates from this process were collected in a separate dry dust collector system and bagged for disposal.

- Finished Products – These materials were stored on site pending off-site shipment to customers.

1.1.3 Environmental Permits

The Raymark Facility was subject to the requirements of both state and Federal Permits.

1.1.3.1 RCRA Activities

Raymark filed a Notification of Hazardous Waste Activity form on August 15, 1980, under the name of Raybestos Friction Materials Company. This form indicated that the company generated, treated, stored, and disposed of hazardous wastes such as chlorinated solvents, acetone, formaldehyde, toluene, sludge from lime treatment generated from steel finishing operations, asbestos, acids, phenols, methyl ethyl ketone, and ignitable, corrosive, toxic wastes.

On November 12, 1980, the notification was expanded to include the activities and quantities listed below for each waste activity. However, the quantities listed below were the total permitted quantities and not the actual quantities or units reportedly used at Raymark.

- The Raymark Facility was permitted to process more than 2.5 billion gallons of lead-contaminated waste liquid each year in the on-site lagoons. It is estimated that 6 million gallons of the 2.5 billion gallons were treated each year.

- The Raymark Facility container storage area was permitted to handle approximately 23 million gallons of toxic, ignitable, corrosive, and acidic wastes each year.

- The Raymark Facility tank storage area was permitted to handle approximately 10 million gallons of waste yearly.

- The Raymark Facility incinerator was permitted to process approximately 240,000 gallons per year of toxic and ignitable wastes.

In 1986, Raymark filed a permit application for the various Raymark Facility activities under the name of Raymark Industries, Inc. At that time, the original RCRA Part A notification was re-filed and the on-site activities and waste generated were significantly reduced. The activities described in the revised submittal included 7,040 gallons of liquid container waste, 150 cubic yards of solid container waste stored on the property, and an approximately 7-acre landfill on the property. The "landfill" was comprised of the lagoons previously located along the southern boundary of the Raymark Facility. Each of these activities appeared to include the handling of ignitable, toxic, corrosive, and toluene-contaminated wastes.

The facility closed in September 1989. In 1990, pursuant to a RCRA 3007 information request, Raymark indicated it still had significant quantities of waste and unused products remaining on site. Some of these waste products were 400,000 gallons of asbestos slurry in tanks and 1,700 cubic yards of unfinished asbestos product. These wastes were removed from the Raymark Facility between 1990 to 1994.

During the operations of the Raymark Facility, wastewaters were routed into four lagoons. Three of the lagoons stopped receiving waste in 1984, and were temporarily closed in December 1992 and January 1993, under an EPA order. The fourth lagoon was temporarily closed in 1994. In 1993 on-site storm water was rerouted around Lagoon No. 4 so the storm water no longer discharged into Lagoon No. 4. The facility cleanup/remediation was conducted under the CERCLA program, and the on-site sources (lagoons, tanks, incinerator) were removed and/or remediated as part of the long-term solution.

1.1.3.2 Wastewater Activities

The Raymark Facility had a 2.5 million gallon per day water and wastewater discharge flow from the plant operations into the lagoons for discharge into Ferry Creek. This discharge was permitted under the State of Connecticut National Pollution Discharge Elimination System (NPDES) program from the early 1970s until the early 1990s, with volumes decreasing as plant activities were reduced. The activities permitted included: acid treatment plant wastewater, dust collection system wastewater, noncontact cooling water, and solvent recovery plant wastewater. A separate permit was issued for an extraction well installed on site to remove groundwater contaminated with toluene from the aquifer. The groundwater was discharged to the sanitary sewer. The toluene contamination was the result of a spill that occurred on site in 1984.

1.1.4 Study Area Description and Setting

The OU4 study area evaluated in this document is adjacent to the facility, separated only by railroad tracks. As detailed in the Final RI Report (TtNUS, 1999), the study area encompasses a total area of 13.5 acres and includes the 3-acre Raybestos Memorial Ballfield, an 8.5-acre vacant field, and a 2-acre densely wooded area. Residential properties border the north/northwest side of the study area along Patterson and Clinton Avenues. Town commercial and industrial properties are located along Frog Pond Lane to the northeast. Railroad tracks and the former Raymark Facility border the study area to the east/southeast, and an inactive industrial property abuts the study area to the south/southwest.

Aerial photographs indicated that the Raybestos Memorial Field was built between 1940 and 1949. The ballfield area was used as a softball field for the Raybestos women's softball team from the 1940s until the 1980s. The study area still currently contains the bleachers, fencing, lighting, parking area, and playing field outline that was used during team play. The vacant area outside the ballfield was used as a source of sand and gravel in the 1940s. A large pond (Frog Pond) was located in the southern portion of the field. Apparent filling of the pond occurred over the years and is not present today.

Evaluation of test borings, geophysical surveys, and analytical data indicates that the pond was filled with Raymark-type waste materials. It is unclear whether Frog Pond was formed as a result of excavation activities associated with the sand and gravel operations mentioned above. A peat layer of unknown thickness was encountered in the area of the pond during test borings. Depending on the thickness of the peat layer, this peat could be indicative of the pond's existence prior to excavation activities. The pond may have been formed in association with regional deglaciation during the last ice age. It appears the historical pond (1940s) outlet drained south towards the railroad tracks and eventually discharged to Long Brook or Ferry Creek.

The wooded area in the southwest corner of the site was the proposed location of Lafayette Road, which was to be developed near the property boundary. The road was never built, and the property was abandoned by the town and divided and deeded to abutting landowners and the Daley Development Corporation. The wooded area is the portion of the land deeded to Daley Development Corporation, the present owner of the study area.

On-site sand and gravel removal activities ceased in approximately 1940, and the excavated area was used for disposal purposes. The former Raymark Industries, Inc. company disposed of unknown quantities of wastes containing asbestos and non-asbestos material, metals, pheno-formaldehyde resins, and various adhesives on this study area. As a result of the disposal activities, soils at the site are known to be contaminated with asbestos, lead, PCBs, and other pollutants, disposed of from the early 1940s to 1977 (USEPA, 1992). Reportedly, the Town of Stratford also used the study area as a dumping and temporary storage area for asphalt, road salt, dirt, and trash (EAI, 1990).

In the 1970s, Raymark Industries, Inc. performed two cleanup activities to place a 2-foot soil cover over identified areas of surficial asbestos contamination. The study area was purchased by the Daley Development Corporation of Stratford, Connecticut in 1986.

In 1989, EPA conducted a preliminary assessment of the study area and, in 1990, issued an Administrative Order for Removal Action to the Daley Development Corporation. In 1992, EPA assumed responsibility for site actions. The removal action implemented by EPA included installation of a site security fence, clearing of vegetation that would interfere with cap/cover placement, grading and capping areas of the site with clean soil (6-inch minimum cover), and sampling and removal of onsite drums. Soils sampling profiles collected after completion of the cover indicate the soil cover ranges in thickness from approximately 6 to 11 inches. Other study area investigations were performed during the period from 1988 through 1992 (including soil borings, soil sampling, and test pits) (EPA, 1992).

1.1.5 Other On-Going Activities

Activities undertaken in the vicinity of the study area that are related to Raymark include:

- ***OU1* – Cleanup of the source at the OU1-Raymark Facility is complete**. EPA completed a Remedial Investigation and Feasibility Study for controlling sources of waste at the 33-acre Raymark Facility in 1995 describing the type and location of wastes, the risks posed by those wastes, and discussed possible cleanup solutions. After receiving public comments, EPA decided to consolidate Raymark wastes excavated from the residential areas and the Wooster Middle School at the OU1-Raymark Facility and cap the property. EPA documented this decision in a ROD in June 1995. Once the approach was selected, EPA began the actual cleanup. This included demolition of 15 acres of buildings, consolidation of over 100,000 cubic yards of off-site Raymark waste and the placement of an impermeable cap with a soil gas collection system over the entire property. Solvents, called dense non-aqueous phase liquids (DNAPLs), in the underlying groundwater and gases beneath the cap are treated at facilities on site. Final construction was completed in November 1997. The site is now operated and maintained by the CT DEP.

- ***OU2* – Groundwater Remedial Investigation Activities** – The Remedial Investigation/ Feasibility Study is in progress. This groundwater investigation focuses on a 500-acre study area largely downgradient of the OU1-Raymark Facility that has become contaminated with volatile organic compounds (VOCs) and metals, presumably from the activities conducted on the property. The study area includes businesses that have handled or continue to handle hazardous materials, but investigations are focused on groundwater contaminants that appear to be attributable to the OU1-Raymark Facility. Currently, groundwater in this operable unit is not used as a drinking water supply. In some portions of the study area, contaminants in the groundwater appear to be volatilizing, or discharging to surface water, which may pose a threat to human health or the environment.

EPA intends to issue a Final Remedial Investigation in 2001 describing contamination and potential health risks for this operable unit. EPA also plans to release a Feasibility Study, analyzing potential cleanup solutions for the area, in 2001/2002. Possible remediation alternatives include no action; limited pumping and treating; and in situ groundwater treatment.

- ***OU3* – Groundwater Remedial Investigation Activities** – The Remedial Investigation for this operable unit is complete, and the Feasibility Study is in progress. This 33-acre area encompasses Ferry Creek and adjacent wetlands where Raymark wastes were deposited through dumping or erosion (see Figure 1-2). To minimize public contact with contaminated soils, the CT DEP initially put a fence around the Morgan Francis property, which is part of this area. CT DEP also covered parts of this area that had high levels of contamination with paving, wood chips and geotextile fabric, or clean fill. EPA has sampled this area to identify the extent of contamination.

  EPA released a Remedial Investigation in 1999 that described contamination and potential health risks in this area. EPA plans to release a Feasibility Study in 2001 analyzing potential cleanup solutions for the area. Possible remediation options include isolating Ferry Creek using pipes or culverts; using rip-rap on the banks of Ferry Creek to prevent further erosion; fencing; removal of contaminated sediment (approximately 11,000 cubic yards); and treatment of contaminated sediment in place. Cleanup solutions for the commercial properties in this area will be evaluated in a separate Feasibility Study as part of OU6. Cleanup solutions for this operable unit will depend, in part, on the selected groundwater remediation alternative for OU2.

- ***OU5* – Shore Road Activities** – This area is a roughly 4-acre section of Shore Road near the Housatonic Boat Club and the former Shakespeare Theater that borders on the Housatonic River (see Figure 1-2). As a temporary measure, contamination in this area was covered with an interim plastic fabric barrier and wood chips by the CT DEP in 1993. The area was sampled extensively in 1998/1999 and high levels of contamination were found in the surface soils. As the area is contaminated, and because the plastic barrier was beginning to wear and the wood chips were beginning to erode, EPA accelerated cleanup. An Engineering Evaluation/Cost Analysis (EE/CA), completed in June 1999, presented cleanup alternatives. In September 1999, following the public comment period, EPA released an Action Memorandum documenting its cleanup strategy.

The Action Memorandum stated that EPA will test waste stabilization techniques that could minimize the release of waste dust during the excavation of Shore Road wastes. It also stated that wastes from the Shore Road study area will be deposited in a temporary storage facility within Stratford. During the public comment period on the EE/CA, EPA discussed the Raybestos Memorial Ballfield and/or the Contract Plating Company property as potential temporary storage facilities for the approximately 35,000 cubic yards of soil. Based on the negative public sentiment for waste storage at either location, EPA decided to suspend final remedial action at the study area. Instead an interim removal action was planned. This action included limited temporary capping of contaminated hot spots, relocation of utilities, repair of existing stone riprap revetment, restoration of the western shoulder and embankment cover along Shore Road, and placement of sheet piling to prevent erosion of materials.

EPA began these excavation and cleanup activities in November 1999 and completed the interim action in July 2000. As EPA completes investigations for other Raymark operable units in Stratford, it will decide on a final remedy for this study area that is compatible with the other operable units.

- ***OU6* – Commercial Properties Activities** – A Remedial Investigation is in progress. This 48-acre area encompasses approximately 22 commercial properties, many along Ferry Creek that received Raymark wastes as fill (see Figure 1-2). Additional properties may be added to the list in the future. These areas are being investigated separately by EPA because commercial landowners face a unique set of issues related to site cleanups under Superfund.

  The type and extent of contamination at these sites will be described in the Remedial Investigation scheduled for release in 2001. A Feasibility Study examining cleanup options for this area is also planned for 2001. The particular cleanup approaches for these properties will vary by property depending on the extent of contamination and the risks to human health and the environment at each property. Cleanup options may include addressing portions of each property containing Raymark wastes through excavation, consolidation, treatment, or capping.

- ***OU7 Activities/OU3 Area II*** – A Draft Final Remedial Investigation has been completed. This area includes approximately 36 acres of wetlands roughly in the center of the Raymark Industries, Inc. Superfund Site (see Figure 1-2). Interim measures for this operable unit have included placement of signs at Selby Pond warning people not to eat eels caught in the pond, and placement of signs warning of contamination within the wetlands. EPA has also excavated contamination from a residential area abutting Selby Pond. EPA sampled these water bodies that make up OU7 in which Raymark wastes have been deposited through dumping and erosion.

  A Feasibility Study for these areas is planned to be released in 2001. This area contains approximately 315,000 cubic yards of contaminated soils and fill and approximately 50,000 cubic yards of contaminated sediment. Possible cleanup approaches for this operable unit include capping in place, treatment, excavation, and dredging with wetland restoration.

- ***OU8 Activities/OU3 Area III*** – A Draft Final Remedial Investigation has been completed. This 21-acre area is the southernmost operable unit of the Raymark Industries, Inc. Superfund site, and includes the Beacon Point boat launch area and wetlands along Elm Street (see Figure 1-2). EPA removed contaminated soil from several acres of an Elm Street residential property within this area in 1994. This soil was consolidated and capped at the Raymark Facility. EPA recently completed sampling for these areas.

  The Feasibility Study for these areas is also anticipated in 2001. This area contains approximately 200,000 cubic yards of contaminated soils and fill, and 18,000 cubic yards of sediment. Possible cleanup approaches include capping in place, treatment, excavation, and dredging with wetland restoration.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section identifies and screens technologies that may be assembled into remedial action alternatives for detailed evaluation. To develop a list of candidate technologies, the following activities need to be performed:

- Develop media-specific Remedial Action Objectives (RAOs) that are protective of human health and the environment and comply with Applicable or Relevant and Appropriate Requirements (ARARs). RAOs may specify:
  - contaminants of concern (COCs)
  - exposure pathways and receptors
  - preliminary remediation goals (PRGs) that identify potentially acceptable contaminant levels or ranges of levels for each exposure route
- Develop general response actions that define media-specific measures that will satisfy the site-specific RAOs.
- Develop initial estimates of areas or volumes of media to which the general response actions might be applied.
- Identify and screen the technologies applicable to each general response action.
- Consider future use of the study area, to the maximum extent practicable, when identifying and screening technologies.

Section 2.1 presents a preliminary listing of ARARs and other guidance to be considered in developing RAOs. Section 2.2 presents the COCs, PRGs, and RAOs and the rationale for how they were formulated, as well as volumes of contaminated media. Section 2.3 presents the general response actions that may be implemented at the study area, and Section 2.4 presents the identification and screening of representative technologies and process options.

2.1 ARARs and TBCs

ARARs and standards and guidance to be considered (TBCs) are the regulatory and non-regulatory environmental criteria that must be considered while evaluating remedial actions. In this section, the terms ARARs and TBCs are discussed in greater detail.

Section 121 of CERCLA, as amended, states that all remedial actions shall "attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." With respect to hazardous substances, pollutants, and contaminants that will remain on site after the remedial action has been implemented, CERCLA Section 121 states, "if any standard, requirement, criteria, or limitation under any Federal environmental law, ... or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation... is legally applicable to the hazardous substance... or is relevant and appropriate under the circumstances of the release or threatened release... the remedial action selected... shall require, at the completion of the remedial action, a level or standard of control for such hazardous substance or pollutant or contaminant which at least attains such legally applicable or relevant and appropriate standard, requirement, criteria, or limitation." These requirements of CERCLA Section 121 are applicable to any cleanup action.

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

> Applicable Requirements – Section 300.5 of the National Oil and Hazardous Substances Contingency Plan (NCP) defines applicable requirements as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site."

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

TBCs, as defined in Section 300.400(g)(3) of the NCP, consist of "advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies." Along with ARARs, TBCs may be used to develop the remedial action (cleanup) alternatives necessary to protect human health and the environment.

The NCP Section 300.430(f) states that remedial actions must meet ARARs unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. ARARs and TBCs are further divided into three categories: chemical-specific, action-specific, and location-specific. In Sections 2.1.1, 2.1.2, and 2.1.3, chemical-specific, action-specific, and location-specific categories are briefly described, and potential ARARs and TBCs for the study area are identified.

2.1.1 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the determination of numerical values that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. In general, chemical-specific requirements are set for a single chemical or a closely-related group of chemicals. These requirements do not consider the mixture of chemicals (EPA/540/G-89/006, 1988). A set of potential chemical-specific ARARs and TBCs that may be applied to the study area is presented in Table 2-1A.

2.1.2 Action-Specific ARARs and TBCs

Action-specific ARARs and TBCs are usually technology- or activity-based requirements or limitations on actions taken with respect to the management of hazardous substances, pollutants, or contaminants. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous substances, pollutants, or contaminants. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved (EPA/540/G-89/006, 1988). A set of potential action-specific ARARs and TBCs that may be applied to the study area is presented in Table 2-1B.

2.1.3 Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs are restrictions placed on the conduct of activities solely because they are in specific areas. Wetland and floodplain regulations are common location-specific ARARs for CERCLA cleanup actions. Additional potential location-specific ARARs include state and federal regulations that protect endangered species, fish and wildlife, and historical and archaeological resources. A set of potential location-specific ARARs and TBCs that may be applied to the study area is presented in Table 2-1C.

2.2 COCs, PRGs, and RAOs

Developing the preliminary list of technologies for source control at the study area depends on formulating RAOs that consist of medium-specific goals to protect human health and the environment. In addition, to the maximum extent practicable, the RAOs should consider other goals such as facilitating future use of the property.

RAOs for the protection of human health and the environment specify the contaminant medium of interest, exposure pathways, and acceptable contaminant level or range of levels for each exposure route. By specifying both an exposure pathway and a target contaminant level(s), protectiveness may be achieved by reducing exposure as well as by reducing contaminant concentrations.

Protection of human health and environment RAOs are formulated by identifying the COCs by medium and then developing PRGs for the COCs.

The human health COCs are site specific and are selected based on the results of the baseline risk assessment performed during the Final RI (TtNUS, 1999). The selection considers whether the media pose excess risk to human receptors outside the acceptable range specified in the NCP (10^{-4} to 10^{-6} for carcinogens) or a hazard quotient of 1.0 for non-carcinogens. The EPA target cancer risk range is 10^{-4} to 10^{-6}. Under EPA guidance, media with estimated risks greater than 10^{-4} are identified and selected for remediation. Those contaminants contributing most to the total risk are selected as COCs. PRGs are developed for each of these COCs, with the goal of bringing total site risk to less than 10^{-4}. Individual contaminant PRGs may be developed based on target risks of 10^{-4}, 10^{-5}, or 10^{-6} as needed to achieve the total site target risk. Since there are fewer than ten COCs at this site, PRGs were developed based on target risks of 10^{-5}. The CTDEP target risk level is 10^{-6} for any single contaminant and a total risk of 10^{-5}, if there are more than 10 contaminants. Individual chemicals posing risks greater than or equal to 1×10^{-5} or hazard quotients of 1.0 are selected as human health COCs based on EPA's recommendation. Lead and asbestos also pose health risks and are retained as human health COCs. Environmental protection COCs are selected by identifying contaminants present in the study area soil-waste/fill materials at concentrations that result in unacceptable levels of contaminants leaching to groundwater.

PRGs are developed for each of the identified COCs. PRGs are numerical values that are protective of human health and the environment if contaminant concentrations in the environmental media are reduced to these levels. Human health PRGs are established using readily available information including reference doses, risk-specific doses, chemical-specific ARARs, and site-specific risk-related factors. The potential re-use of the property is an additional factor to be considered in the development of RAOs for the study area. As such, the PRGs developed for the protection of human health would be relevant to facilitating future site re-use. Environmental PRGs are established based on contaminant leaching.

An ecological risk assessment was performed as part of the Final RI; however, no ecological PRGs were developed for the protection of ecological species at the study area because no significant identifiable ecological habitats or species were found within the study area.

Detailed discussions of the identification of COCs, development of PRGs, and formulation of RAOs for the study area are presented in the following sections.

2.2.1 Contaminants of Concern (COCs)

Tables 2-2A and 2-2B present summaries of risks to humans posed by direct contact with and incidental ingestion of contaminants that exceed acceptable risk levels in the soil-waste/fill materials, as detailed in the Final RI (TtNUS, 1999). Exposure to study area surface and subsurface soil-waste/fill materials, under the scenarios developed in the baseline risk assessment, results in total carcinogenic risks for the lifetime resident that exceed the EPA target range of 10^{-4} to 10^{-6} and results in non-carcinogenic risks that exceed a hazard quotient of 1.0 for the resident child and the commercial worker. In addition, lead exposures exceed the EPA level of concern for the resident child and the commercial worker.

A review of Tables 2-2A and 2-2B indicates that several chemicals present at the study area individually pose carcinogenic risks in excess of the EPA target range and/or non-cancer hazard quotients in excess of 1.0. Table 2-3 identifies the COCs used to develop the PRGs. COCs are defined as those contaminants causing cancer risk in excess of 1×10^{-5} or having a hazard quotient of greater than 1.0. Lead is included as a COC based on the evaluation in the RI of modeled blood lead concentrations. Asbestos also poses non-carcinogenic health threats; however, sufficient risk data are not available to quantify these health threats. Therefore, asbestos is included as a COC.

2.2.2 Preliminary Remediation Goals (PRGs)

PRGs are developed to determine the degree of remediation necessary to protect human health. PRGs can be developed based on chemical-specific ARARs, when available, or risk-based factors. In addition, the protection of groundwater, the presence of COCs in background locations, and the analytical detection limits for contaminants are all considered in developing the PRGs. The methods used to develop candidate PRGs are discussed below.

Table 2-4 presents a set of candidate PRG numerical values for soil COCs derived to fulfill the following:

Protection of Human Health: Risk-based PRG values were developed for the COCs identified in Table 2-3. Based on future land use for the study area, the residential scenario was used to develop a set of risk-based candidate PRG numerical values. The risks are based on a target cancer risk of 1×10^{-5} or a hazard quotient of 1.0.

Protection of Groundwater: Candidate PRGs for the protection of groundwater were developed based on theoretical contaminant leaching from soil-waste/fill to groundwater within the study area. The Connecticut Pollutant Mobility Criteria (PMC) are used as PRGs. These PRGs would be adequate to prevent further degradation of the Class GB aquifer (as designated by the State) beneath and surrounding the study area. For PCBs and metals, the Connecticut regulations specify acceptable concentrations resulting from Toxicity Characteristic Leaching Procedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP) tests in lieu of acceptable soil concentrations.

Protection of Ecological Species: No ecological PRGs were developed for the protection of ecological species at the study area because no significant identifiable ecological habitats or species were found within the study area.

Background Concentrations: Some of the metals present in study area soils are naturally occurring substances that may be present in background areas not affected by past disposal activities at concentrations comparable to or higher than in the study area soil-waste/fill materials. Background soil concentrations may be used as PRGs since these values represent contaminant concentrations when no excess risk is anticipated. Using samples from representative background locations selected by EPA, the mean background soil concentration values for metals were calculated.

Analytical Detection Limits: The analytical detection limits for the organic and inorganic COCs were also considered in developing the PRGs. Because the PRGs have to be detectable by current analytical means to ascertain attainment of these levels, analytical detection limits were designated as the lowest achievable PRGs. The detection limits for organics and inorganics are the EPA Contract Laboratory Program (CLP) Contract Required Quantitation Limit (CRQL) and Contract Required Detection Limit (CRDL) values, respectively.

ARARs/TBCs: EPA recommends an acceptable value of 1 mg/kg PCBs for residential sites (EPA, 1990). NESHAPs (40 CFR 61, Subsection M) identifies materials containing 1 percent or greater asbestos as needing to be addressed. EPA recommends an acceptable value of 400 mg/kg for residential sites (EPA, 1994).

Table 2-5 presents the recommended PRG used for each COC and the basis for selection. Recommended PRGs are the more conservative of the risk-based and groundwater protection values, unless superceded by the background value, CRQL/CRDL, or ARAR/TBC. PRGs for PCBs, lead, and asbestos were selected based on ARARs/TBCs.

2.2.3 Remedial Action Objectives (RAOs)

RAOs are protective of human health and the environment. RAOs specify the environmental media receptors, exposure pathways, and acceptable contaminant cleanup levels for each medium used in the analysis of risk. The first column of Table 2-6 presents the RAOs for study area soils. The following summarizes the RAOs:

- Based on the human health risk assessment and RI, the human health RAO is **"to prevent human exposure (incidental ingestion and/or dermal contact) to the contaminated soil-waste/fill above acceptable risk levels."**

- The RAO for protection of the environment is to **"minimize leaching of contaminants to groundwater from the soil-waste/fill, to the extent practicable."**

2.2.4 Volume of Contaminated Media

The volumes of soil-waste/fill materials currently at the study area are approximately 94,000 cubic yards based on the volume of soil-waste/fill above the water table. Since these estimates were developed using sampling data from boring locations with limited depth intervals, the estimates contain a level of uncertainty. All volumes are based on estimated fill thicknesses above the water table. The actual volumes and depths of excavation or treatment will need to be determined during the remedial design if an excavation or treatment alternative is selected.

2.3 General Response Actions (GRAs)

GRAs describe broad media-specific remedial actions that will satisfy RAOs. GRAs identified as applicable for addressing soils within the study area are no action, limited action, removal, disposal, containment, treatment, and consolidation. The second column of Table 2-6 presents the GRAs for soils. A description of each GRA is provided in the following subsections.

2.3.1 No Action

Under the no-action option, the site is left "as is," without implementing institutional controls, containment measures, removal, or treatment. This option does not provide for monitoring or placing access restrictions on contaminated media at the site. However, examination of this option is retained throughout the screening process, as required by the NCP. Although this option proposes no remedial action, it provides a baseline against which the effectiveness of other GRAs can be evaluated.

2.3.2 Limited Action

The focus of the limited-action option is institutional controls and access restrictions which will limit the use of or access to the impacted areas in order to reduce or eliminate the risk of exposure to COCs. Examples of such controls and restrictions are deed restrictions, local ordinances, posting no trespassing signs, and installing fencing. This option also includes implementing a long-term monitoring program to assess changes in contaminant concentrations and distribution at the site. While institutional controls and access restrictions alone do not reduce the toxicity, mobility, or volume of contaminated media, naturally occurring attenuation processes may reduce contaminant concentrations over an extended period of time. Data generated from long-term monitoring activities would provide information to assist in determining natural attenuation kinetics. Monitoring would also provide information which could be used to determine if additional remedial actions are warranted, for instance if contaminant migration is observed.

2.3.3 Removal

Under this option, removal technologies would be used to collect contaminated media and prepare the material for disposal or treatment. Removal reduces the volume of contaminated media on site, thereby reducing the risk of human and environmental receptor exposure to COCs. For unsaturated soils, removal is typically performed by the use of mechanical excavation equipment.

2.3.4 Disposal

Depending on the nature of the contaminated media, disposal sites may include building a secure landfill at a location(s) within the town of Stratford or moving the waste out of Stratford to a secure landfill. Disposal in a properly secured and maintained manner will effectively reduce the mobility of COCs.

2.3.5 Containment

Containment options reduce the potential for exposure to contaminated materials through the use of physical barriers. These barriers prevent direct contact with contaminated materials and reduce or prevent migration of contaminated media. Barriers may be permeable or impermeable and are comprised of natural and/or synthetic materials. Containment reduces the mobility of the contaminated media but does not reduce volume or toxicity.

2.3.6 Treatment

Under this option, contaminated soils would be treated following removal to reduce their toxicity, mobility, and/or volume. Treatment options can be divided into five categories: immobilization, thermal, physical, chemical, and biological technologies. Some types of treatment may have the option of being conducted on site, at another in-town location, or at an out-of-town facility, while others can only be done at an out-of-town facility. Treated material may be disposed of in town or out of town.

2.3.7 Consolidation

Consolidation is an option in which soils, wetland soils, and sediments from different Raymark OUs would be relocated and consolidated in one in-town location. Consolidation makes it possible to address soils and sediments from various source areas in order to manage more effectively the larger volume of waste as a whole.

2.4 Identification and Screening of Representative Technologies and Process Options

A variety of technologies and specific process options exist for each GRA described in Section 2.3. A wide range of technology types and process options were identified and are presented along with the RAOs and GRAs in Table 2-6. The technology types and process options identified were screened to focus on technologies and specific process options appropriate for each area. Summaries of the identification and preliminary screening of technologies and specific process options for the study area are presented in Table 2-7. Technologies that were eliminated are shaded gray in the tables. Brief explanations for the elimination or retention of options is given in the "Screening Comment" column of the tables. In addition, the current status of each technology, showing its availability for use is presented.

Further information is provided in the text for all technologies that were retained in Table 2-7, as well as any well-established technology that was eliminated. No further discussion is provided for technologies that are not well established that were eliminated.

Technologies and process options were screened based on effectiveness, implementability, and cost, with a focus on effectiveness. Further screening of technologies will focus on implementability and cost. Brief descriptions of these criteria are as follows:

- Effectiveness – focuses on the potential ability of the technology and specific process option to remediate the estimated areas or volumes of media, and to meet the remediation goals identified in the RAOs, the potential impacts to human health and the environment during construction and implementation, and the technical reliability (effectiveness of innovative technologies versus proven technologies) with respect to the contaminants and conditions within the study area.

- Implementability – encompasses both the technical and institutional feasibility of implementing a process. The screening of technology types and specific process options was based on an evaluation of technical implementability issues in order to eliminate options that were clearly ineffective or unworkable. The subsequent, more detailed evaluation places greater emphasis on the institutional aspects of implementability (coordination with various regulatory agencies and contractors; the availability of treatment, storage, and disposal services; and the availability of necessary equipment and skilled workers to provide long-term operation and maintenance (O&M) services, etc.).

- Cost – plays a limited role in this initial screening of process options. Options are evaluated based on relative capital and O&M costs (whether the costs are high, medium, or low relative to the other options within the same remedial technology type). For this screening, the cost analysis is based on engineering judgment and not on detailed estimates. Cost of a remedial option is fully evaluated during the Feasibility Study process.

The following subsections present the evaluations of technologies for each GRA shown in Section 2.3.

2.4.1 No Action

The No Action scenario is considered to provide a baseline level to which other remedial technologies and alternatives can be compared. Under this scenario, no removal or treatment of the contaminated soils would occur.

Effectiveness – The No Action option would not achieve any of the remedial objectives. Human health risks associated with exposure to carcinogenic and non-carcinogenic contaminants in the study area soils would become greater over time as a result of the continuing deterioration of the clean soil cover; long-term protection of groundwater would not be provided since the contaminants in the soils would potentially continue to migrate into the groundwater; and re-use of the property would be impeded. Because contaminated soils would remain on site, 5-year site reviews would be conducted to evaluate the contamination status of the study area. Other effectiveness criteria are not applicable for the No Action scenario.

Implementability – No implementability considerations are associated with the No Action scenario.

Cost – Because no actions would be taken at the study area other than 5-year reviews of site status, capital and O&M costs would be negligible.

Conclusion – Retain the No Action scenario as a baseline, as required by the NCP.

2.4.2 Limited Action

The components of limited action that are evaluated in this screening are deed restrictions, local ordinances, fencing, posting of signs, and monitoring.

Deed Restrictions

Deed restrictions are institutional controls that are placed on property deeds. These restrictions are used to limit future activities or uses of a site to prevent human contact with contaminated soils or groundwater. Deed restrictions commonly used to reduce exposure to contaminated media include prohibitions on installing water supply wells, restrictions on types of development allowed (e.g., no residential use), and limitations on certain types of construction (e.g., excavation, buildings with basements). Study area deed restrictions will consist of limiting excavation of soils and prohibition of residential home construction.

The State of Connecticut requires Environmental Land Use Restrictions (ELURs) in most cases where contaminants are left in place. An ELUR has four components: a declaration of the ELUR, a class A-2 survey of the parcel or portion of a parcel; a certificate of title demonstrating that all persons with an interest in the land have subordinated their interest to the ELUR, and a decision document signed by the Commissioner of Connecticut Department of Environmental Protection or a Licensed Environmental Professional. The decision document describes the types of pollutants, location of pollutants, what activities and uses are prohibited, and a summary of the public comments received. An ELUR cannot be placed on a parcel unless the State has determined that the actions taken at the site are consistent with Connecticut Remediation Standard Regulations (RSRs). An ELUR must be placed on the deed by the property owner, and there are no legal actions that the state or locals can take, short of taking the property, if the property owner is unwilling to place an ELUR on the property.

Effectiveness – Deed restrictions could be applied to limit construction activities and future residential or commercial/industrial land use on the study area. However, historically these restrictions, by themselves, have not proven to be reliable because they are difficult to enforce and would not address the contaminant migration component of the remedial objectives. They are also not effective for ecological receptors. Deed restrictions, by themselves, are not effective in the long term to reduce risk and therefore, would not achieve the RAOs. No additional risks to human health and the environment would directly result from the imposition of deed restrictions.

Implementability – Deed restrictions may be implemented by the property owners or by state and local authorities. If property owners are not willing to place the desired restrictions on the property deeds, legal action by state or local authorities would be necessary to implement the deed restrictions. Deed restrictions are typically difficult to implement. Consideration of the availability of treatment, storage, or disposal (TSD) facilities and the need for permits are not applicable to deed restrictions.

Cost – Because only administrative actions would be taken at the study area, capital costs would be very low and no O&M costs would be incurred.

Conclusion – Although deed restrictions are not effective as a stand-alone action, this option can be used in conjunction with other technologies to restrict future exposure to surface or subsurface contaminants (including contaminants below the water table). As a result, deed restrictions will be retained for consideration only in combination with other process options.

Local Ordinances

Local ordinances are institutional controls enacted by municipalities to limit property use or activities. Local ordinances may be used to limit future uses or activities on a site to prevent human contact with contaminated soils. Local ordinances commonly used to reduce exposure to contaminated media include zoning regulations that prohibit particular land uses (such as residential development) in an area and regulations that restrict activities such as installation of potable water supply wells.

Effectiveness – Local ordinances could be applied to restrict land use and activities such as installation of water supply wells on the study area. These restrictions alone would not reduce human health risk and would not address the contaminant migration component of the remedial objectives. However, in combination with remedial actions such as capping that limit potential exposure to contaminants left in place, local ordinances may provide added assurance that contaminated media are not disturbed. No additional risks to human health and the environment would directly result from the imposition of local ordinances.

Implementability – The cooperation of local authorities is necessary to implement local ordinances. Consideration of the availability of TSD facilities and the need for permits are not applicable to local ordinances.

Cost – Because only administrative actions would be taken at the study area, capital costs would be very low and no O&M costs would be incurred.

Conclusion – Although local ordinances are not feasible as a stand-alone action at the study area, this option may be used in conjunction with other technologies to restrict future exposure to subsurface contaminants, if left in place. If future uses of the area include commercial/industrial development, local ordinances in the form of limitations on future land use or well installation may be required. This option is retained for further consideration only in combination with other process options.

Fencing

Fencing may be used as a barrier to restrict access to areas where contaminants are present at or near the surface, thereby limiting direct contact exposure. Access to the study area, where contaminated soil is present beneath the surface, is currently restricted by perimeter fencing, gates, and warning signs.

Effectiveness – Fencing would not meet RAOs because it does not reliably prevent access to contaminated soils and would not reduce leaching of contamination to groundwater. Fencing provides limited protection of human health by discouraging trespasser access to areas where subsurface contamination is present. The effectiveness of fencing in reducing access and thereby reducing exposure to contaminants is highly dependent on fence maintenance and on the determination of the would-be trespasser. Even well maintained fencing is not likely to be completely effective in restricting access, particularly by a determined trespasser. Fencing would not be effective in the long term to eliminate risk. Fencing would not protect groundwater or limit the migration of contaminants from source areas and may impede re-use of the property. No additional risks to human health and the environment would result from the installation of fencing.

Implementability – Maintenance and replacement of existing fencing are readily implementable. Installation of new fencing is readily implementable. Contractors and equipment are readily available for fence maintenance and installation.

Cost – The capital and O&M costs for fencing would be low.

Conclusions – Although fencing alone is not effective for achieving RAOs, it may be used in conjunction with other technologies to limit exposure to soil contaminants. The existing fencing and gate appear to be somewhat effective in reducing access to the facility. Fence installation and fence repair/replacement are retained for further consideration only in combination with other process options.

Post Signs

The posting of signs may be used as a means of indicating areas where contaminants are present at or near the surface, thereby preventing direct contact exposure. Access to the study area, where contaminated soil is present beneath the surface, is currently posted with warning signs.

Effectiveness – Sign posting would not meet RAOs because it does not reliably prevent access to contaminated soils and would not reduce leaching of contamination to groundwater. Signs provide only limited protection of human health by discouraging trespasser access to areas where subsurface contamination is present. Signs would not be effective in the long term to eliminate risk, nor would they protect groundwater or limit the migration of contaminants from source areas. No additional risks to human health and the environment would result from the installation of signs.

Implementability – Maintenance and replacement of existing signs are readily implementable. Installation of new signs is readily implementable. Contractors and equipment are readily available for sign maintenance and installation.

Cost – The capital and O&M costs for posting signs would be low.

Conclusions – Although signs alone are not effective for achieving RAOs, they may be used in conjunction with other technologies to limit exposure to soil contaminants. Sign installation and repair/replacement are retained for further consideration only in combination with other process options.

Monitoring

Sampling and analysis of groundwater and soils at the study area could be used to evaluate potential leaching and migration of contaminants from contaminant source areas. Monitoring will be required for any technologies and process options where soil-waste/fill remains in the study area.

Effectiveness – Monitoring would not reduce the toxicity, mobility, or volume of contaminants in the soils or groundwater. Monitoring would not provide any additional protection to the environment since contaminants would continue to spread into uncontaminated or less contaminated areas. However, by serving as a warning mechanism, periodic monitoring would allow the responsible agency to gauge contaminant migration and determine whether future actions are necessary to mitigate risk. Monitoring will facilitate evaluating the effectiveness of source control measures in preventing contaminant leaching.

Implementability – A monitoring program could be readily implemented at the study area. Access agreements may be required for sampling or installation of new monitoring wells and borings on town, state, or private properties.

Cost – The capital and O&M costs for periodic monitoring would be moderate.

Conclusion – Monitoring would be an effective and easily implementable method of observing contaminant migration and the progress of remediation. Alone, it would provide no additional protection of human health or the environment. Monitoring will be required for any technologies and process options where soil-waste/fill remains in the study area. As a result, monitoring will be retained for consideration only in combination with other process options.

2.4.3 Removal

The components of removal that are evaluated in this screening are bulk excavation and dredging.

Bulk Excavation

Bulk excavation involves the large-scale removal of soil and waste materials. Traditional excavation equipment such as hydraulic excavators, scrapers, bulldozers, wheel loaders, and off-road dump trucks are typically used. The excavated material could be loaded onto trucks and hauled to an approved treatment or disposal facility, or could be treated and/or relocated at the study area or another in-town location. Backfilling open excavations would require the use of clean fill or decontaminated, solidified/stabilized soils.

Effectiveness – Bulk excavation would be effective for handling the volume of contaminated soil at the study area. Control of airborne asbestos and fugitive dust would be required during excavation to protect on-site workers and the surrounding community. Standard engineering controls such as dust suppressants and negative pressure enclosures would adequately and safely collect and control airborne contaminants. This technology, combined with subsequent treatment and/or disposal, would be a permanent solution and attain the goals outlined in the RAOs. The quantities of material involved and the types of soils at the study area can be excavated.

Implementability – Excavation is readily implementable for shallow, easily accessible soils. Deeper soils and saturated soils at or near the water table are somewhat more difficult to excavate. Excavation would most likely be accomplished in a staged approach to minimize adverse conditions. Contractors for this type of excavation are readily available in this area. The need for TSD facilities should not be required for excavation if waste materials are disposed of at an in-town location. If excavated materials are disposed of out of town, transportation and TSD facility requirements must be met.

Cost – The costs range from moderate for shallow soils to high for deeper, saturated soils.

Conclusion – Removal of contaminated soils by bulk excavation is retained for further evaluation in conjunction with other process options.

2.4.4 Disposal

Landfills

Contaminated soil-waste materials may ultimately be disposed of at a regulated landfill. Depending on the contaminants and their concentrations, the material may or may not require treatment prior to landfilling. The treatment, if necessary, can be part of a process option chosen in the selected remedy or can be provided by the operator of the landfill as part of the disposal service.

The types of landfills considered are hazardous waste landfills and non-hazardous waste landfills. The principal differences between these landfills are the administrative requirements and the design of the cap and base to prevent infiltration and leaching. These two types of landfills are described as follows:

- **Hazardous Waste Landfill**

  Hazardous waste landfills are regulated by the landfill and post-closure requirements of RCRA (40 CFR 264 and 265, Subparts G and N), the Toxic Substances Control Act (TSCA) for PCBs, and state and local laws. Among the requirements are foundations, double liner systems, leak detection systems, leachate collection and treatment systems, capping, post-closure inspections and maintenance of the landfill (30-year period), and post-closure groundwater monitoring (30-year period).

- **Non-hazardous Landfill**

  Non-hazardous landfills include municipal waste landfills and construction/demolition waste landfills. Design and operating practices are somewhat similar to hazardous waste landfills; however, the permitting requirements are not as stringent. These landfills may be used for wastes that are not classified as hazardous but may still significantly contaminate groundwater. Among the design and operating requirements are foundations, liner systems, leak detection systems, leachate collection and treatment systems, capping, post-closure inspection and maintenance of the landfill, and post-closure groundwater monitoring.

Hazardous and non-hazardous landfills are currently available out of town to accept wastes. A new hazardous or non-hazardous landfill could also be constructed in a location within the study area or elsewhere in the Town of Stratford.

<u>Effectiveness</u> – Disposal of soil-waste/fill at a landfill would achieve the RAOs by preventing direct exposure to and the leaching of contaminated soils. Since a significant portion of the soils is contaminated with metals and asbestos, which are not easily treated, a landfill may be required for ultimate disposal. The options available include a secure hazardous waste landfill and a non-

hazardous landfill. The selection of one landfill over another depends on the relative toxicity of the soils and debris, the risks associated with their disposal, and the regulatory requirements. The contaminated soils contain elevated levels of metals, asbestos, and organics.

Soils containing contaminants restricted under RCRA land disposal restrictions (LDRs) regulations would have to be treated to acceptable levels prior to landfilling. In addition to these RCRA-mandated LDRs, pre-treatment requirements are typically established by individual landfill operators to comply with their respective permit conditions. The treatment can usually be provided by the operator of the landfill as part of a turnkey package of the disposal service of an out-of-town landfill.

Disposal of hazardous substances from the study area would have to comply with the CERCLA Off-site Rule (EPA, 1993), which establishes criteria for selecting an appropriate TSD facility and prohibits the use of a RCRA facility for off-site management of Superfund hazardous substances if the facility has significant RCRA violations.

A hazardous waste landfill is appropriate for disposal of most contaminated soils, and a non-hazardous landfill may be appropriate for slightly contaminated soils or those that have been treated by a process option.

Landfills should be capable of handling the volumes of contaminated soil-waste materials. Landfilling alone would achieve some of the remediation objectives. Because concentrations of leachable metals are present in the study area soils, some treatment (either as part of the selected remedy or by the landfill operator) would likely be required prior to landfilling most of the contaminated soils. Risks to human health and the environment associated with implementing landfilling are considered minor.

<u>Implementability</u> – Landfills are implementable, although availability of out-of-town landfill capacity may be limited. For an out-of-town landfill, transportation requirements must be met to transport the various types of wastes from the study area. Treatment of the wastes in compliance with RCRA LDRs prior to landfilling may be required for some of the soils. Out-of-town TSD facilities are available to receive this waste, although the high volume of soil-waste/fill materials from the study area may limit the number of facilities willing to accept the material. Also, no hazardous waste

landfills are located in Connecticut (the closest is Model City, New York). Equipment and resources needed to transport the soil-waste/fill are readily available.

In-town landfill options would consist of constructing a new facility for either hazardous or non-hazardous waste, either in the study area or elsewhere in the Town of Stratford. Siting, construction, and permitting requirements of the State of Connecticut would have to be met and will be difficult and lengthy. The scale of construction and certification of a new landfill makes the option of the in-town landfill undesirable as compared to existing, currently-operating landfills out of town.

Cost – For out-of-town landfills, the relative capital costs are moderate to high (depending on the distance of transportation of wastes). Out-of-town disposal in hazardous waste landfills is the most expensive of the landfill options, while disposal in a non-hazardous landfill is less expensive. The cost for an in-town landfill would be high because of the cost of new construction.

Conclusion – Landfilling is an effective containment option for the contaminated soils. It is implementable when using existing out-of-town facilities although very difficult to implement in town, as new construction would be required. As a result, out-of-town landfills are retained for further consideration, and in-town landfills are eliminated.

2.4.5 Containment

The following containment technologies and process options for contaminated soils are evaluated in this section.

- Horizontal Barriers
    - Impermeable Cap
    - Permeable Cover

Impermeable Cap

Capping involves installing an impermeable barrier over the contaminated soils to restrict access and reduce infiltration of precipitation into the subsurface. Impermeable and low-permeability barriers are appropriate where soil contamination threatens groundwater. Regrading of soils prior to capping may be required. Cap materials can either be natural or synthetic. Frequently used materials include low-permeability clays such as bentonite and synthetic membranes such as high-density polyethylene (HDPE), polyvinyl chloride (PVC), and Hypalon. These materials are typically covered with a clean fill and vegetation (grass) or asphalt to protect them against damage caused by puncturing and weathering. Capping will involve regrading to provide for erosion and drainage control.

Effectiveness – Capping can achieve RAOs associated with preventing exposure to contaminated soils and waste materials and minimizing the migration of contaminants from the study area. Capping is a reliable technology that would reduce risk to human health by providing a barrier between contaminated soils and potential receptors, thus significantly limiting fugitive dust emissions and direct contact with contaminated soils. Capping would be effective in limiting the infiltration of precipitation and consequently the potential leaching of contaminants from unsaturated soils and waste materials to groundwater. Capping alone would not prevent potential contaminant leaching to groundwater from saturated soils. Because capping does not alter the natural flow of groundwater through the subsurface, contaminated saturated zone soils would remain a continuing source of contamination to groundwater. Capping only isolates existing contamination, offering no decrease in contaminant levels. Since contaminants remain in place, the long-term effectiveness of capping depends on adequate long-term cap maintenance. During remedial activities, fugitive dust emissions would have to be controlled to minimize effects on human health and the environment. Emissions can be safely and adequately controlled using standard engineering controls such as dust suppressants and enclosures.

Implementability – The construction of an impermeable cap is readily implementable at the study area. A variety of proven capping materials can be used, including soils, clay soils, geosynthetic membranes, and combinations of these materials. Due to the considerable grade differential across the study area and the close proximity of contaminated soils to the study area boundaries, significant earthwork may be required to achieve proper slopes for cap stability and surface water runoff control. Remedial activities involving capping are relatively common and can be conducted by many contractors. No permits or other administrative requirements would be necessary for on-site activities. Because the contaminated soil-waste/fill would remain in the study area, the need for TSD facilities is not a concern. However, deed restrictions and ELURs would be required in conjunction with capping to limit the future use of the capped areas or actions that may damage the cap. Long-term groundwater monitoring would also be implemented.

Cost – The capital costs for conventional cap construction are expected to be moderate. O&M costs are low for an impermeable cap.

Conclusion – Capping would prevent exposure to contaminated soils and minimize migration of source contaminants. Because capping alone does not prevent saturated soil contaminants from migrating in the groundwater, other technologies, such as vertical barriers, may be considered and used in conjunction with capping when groundwater issues are addressed under OU2. Capping with an impermeable barrier will be retained for further consideration.

Permeable Cover

Permeable covers and soil caps are lower cost alternatives to conventional caps. Permeable covers and soil caps are placed over contaminated soils to prevent access to surficial and near-surface contaminants. Because they provide little or no reduction in infiltration, they are appropriate for use where direct exposure to contaminated material is to be prevented and contaminant leaching to groundwater is not a concern.

Effectiveness – Installation of a permeable cover or soil cap would achieve the RAO for preventing direct exposure to contaminated soils but would not achieve the RAO for protection of the environment, which is to minimize leaching of contaminants to groundwater. A permeable cover or soil cap would not be effective in preventing infiltration or potential leaching of soil contaminants to groundwater. Because contaminated soils remain in place, the effectiveness of a permeable cover or soil cap in preventing direct exposure to contaminants depends on adequate cover maintenance.

Implementability – Construction of a permeable cover or soil cap is readily implementable at the study area. Specialized construction techniques are not required, and qualified contractors and necessary cover materials are readily available. Earthwork requirements would be similar

Sections 2.4.6 to 2.5,
3.0, and Tables
(pages 45-95)
are available
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Figures and References
(pages 96-106)
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