Superfund Records Center
SITE: Wells G+H
BREAK: 4.6
OTHER: 18163

3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

This section develops and discusses the initial screening of remedial alternatives. In this section, technically feasible remedial technologies identified in Section 2.0 are grouped into potential remedial action alternatives. CERCLA amendments, Section 121(b), indicate the following statutory preferences when developing and evaluating remedial alternatives:

- Remedial actions that involve treatment to permanently and significantly reduce the volume, toxicity, or mobility of the contaminants or hazardous substances are preferred over remedial actions not involving such treatment.

- Off-site transport and disposal of hazardous substances or contaminated materials without treatment is considered the least-favored remedial alternative when practical treatment technologies are available.

- Remedial actions using permanent solutions, alternative treatment technologies, or resource recovery technologies shall be addressed.

Based on these statutory preferences, emphasis has been placed on developing alternatives which, as a principal element, permanently and significantly reduce the volume, toxicity, or mobility of the waste. Furthermore, alternatives have been developed to attain response objectives developed and discussed in Section 2.0.

The remedial alternatives are categorized in two groups, Source Control (SC) and Management of Migration (MOM) as discussed in Section 1.4. The SC alternatives address remediation of contaminated soils at Wildwood Conservation Corporation, Olympia Nominee Trust, New England Plastics and Unifirst Corporation, and hazardous sludges and debris piles at Wildwood Conservation Corporation. The MOM alternatives address management of migration of groundwater contamination from the five source areas in and around W.R. Grace, Wildwood Conservation Corporation, Olympia Nominee Trust, New England Plastics, and Unifirst Corporation and also in the Central Area around Wells G and H, to achieve the response objective of aquifer restoration.

The EPA OSWER Directive No. 9355.0-19, dated December 24, 1986, provides guidance regarding implementation of SARA and its effects on the remedy selection process. The OSWER directive states "treatment alternatives should be developed ranging from an alterative that, to the degree possible, would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce toxicity,

mobility, or volume as their principal element." Thus, alternatives may involve different technologies for different types of contaminated material, but vary principally in the degree to which they rely on long-term management of treatment residuals or low-concentration contaminated material. For groundwater remediation, a range of restoration rates would be developed to identify the time required to achieve specific remediation levels.

The purpose of the initial screening is to narrow the number of potential remedial alternatives for detailed evaluation while preserving a range of options. The discussions and evaluations comprising this screening are not intended as a substitute for or supplement to the detailed analysis of each alternative conducted in the next section of this report.

Screening criteria conform with remedy selection requirements set forth in CERCLA as amended, Section 121, and in the NCP (40 CFR 300.68(g)). Each alternative is evaluated herein for effectiveness, implementability, and cost factors as follows:

- Effectiveness: A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment, by achieving the target levels specified for the various media of concern. Each alternative is evaluated as to the protectiveness it will provide and the reductions in toxicity, mobility, or volume of contaminants it will achieve. Both short- and long-term components of protectiveness would be evaluated, short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatments that decrease the threats or risks associated with the hazardous material.

- Implementability: Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative, is used during screening to evaluate the combinations of process options with respect to site specific conditions. Technical feasibility refers to the ability to construct and reliably operate the remedial alternative until a remedial action is complete; it also includes operation, maintenance, replacement, and monitoring of

technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services and capacity, and the requirements for, and availability of, specific equipment and technical specialists.

- Cost: Both capital costs and operating and maintenance (O&M) costs are considered, where appropriate, during the screening of alternatives. The evaluation includes the O&M costs that will be incurred as long as necessary, even after the initial remedial action is complete. Likewise, potential future remedial action costs are considered during alternative screening to the extent they can be defined. Present worth analyses are used during alternative screening to evaluate expenditures that occur over different time periods. By discounting all costs to a common base year (current year), the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. Because uncertainties associated with the definition of final alternatives often remain, it may not be practicable at this stage to define the costs of alternatives within the accuracy of +50 percent to -30 percent used in the detailed analysis.

3.1 SOURCE CONTROL

The various target levels for contaminated soil based on direct contact and leaching of contaminants to groundwater are presented in Section 1. For estimating volumes and costs for source control alterna- tives in this report, the leaching based levels for a 1% organic carbon content in soil were used for VOCs and a 10^{-6} risk based level were used for all other contaminants except lead as discussed in Section 1.

The nature and extent of soil and sludge contamination exceeding target levels is based on direct contact and the leaching pathways. At the Wildwood Conservation Corporation property removal of the VOC contaminated soil as well as soil contaminated with VOCs, PCBs, cPAHs and chlordane ("mixed contaminant soil") that exceeded the target levels are required. At the Unifirst Corporation and New England Plastics properties removal of only VOC contaminated soil tht exceeded the target levels is required. At the Olympia Nominee Trust property removal of only cPAHs contaminated soil that exceeded the target levels is required.

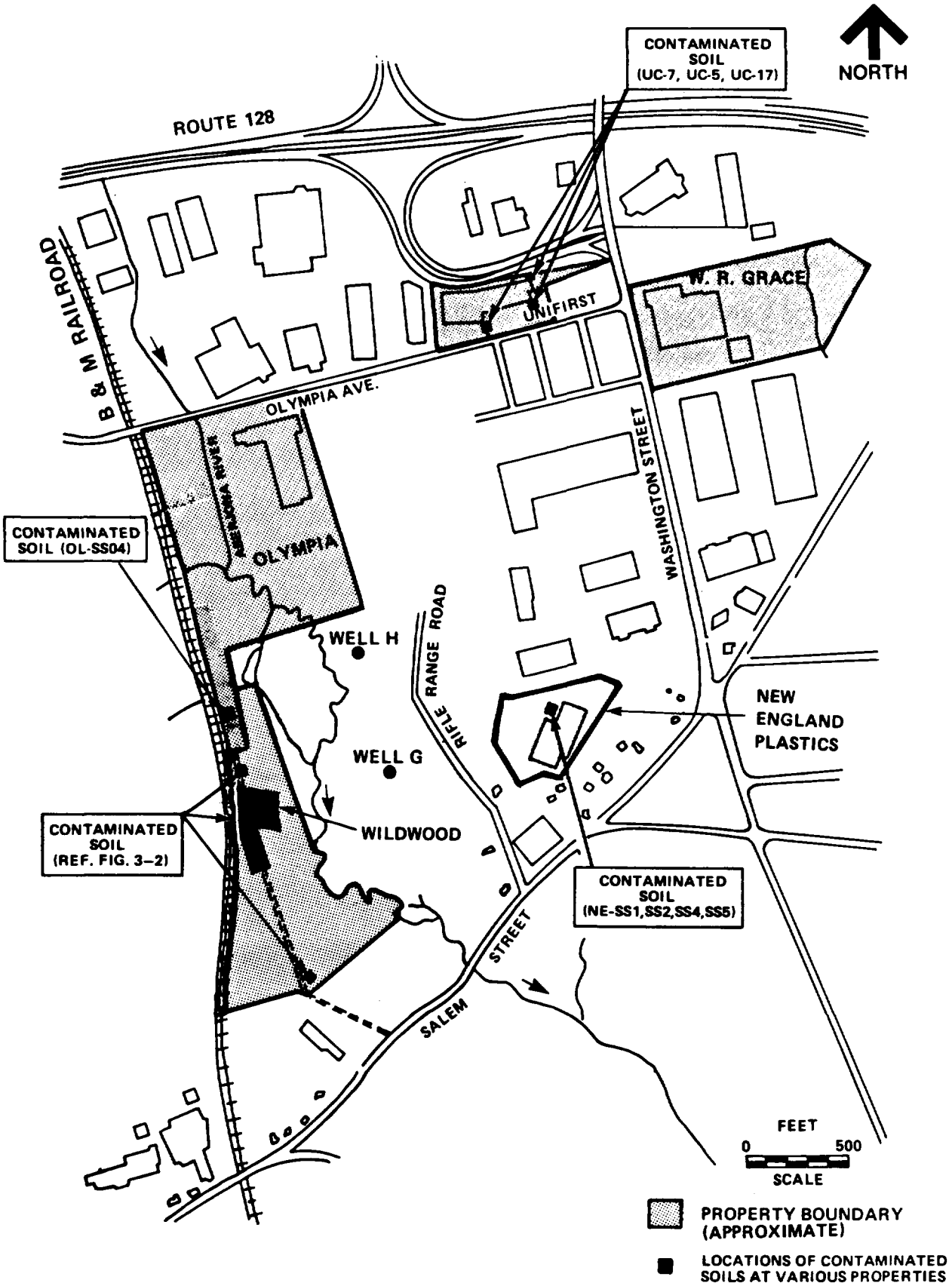
The general locations of contaminated soils at the Wells G&H site are shown in Figure 3-1. Most of the contaminated soil at the site is present at the Wildwood Conservation Corporation property (Figure 3-2) with smaller areas located at the Olympia Nominee, New England Plastics and Unifirst Corporation properties.

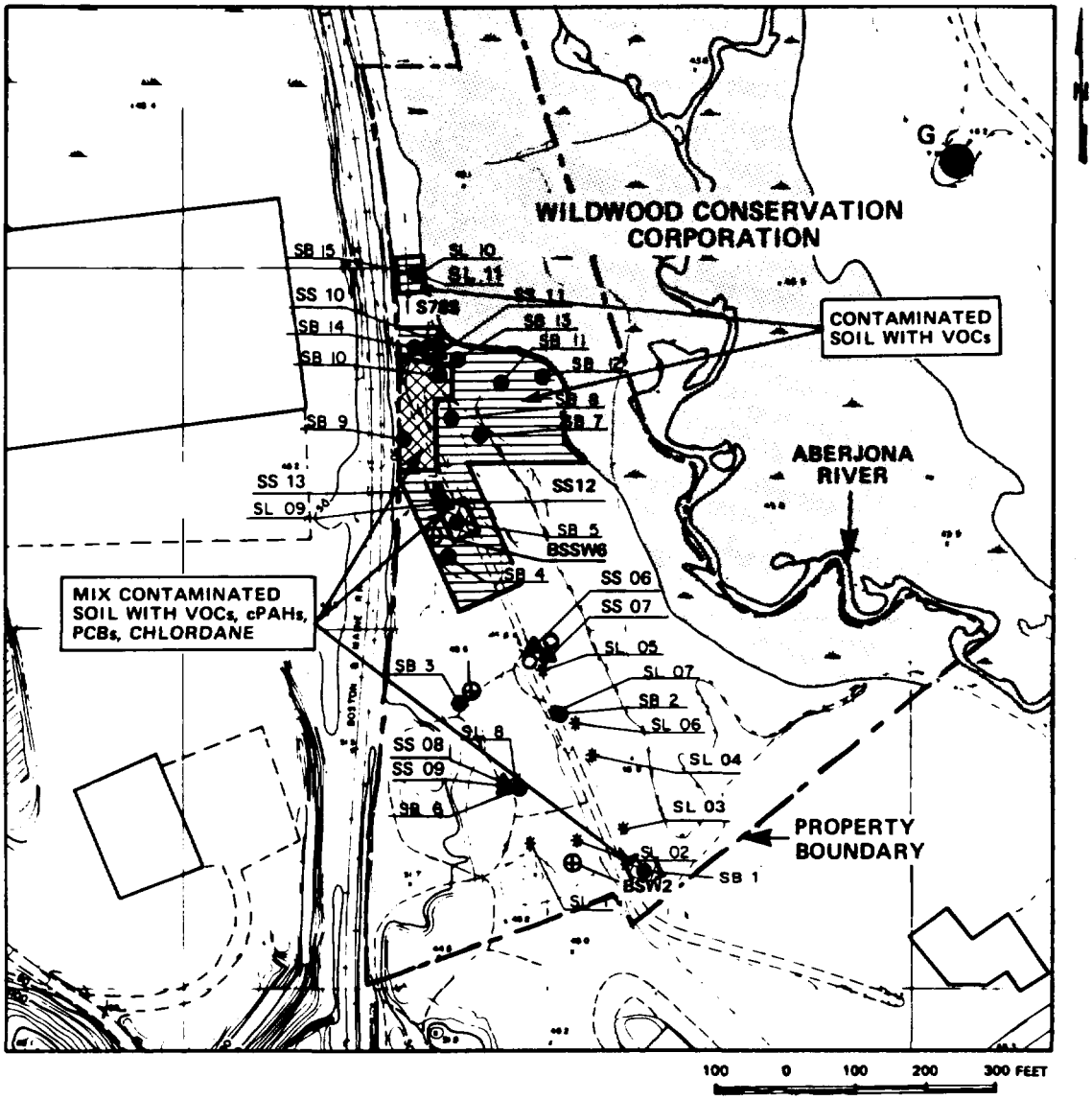
Table 3-1 and Appendix D present a summary of the volume of contaminated soil, sludge and debris at each of the properties based on target risk levels of 10^{-6}, 10^{-5} and 10^{-4} for the direct contact pathway and the leaching pathway. The Wildwood Conservation Corporation property contains approximately 9,300 cubic yards of soil contaminated with VOCs. Within this area of VOC contamination there are separate areas (three) of mixed contaminants containing VOCs, PCBs, cPAHs and pesticides. These mixed contaminant soil locations are shown in Figure 3-2. In addition, there are approximately 10 cubic yards of sludge material contaminated with VOCs, cPAHs, chlordane, and lead and 400 cubic yards of debris piles which may require remediation. Smaller volumes of contaminated soil are present at Olympia Nominee Trust (5 cubic yards), New England Plastics (40 cubic yards) and Unifirst Corporation (150 cubic yards). The total volume of soil, debris and sludge requiring remediation at wells G&H site is 9,905 cubic yards. The total soil volume requiring remediation is primarily determined by the target levels for VOCs, based on the leaching pathway since the VOCs are the primary soil contaminants. These VOC-based target levels are constant and are not a function of the risk level as in the case of cPAHs, PCBs, and chlordane. A change in risk level can therefore affect the remedial choices for these contaminants.

Table 3-2 summarizes the soil contaminants, average soil contaminant concentrations, target levels, and percent contaminant removal required for soil requiring remediation. Based on the target risk level of 10^{-6} and the leaching pathway, the total soil volume contaminated only with VOCs is approximately 7,600 cubic yards and soil contaminated with mixed contaminants is estimated at 1900 cubic yards. TCE removal seems to dominate the selection of remedial technology and requires as high as 99.8 percent removal to achieve target levels based on the leaching model.

For the purpose of evaluation of potential remedial alternatives eleven (11) source control (SC) altenatives were developed. The technologies included in these alternatives are only those which passed the initial screening process. Alternative SC-1 (No Action) provides a minimal action as a basis for comparison of other alternatives. Alternative SC-2 (Off-Site RCRA Landfill), would involve excavation and transport of contaminated soil to an off-site RCRA landfill.

FIGURE 3-1
AREAS OF CONTAMINATED SOILS AT WELLS G&H





SOIL CONTAMINATED WITH VOCs

SOIL CONTAMINATED WITH VOCs, cPAHs, PCBs, CHLORDANE

WETLANDS

- SB 4 – SOIL BORING LOCATION AND NUMBER
- S78S – WELL LOCATION AND NUMBER
- SS 06 – SURFACE SOIL LOCATION AND NUMBER
- SL 09 – SLUDGE SAMPLE LOCATION AND NUMBER

PROPERTY BOUNDARY

APPROXIMATE SEWER MANHOLE LOCATIONS

U.S. ENVIRONMENTAL PROTECTION AGENCY

WELLS G & H

FIGURE 3–2

AREAS OF CONTAMINATED SOIL AT WILDWOOD

EBASCO SERVICES INCORPORATED

TABLE 3-1

ESTIMATED VOLUME OF CONTAMINATED SOILS AND WASTES
BASED ON FUTURE RESIDENTIAL USE

Locations	Soil Volumes (cy)			Remarks
Wildwood Conversation Corporation				
Sludges (10 locations)	10			Based on leaching model
Debris Piles	400			Based on visual observation
Soil				
- Total VOCs Soil including mixed contaminant soil	9300			Based on leaching model
- Mixed Contaminant Soil Area for target level of (VOCs, cPAHs, PCBs and chlordane)	1900 (10^{-6})*	1670 (10^{-5})*	460 (10^{-4})*	Based on leaching and direct contact pathways
- VOCs Only	7400	7630	8840	Based on leaching model
Olympia Nominee Trust				
Soil				
- cPAHs (10'x10'x1')	5 (10^{-6})*	0 (10^{-5})*	0 (10^{-4})*	Based on leaching and direct contact pathways
New England Plastics Corporation				
Soil				
- VOCs (10'x10'x10')	40			Based on leaching model
Unifirst Corporation				
Soil				
- VOCs (20'x20'x2')2+ (20'x20'x6')	150			Based on leaching model

(*) Risk level based on direct contact pathway

Notes: (1) Soil volumes are estimated using samples collected during remedial investigations. In absence of adequate data to delineate the contaminated areas, a surface area of 10 feet x 10 feet for surface soil contamination and 20 feet x 20 feet for contamination detected in soil boring samples was used. Depth of contamination are estimated from soil sampling or depth to water table for VOC contaminated soil and 1 foot for mixed contaminants in surface soil.

(2) The leaching model based levels are used for VOCs in this table because they represent the most protective levels for both direct contact and for groundwater.

TABLE 3-2

ESTIMATED SOIL VOLUMES, CONTAMINANT CONCENTRATIONS AND PERCENT REMOVAL REQUIRED AT VARIOUS TARGET LEVELS

TARGET LEVELS	CONTAMINANT EXCEEDING TARGET LEVEL	AVERAGE CONCENT-RATION (ppb)	TARGET[1] LEVEL (ppb)	% REMOVAL[2] REQUIRED
Leaching Pathway Only (VOCs only)	Chloroform	226	62.5	72.3
	TCE	8,813	12.7	99.8
	PCE	920	36.7	96.0
	Trans-1,2-DCE	1,743	83.2	95.2
	1,1,1-TCA	474	613	0.0
Direct contact pathway (10^{-6}) and leaching pathway (Mixed contaminants)	TCE	2,822	12.7	99.5
	PCE	260	36.7	85.9
	Trans-1,2-DCE	13	83.2	0.0
	1,1,1-TCA	613	613	0.0
	cPAHs	8,506	700	91.7
	Chlordane	10,788	6,140	43.1
	PCBs	52,710	1,040	98.0

(1) Action levels for VOCs are based on leaching pathway. Action levels for cPAHs, PCBs, and chlordane, are based on direct contact pathway (for future residential use)

(2) $\% \text{ Removal} = \frac{\text{Average Contaminant Concentration} - \text{Target Level}}{\text{Average Contaminant Concentration}}$

Treatment alternatives consisting of both single and multiple treatment technologies were developed to treat site contaminants. Single technologies which can treat all the site contaminants include on-site or off-site incineration, on-site high temperature enhanced volatilization, on-site solvent extraction and on-site supercritical fluid extraction (SCF system). Off-site treatment alternatives for high temperature enhanced volatilization, solvent extraction and the SCF system are not included because mobile/transportable treatment units are commercially available and no permanent commercial facilities are available for these technologies. Therefore, the following single-technology remedial alternatives involving soil treatment were developed for further screening:

Alternative SC-3: Excavation/On-Site Incineration/Backfill On-Site
Alternative SC-4: Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
Alternative SC-5: Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site
Alternative SC-6: Excavation/On-Site Solvent Extraction/Backfill On-Site
Alternative SC-7: Excavation/On-Site Supercritical Fluid Extraction/Backfill On-Site

Two remedial technology alternatives (i.e., treating the VOC contaminated soil with one technology and mixed contaminant soil with a second technology) are also evaluated. Combinations of remedial technology alternatives include either enhanced volatilization or in situ volatilization for VOCs removal, with on-site or off-site incineration for mixed contaminant soil (VOCs, cPAHs PCBs, and chlordane). The following combined remedial technology alternatives involving treatment were thus developed for screening:

Alternative SC-8: Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/Backfill On-Site
Alternative SC-9: Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/Backfill with Treated and Clean Off-Site Soil
Alternative SC-10: In Situ Volatilization/Excavation/On-Site Incineration/Backfill On-Site
Alternative SC-11: In Situ Volatilization/Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil

In addition to on-site treatment of contaminated soils, the sludges and contaminated debris piles from Wildwood Conservation Corporation property (approximately 410 cubic yards) would have to be sent to an off-site disposal facility for all alternatives except for the no action alternative.

Secondary waste management would be required for all treatment technologies except for no action and off-site incineration. Examples of secondary waste management include scrubber water treatment from incineration, high temperature enhanced volatilization and enhanced volatilization. Also included would be carbon adsorption for in situ volatilization, and incineration of concentrated contaminants from both solvent extraction and SCF extraction. (Note the terms low temperature enhanced volatilization and enhanced volatilization are used interchangeably in the following discussion).

3.1.1 Alternative SC-1: No Action (soil)

Key Components:

- Posting warning signs
- Access restriction by institutional controls
- Land use/deed restrictions
- Sampling of existing monitoring wells
- Conducting public education programs

Screening Evaluation

Effectiveness: This alternative does not involve treatment. The No Action alternative will leave contaminated soil on-site. This alternative would not achieve target levels. Contaminant concentrations in soil would be reduced through natural degradation, adsorption and leaching to groundwater over a long period of time. This remedial alternative would not achieve any immediate reduction in toxicity, mobility or volume of contaminants. On-site workers and the public would be properly protected during the implementation of this alternative. Protection would also be provided to minimize any short-term adverse environmental effects that might arise during the implementation of this alternative. This alternative would reduce the potential for human exposure to contaminated soil by limiting access, however, long-term protection of public health and environment is not assured. Environmental degradation could still occur because soil would continue to leach contaminants to groundwater and wildlife would continue to be exposed to contaminants.

Implementability: From a technical perspective, this alternative would be easy to implement, but long-term institutional management for site monitoring and evaluation would be required. Soil and groundwater sampling and monitoring is easy to implement and the necessary resources are readily available. No major construction will be required for the implementation of this alternative. Some administrative effort would be required to implement institutional controls and public education programs.

Cost: The No Action alternative would be the least expensive alternative under consideration. Existing monitoring wells can be used for monitoring. No additional fencing is required. Capital cost is assumed to be zero. Annual operation and maintenance costs are estimated at $50,000. Present worth cost is estimated to be 0.77 million dollars at 5% interest rate and 30 year period.

Summary: This alternative is retained for detailed evaluation and comparison with other remedial alternatives.

- Conclusion: Retained for detailed evaluation.

3.1.2 Alternative SC-2: Excavation/Off-Site RCRA Landfill/Fill Excavation with Clean Off-Site Soil

Key Components:

- Soil excavation
- Segregation and containerization of contaminated soils, hazardous sludge and debris piles
- Transportation to an off-site RCRA landfill
- Off-site landfilling
- Backfilling with clean off-site soil and restoration of the site

Screening Evaluation

Effectiveness: This alternative does not use treatment to achieve reduction in toxicity, mobility or volume. It would achieve the required target levels at the site due to removal of contaminated soil. This alternative would not achieve permanent reduction in volume or toxicity of contaminants, although mobility would be reduced by placement in a properly managed RCRA landfill. Remediation of contaminated soil could require the use of personal protection equipment and air monitoring. Protection would also be provided to minimize any short-term adverse environmental effects that might arise during the implementation of this alternative. This alternative would be effective in eliminating contaminant sources, leachate generation and contaminant migration from the site, therefore, no long-term environmental or public health hazards would remain from source materials on site.

Implementability: This remedial alternative has been used at many hazardous waste sites. There should be no special difficulties in removing and transporting the soil and restoring

the site. The major uncertainty in implementing this alternative is identifying the disposal facilities capable of accepting waste materials in question and the associated cost of transportation and disposal at the time of remediation.

Although this alternative provides reduction in the mobility of contaminants, the off-site disposal of contaminated soils without any treatment may not meet future land disposal restriction requirements. Off-site disposal of soil from contaminated areas is a feasible alternative if an acceptable facility can be identified with sufficient capacity. The facility must be able to accept soils with PCBs, cPAHs, chlordane, and volatile organic compounds. The only currently recognized type of permanent land disposal facility is a double-lined landfill. There are only four commercial facilities in the eastern United States available to receive PCB contaminated soils. Implementation of this alternative would depend on the available capacity at the time of remediation.

Implementation of this alternative would require administrative efforts to secure an off-site RCRA landfill for disposal. Permits for transportation of contaminated soils will be required.

Cost: Costs for this alternative are dependent on the quantity of soils and location of RCRA landfill facilities. No long-term management cost would be required. Off-site disposal would cost approximately $5.26 million. Although the availability of suitable RCRA landfill capacity is now uncertain, for cost estimation purposes it is assumed that such a facility would be available during remediation, within a radius of 500 miles from the site. No long term operation and maintenance would be required.

Summary: This alternative would not be feasible as a stand alone alternative due to the limited availability of commercial RCRA landfill facilities and the TSCA PCBs landfill limits. In addition, this alternative does not use treatment to reduce toxicity, mobility and volume.

- Conclusion: Eliminated from detailed evaluation.

3.1.3 Alternative SC-3: Excavation/On-Site Incineration/ Backfill On-Site

Key Components:

- Soil excavation
- Mobilization of incineration unit

- On-site incineration of contaminated soil
- Backfilling of incinerated soil and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: This alternative would provide reduction of toxicity, mobility and volume of organic contaminants by treatment. Protection would also be provided to minimize any adverse environmental effects during the implementation of this alternative. On-site incineration of contaminated soils would destroy the organic contaminants including volatile organics, cPAHs, PCBs and chlordane and would achieve the target level based on direct contact and the leaching pathway. This remedial alternative would adequately protect human health and the environment. Through excavation and treatment of contaminated soils, the potential for continued leaching of contaminants to groundwater and the exposure contact with contaminated soil by humans and wildlife would be greatly reduced. Excavation of contaminated soils would require the use of personal protecion equipment and air monitoring. Protection would also be provided to minimize any adverse environmental effects during the implementation of this alternative. Long-term management would not be necessary because this alternative would not leave any significant residual contaminants at the site.

Implementability: Incineration is a well-developed and reliable technology. Several mobile incinerators are currently available. For example, mobile rotary kiln and infrared incineration systems have been used effectively for PCBs and have operated commercially at a full-scale level. Both incineration systems use a secondary chamber to combust offgases followed by air pollution control devices. Test burns would be required at the time of remediation to determine their effectiveness and performance on the contaminated soil at the site. Air pollution control and health/safety measures, and monitoring and maintenance would be required during excavation and incineration. This alternative would be highly feasible, and reliable and technologies would be readily available.

Cost: The initial investment to purchase or lease incineration equipment and to conduct soil excavation and restoration would constitute most of the costs associated with this alternative. The capital cost is estimated at $5.49 million. Operation and maintenance costs would be incurred during operation of the incinerator only and would be considered as a portion of the capital costs. No long term maintenance would be required for soils in the source areas.

Summary: Incineration of contaminated soil would provide a permanent remedy designed to reduce the toxicity, mobility and volume of organic contaminants. Long-term management would not be required for soils at the site after remediation.

- Conclusion: Retained for detailed evaluation.

3.1.4 Alternative SC-4: Excavation/Off-Site Incineration/ Backfill Excavation with Clean Off-Site Soil

Key Components:

- Soil excavation
- Packing and transportation to off-site incineration facility
- Off-site incineration of contaminated soil
- Backfilling with clean off-site soil and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: This alternative would significantly reduce the toxicity, mobility and volume of contaminants using treatment at an off-site facility. Off-site incineration would reduce the risks associated with direct human contact and exposure to wildlife, and would not be expected to result in unacceptable environmental impacts at the site. The incineration would achieve a permanent remedy by destroying organic contaminants. Excavation and treatment of contaminated soils would reduce the potential for continued migration of contaminants to groundwater. Excavation of contaminated soils would require the use of personal protection equipment and air monitoring. Long-term management or protection of public health and the environment would not be required since the contaminated soil would be removed from the site.

Implementability: Incineration is a proven and highly reliable technology for destroying organic compounds. Presently only a few off-site incineration facilities are available for use in the United States. Available capacity at these facilities could limit the implementability of this alternative. This alternative would be more feasible for small volumes of highly contaminated waste. Monitoring and maintenance would be required only during excavation and handling operations. Off-site incineration of soil would have to be performed at a

permitted hazardous waste treatment storage and disposal facility (TSD). Permits for transportation and treatment at an off-site TSD facility would be needed. Since the contaminated soil volume is substantial and the availability of commercial incineration facilities for this volume may be low or require a waiting period, implementation may take a long time. Permits will be required for transportation of contaminated soil to an off-site incineration facility.

Cost: This alternative would involve substantial costs for transporting large quantities of soil to the available and permitted incineration facilities. The capital cost for this alternative is estimated at $ 17.44 million. No long term operation and maintenance would be required.

Summary: Incineration would provide a permanent remedy designed to reduce the toxicity, mobility and volume of organic contaminants by treatment. The limited availability of licensed RCRA/TSCA incineration facilities would require further consideration.

- Conclusion: Retained for detailed evaluation.

3.1.5 Alternative SC-5: Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site

Key Components:

- Soil excavation
- Mobilization of high temperature enhanced volatilization unit
- On-site high temperature enhanced volatilization of contaminated soil
- Backfilling of excavated areas with treated soil and restoration of the site
- Off-site disposal of sludges and debris piles

Effectiveness: This alternative would provide reduction of toxicity, mobility and volume of organic contaminants by treatment. This alternative is expected to achieve target levels. However, this data is lacking on the effectiveness of this process to achieve target levels for chlordane and the cPAHs of concern at the site. It is expected to provide adequate protection to public health and the environment. Organics would be vaporized from the soil to an afterburner or adsorption treatment system for permanent destruction. Excavation of contaminated soil would require the use of personal protection equipment and air monitoring. Protection

would also be provided to minimize any adverse environmental effects that might arise during the implementation of this alternative. Long term management for the site for protection for the public health and environment would not be required after remediation.

Implementability: This alternative can be easily implemented and constructed by bringing in a mobile treatment system. Several types of mobile high temperature enhanced volatilization units are commercially available from vendors such as American Toxic Disposal, Inc. (ATD), Kipin Industries, Inc. and Combustion-Engineering Environmental, Inc.

High temperature enhanced volatilization processes would separate not only volatile organics but also cPAHs, PCBs and chlordane from the contaminated soil. At a typical operating temperature of 700°F to 1,000°F, effective removal of VOCs and PCBs has been demonstrated. An adequate afterburner would have a destruction and removal efficiency (DRE) greater than 99.9999 percent for PCBs in the off-gas stream. The on-site operations and maintenance of a high temperature enhanced volatilization unit presents no problems at this time. The technology is reliable and is readily available.

Cost: The capital cost of this alternative is estimated at $4.82 million. No long term operation and maintenance would be required.

Summary: This alternative is expected to provide a permanent reduction of toxicity, mobility and volume of organic contaminants by treatment. Data is however, lacking with respect to the effectiveness of this technology to achieve target levels for chlordane and cPAHs. It appears to be a feasible, reliable and available technology to provide proper protection of public health and the environment.

- Conclusion: Retained for detailed evaluation.

3.1.6 Alternative SC-6: Excavation/On-Site Solvent Extraction/ Backfill On-Site

Key Components:

- Soil excavation and preparation
- Mobilization of solvent extraction unit
- On-site solvent extraction of contaminated soil

- Backfilling treated soil and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: The effectiveness of solvent extraction can only be determined after treatability testing. Theoretically, water or water with an additive can wash almost all water soluble volatile organics, but several types of organic solvents or surfactants would be required to extract relatively water insoluble cPAHs, PCBs and chlordane. Solvent extraction can significantly reduce the level of PCB contamination in the soils. The volume of extracted contaminants is much smaller than the initial soil volume and can thus be disposed of cost-effectively by off-site incineration. Since this alternative has not been proven to achieve the target levels its effectiveness to protect public health and the environment is uncertain. The treated soil may still contain organic contaminants above the target levels. Thus solvent extraction may not provide an acceptable remedy for reducing the toxicity, mobility or volume of contaminants by treatment. Excavation of contaminated soil would require the use of personal protection equipment and air monitoring. The use of extractant would require proper handling and disposal.

Implementability: This alternative can be easily implemented and constructed at the site by bringing in a mobile treatment system. Solvent extraction systems for organic contaminants in soil, sludge and oil, have been developed for commercial use by several vendors such as Acurex and Resource Conservation Company (RCC). However, one potential problem with this technology is that many extraction systems are contaminant specific, e.g., those which work well for one class of contaminants such as semivolatiles may not be effective for other classes such as volatiles. The site soil contains a variety of contaminants and therefore it may not be feasible to use one extraction system to remove all of the contaminants. This would necessitate using more than one system to treat the soil and this would increase operation and maintenance requirements, monitoring requirements and costs. Therefore, the feasibility, reliability and availability of this alternative is considered to be relatively low based on the current state of technology. On-site workers and public would be properly protected during the implementation of this alternative. Safeguards would be provided to minimize adverse public health or environmental effects during implementation of this alternative. Permits would be required for transportation and disposal of extracted contaminants.

Cost: The capital cost of this alternative is estimated at $6.15 million. No long term operation and maintenance would be required.

Summary: The initial screening indicates that this alternative poses limitations to application at the Wells G&H site. It is not certain that the existing commercial extraction systems will adequately remove site contaminants to target levels. It also has low availability and reliability for all of the contaminants at the site.

- Conclusion: Eliminated from detailed evaluation.

3.1.7 Alternative SC-7: Excavation/On-Site Supercritical Fluid Extraction/ Backfill On-Site

Key Components:

- Soil excavation and feed preparation
- Mobilization of supercritical fluid extraction unit
- On-site supercritical extraction of contaminated soil
- Backfilling of treated soils and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: This alternative is expected to provide significant reduction of toxicity, mobility and volume of contaminants by treatment. This alternative has been successfully used to extract organics (including PCBs and PAHs) from oily refinery wastes and sludges but has not yet been applied at full scale level to contaminated soil. It is, therefore, uncertain that this technology can be successfully applied to contaminated soil at the site. There is also uncertainty that the treated soil would attain target levels for all contaminants including pesticides (i.e. the extraction efficiency for more polar volatiles may be relatively lower than for non-polar semivolatiles). This uncertainty would have to be clarified by pilot testing. On-site workers and the public would be properly protected during the implementation of this alternative. Construction safeguards would minimize any adverse public health or environmental effects that may occur during implementation activities.

Implementability: This alternative can be implemented and constructed at the site however, a full scale commercially available mobile unit does not presently exist and would have to

be constructed to provide a capacity of 5 to 10 tons/hour, similar to other available technologies. This system would require significant labor for operation and maintenance. Based on the current status and availability, the supercritical extraction technology will require bench and pilot scale studies for the Wells G&H site. Permits would be required for transportation of extracted contaminants for off-site disposal.

Cost: The capital cost is estimated at $5.49 million. No long term operation and maintenance would be required.

Summary: This alternative is an innovative technology and may be a promising technology for removing organic contaminants from the site soils. Uncertainty does, however, exist regarding the effectiveness of this technology when applied to a soil media.

- Conclusion: Retained for detailed evaluation.

3.1.8 Alternative SC-8: Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/Backfill On-Site

Key Components:

- Soil excavation and feed preparation
- Mobilization of enhanced volatilization and incineration units
- On-site treatment of volatile organic contaminated soil using a low temperature enhanced volatilization unit
- On-site incineration of mixed contaminant soils
- Backfilling treated soil and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: Enhanced volatilization has been demonstrated to achieve a VOCs removal efficiency greater than 99.99 percent for soils contaminated with trans-1,2-dichloroethene, tetrachloroethene and xylene with levels as high as 20,000 ppm (USEPA, 1985). Enhanced volatilization is also expected to effectively remove other volatile organics such as trichloroethene, chloroform and 1,1,1-trichloroethane from the contaminated soil. Reduction of volatile organics in the soil would protect the environment and public health. However, there is some uncertainty as to whether all target levels for volatiles in the site soils can be achieved and pilot tests would be required to

establish the actual performance that could be expected for the site soils. Incineration is expected to reduce VOCs, cPAHs, PCBs and chlordane concentration to target levels. This alternative is expected to achieve a significant reduction in the toxicity, mobility and volume of organic contaminants in the soils by treatment using enhanced volatilization for VOCs and incineration for mixed contaminant soils. On-site workers would be properly protected during the implementation of this remedial alternative. Construction safeguards would minimize any threats to the public health or the environment during the implementation of this alternative. No long-term post-implementation management is expected to be required for the site.

Implementability: This alternative can be easily implemented and constructed at the site by mobilizing an enhanced volatilization unit and a mobile incinerator. The two technologies could be used simultaneously at the site, or sequentially. At present, several types of mobile enhanced volatilization units are available from Roy F. Weston, O.H. Materials, Canonie Engineering and CE-Environmental. However, most vendors have only one or two units, thus implementation may depend on the availability of the equipment. These systems would be available as mobile trailers for on-site use and would be sized to process 5 to 10 tons per hour. Operation and maintenance of this equipment is relatively easy.

The description of the on-site incineration component of this alternative is presented in Section 3.1.3 (Alternative SC-3). Some makeup soil may be required to adjust for the slight volume reduction during incineration. Space required for both enhanced volatilization and incineration is available at the site. Some administrative efforts would be required to delist treated soil. Permits would be required for transportation and disposal of secondary wastes like scrubber water and spent carbon.

Cost: The capital cost for treating soil by on-site enhanced volatilization and on-site incineration is estimated to be $4.42 million. No long-term operation and maintenance would be required.

Summary: This alternative will be retained for the detailed evaluation because there is reason to believe that it would offer acceptable treatment performance and cost-effectiveness.

- Conclusion: Retained for detailed evaluation

3.1.9 Alternative SC-9: Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/Backfill with Treated and Clean Off-Site Soil

Key Components:

- Soil excavation and feed preparation
- Mobilization of enhanced volatilization unit
- On-site treatment of volatile organic contaminated soil using enhanced volatilization unit
- Containerization and transportation of mixed contaminant soil to an off-site incineration facility
- Off-site incineration of mixed contaminant soil
- Backfilling of treated and clean off-site soils and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: As discussed in Alternative SC-8, enhanced volatilization has been demonstrated to be effective in removing volatile organics. However there is some uncertainty as to whether all target levels for volatile organics in soils would be achieved. Pilot tests would be required to establish actual performance. Off-site incineration is a proven technology and would achieve the target risk levels for mixed contaminants. Off-site incineration would significantly reduce the toxicity, mobility and volume of contaminants using treatment. This alternative is expected to reduce the toxicity, mobility and volume of contaminants, by treatment using enhanced volatilization and removal and off-site incineration of mixed contaminant soil from the site. On-site workers and the public would be properly protected during the implementation of this alternative. Protection would also be provided to minimize any adverse environmental effects during the implementation of this alternative. There is some risk of spillage during transportation of contaminated soil to an off-site incineration facility. No long-term management is expected after implementation of this alternative.

Implementability: This alternative can be easily implemented and constructed at the site, however, there is uncertainity in the availability of off-site incineration facilities. Since the contaminated soil quantity for off-site incineration is only approximately 1,905 cubic yards, this alternative is considered to be technically feasible, reliable and available. This

alternative would be relatively easy to construct and implement at the site. Implementation of this alternative would require administrative efforts to secure an off-site incineration facility. Permits would be required for transportation of contaminated soil and spent carbon to off-site facility.

Cost: The capital cost for treating soil by on-site enhanced volatilization and by off-site incineration is estimated at approximately 6.82 million dollars. No long term operation and maintenance would be required.

Summary: This alternative is retained for detailed evaluation due to its competitive effectiveness and implementability with other thermal treatment alternatives.

- Conclusion: Retained for detailed evaluation

3.1.10 Alternative SC-10: In Situ Volatilization/ Excavation/On-Site Incineration/Backfill On-Site

Key Components:

- In situ volatilization of VOC contaminated soils at Wildwood property
- Excavation of soils with mixed contaminants at Wildwood and contaminated soils from other properties
- Mobilization of incineration unit
- On-site incineration of excavated soils
- Backfilling of treated soils and restoration of the site
- Off-site disposal of sludges and debris piles

Effectiveness: The combination of these treatment technologies would remove organic contaminants to the target levels in the treated soil and provide significant reduction in the toxicity, mobility and volume of VOCs, cPAHs, PCBs and chlordane at the site by treatment using in situ volatilization and incineration. The in situ volatilization process is less disruptive of the environment than most other processes since soil excavation is not needed. Since the VOCs removal efficiency by in situ volatilization varies highly with the organic concentration, type of soil, and soil structures, a pilot scale study would be required to optimize the design of the in situ volatilization process. Public health and the environment would be properly protected during the on-site remediation activities. No long term management of the site or protection would be needed after remediation is completed.

Implementability: Two types of in situ volatilization systems, a vacuum extraction system (Terra Vac, Inc.) and forced air ventilation system (Vaportech) are commercially available. The vaccum extraction or forced air ventilation systems consisting of piping, air injection and vacuum pumps can be easily installed at the site. Extracted volatile organics are adsorbed on activated carbon. Spent carbon can be regenerated or disposed at an off-site facility. In situ volatilization is feasible regardless of depth of contaminated soil and depth to the water table. In situ volatilization has been successfully applied to sites possessing high water tables (less than five feet).

Several mobile incineration units are commercially available for on-site incineration as discussed in Alternative SC-3 (On-Site Incineration). Incineration has higher feasibility, reliability and availability than the other thermal treatment processes.

Cost: The cost for in situ volatilization and incineration have been estimated using the vacuum exctraction system. The total capital cost for this remedial alternative is estimated at 2.22 million dollars. No long-term operation and maintenance would be required.

Summary: In situ volatilization and incineration have been demonstrated at the pilot scale and full scale levels. This alternative would be feasible and cost effective and is retained for further evaluation.

- Conclusion: Retained for detailed evaluation.

3.1.11 Alternative SC-11: In Situ Volatilization/Excavation/ Off-Site Incineration/Backfill with Clean Off-Site Soil

Key Components:

- In situ volatilization of VOC contaminated soils at Wildwood property
- Excavation of mixed contaminant soils at Wildwood and contaminated soils at other properties
- Containerization and transportation of excavated soils to an off-site incineration facility
- Off-site incineration of excavated soils
- Backfilling of excavated soils with clean off-site soil and restoration of the site
- Off-site disposal of sludges and debris piles

Screening Evaluation

Effectiveness: This alternative would achieve the target level established for this site and would provide a permanent remedy by reducing toxicity, mobility and volume of organic contaminants by treatment using in situ volatilization and removal and off-site incineration of excavated soil from the site similar to that of Alternative SC-10. This alternative is also expected to provide adequate protection of public health and the environment. Since the VOC removal efficiency of in situ volatilization varies with the organic concentration, type of soil and soil structure, a pilot scale study would be required to optimize the operation of this treatment process. Off-site incineration would minimize the short-term adverse impacts on the public health such as air emissions, but would increase traffic impacts on the environment. Off-site incineration would eliminate any residual contaminants in the soil since the contaminated soil is replaced by clean soil. Long-term post-implementation management or protection for public health or the environment would not be required.

Implementability: This alternative would be potentially more difficult to implement than Alternative SC-10 due to the limited availability of commercial licensed incineration facilities. Permits for transportation and treatment at an off-site incinerator would be needed. The feasibility, reliability and availability of in situ volatilization are considered to be acceptable as discussed in Alternative SC-10.

Cost: The capital cost for treating soil by in situ volatilization and by off-site incineration is estimated at $4.86 million. No long-term operation and maintenance would be required.

Summary: This alternative is comparable to Alternative SC-10 relative to effectiveness and implementability. The limited availability of licensed incineration facilities may be a problem.

- Conclusion: Retained for further evaluation.

3.1.12 Summary of Source Control (Soil) Alternative Screening

Based on the results of the initial screening discussed above, Alternatives SC-2 and SC-6 have been eliminated from further consideration. All other alternatives, i.e., Alternatives SC-1, SC-3, SC-4, SC-5, SC-7, SC-8, SC-9, SC-10, and SC-11 are retained for the detailed evaluation of remedial alternatives in Section 4.0 of this report. Table 3-3 presents a summary of the cost breakdown for these alternatives.

TABLE 3-3

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL SOURCE CONTROL ALTERNATIVES

Potential Source Control Alternatives	Major Remediation Components	Estimated Quantities	Unit Cost	1988 Dollars Capital Cost	Annual O&M Cost
1. Alternative SC-1: No Action (Soil)	1.Sampling, Monitoring and Report Writing			0	50,000
2. Alternative SC-2: Excavation/Off-Site RCRA Landfill/Backfill with Clean Off-Site Soil	1.Excavation	9,905 cy	6/cy	59,400	
	2.Transportation	13,370 ton	125/ton	1,671,300	
	3.Off-Site RCRA Landfill	13,370 ton	250/ton	3,342,500	
	4.Filling Excavation with Clean Off-Site Soil	9,495 cy	20/cy	189,900	
			TOTAL	5,263,100	
3. Alternative SC-3: Excavation/On-Site Incineration/Backfill On-Site	1.Excavation	9,905 cy	6/cy	59,400	
	2.Incineration	9,495 cy	540/cy	5,127,300	
	3.Treated Soil Backfilling On-site	9,495 cy	10/cy	95,000	
	4.Off-Site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	5,487,100	
4. Alternative SC-4: Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil	1.Excavation	9,905 cy	6/cy	59,400	
	2.Transportation	12,820 ton	125/ton	1,602,500	
	3.Incineration (Off-site)	12,820 ton	1,200/ton	15,384,000	
	4.Filling Excavation with Clean Off-Site Soil	9,495 cy	20/cy	189,900	
	5.Off-Site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	17,441,200	
5. Alternative SC-5: Excavation/On-Site High Temperature Enhanced Volatization/Backfill On-Site	1.Excavation	9,905 cy	6/cy	59,400	
	2.High Temperature Enhanced Volatilization	9,495 cy	470/cy	4,462,700	
	3.Treated Soil Backfilling On-Site	9,495 cy	10/cy	94,950	
	4.Off-site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	4,822,450	
6. Alternative SC-6: Excavation/On-Site Solvent Extraction/Backfill On-Site	1.Excavation	9,905 cy	6/cy	59,400	
	2.Solvent Extraction	9,495 cy	610/cy	5,792,000	
	3.Treated Soil Backfilling On-Site	9,495 cy	10/cy	95,000	
	4.Off-site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	6,151,800	

TABLE 3-3 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL SOURCE CONTROL ALTERNATIVES

Potential Source Control Alternatives	Major Remediation Components	Estimated Quantities	Unit Cost	1988 Dollars Capital Cost	Annual O&M Cost
7. Alternative SC-7: Excavation/On-Site Supercritical Extraction/ Backfill/On-Site	1.Excavation	9,905 cy	6/cy	59,400	
	2.Supercritical Extraction	9,495 cy	540/cy	5,127,300	
	3.Treated Soil Backfilling On-Site	9,495 cy	10/cy	95,000	
	4.Off-site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	5,487,100	
8. Alternative SC-8: Excavation/On-Site Enhanced Volatilization/On-Site Incineration/Backfill On-Site	1.Excavation	9,905 cy	6/cy	59,400	
	2.Enhanced Volatilization	7,590 cy	400/cy	3,036,000	
	3.Incineration	1,905 cy	540/cy	1,028,700	
	4.Treated Soil Backfilling On-Site	9,495 cy	10/cy	95,000	
	5.Off-site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	4,424,500	
9. Alternative SC-9: Excavation/On-Site Enhanced Volatilization/Off-Site Incineration/Backfill with treated and clean off-site soil	1.Excavation	9,905 cy	6/cy	59,400	
	2.Enhanced Volatilization	7,590 cy	400/ton	3,036,000	
	3.Transportation	2,570 ton	125/ton	321,300	
	4.Incineration (Off-site)	2,570 ton	1200/ton	3,084,000	
	5.Treated Soil Backfilling On-Site	7,590 cy	10/cy	75,900	
	6.Filling Excavation with Clean Off-Site Soil	1,905 cy	20/cy	38,100	
	7.Off-Site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	6,820,100	
10. Alternative SC-10: In Situ Volatilization/Excavation/On-Site Incineration/Backfill On-Site*	1.In-Situ Volatilization	7,400 cy	115/cy	851,000	
	2.Excavation	2,505 cy	6/cy	15,000	
	3.Incineration	2,095 cy	540/cy	1,131,300	
	4.Treated Soil Redeposition	2,095 cy	10/cy	21,000	
	5.Off-Site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	2,223,700	

TABLE 3-3 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL SOURCE CONTROL ALTERNATIVES

Potential Source Control Alternatives	Major Remediation Components	Estimated Quantities	1988 Dollars Unit Cost	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
11. Alternative SC-11: In Situ Volatilization/Excavation/Off-Site Incineration/Backfill On-Site with Clean Off-Site Soil*	1.In Situ Volatilization	7,400 cy	115/cy	851,000	
	2.Excavation	2,505 cy	6/cy	15,000	
	3.Transportation	2,830 ton	125/ton	353,800	
	4.Incineration (Off-site)	2,830 ton	1200/ton	3,396,000	
	5.Filling Excavation with Clean Off-Site Soil	2,095 cy	20/cy	41,900	
	6.Off-Site Disposal of Sludges and Debris Piles	555 ton	370/ton	205,400	
			TOTAL	4,863,100	

* The quantity of contaminated soil to be treated by in situ volatilization on these dual technology alternatives (SC-10 & SC-11) are slightly lower than Alternatives SC-8 and SC-9, since in situ volatilization can only be applied to soil contaminated with VOCs at Wildwood Conservation Corporation property for practical reasons (small quantities at other properties). However contaminated soil at other properties will be treated by incineration.

3.2 MANAGEMENT OF MIGRATION

Management of Migration (MOM) alternatives address the control of groundwater contaminant migration by pumping at the source areas, pumping at Wells G and H, or a combination of both. The MOM alternatives were developed based on the following considerations:

- Pumping at the individual source areas and the central area as discussed in Section 1.0;
- The groundwater treatment technologies feasible for the Wells G&H site as identified in Section 2.0; and
- The location of treatment plants in each area or a central treatment plant for all areas.

Five high contaminant concentration areas are located at the properties of W.R. Grace, Unifirst Corporation, Olympia Nominee Trust, Wildwood Conservation Corporation, and New England Plastics. The central area at the Wells G&H site has lower groundwater contaminant concentrations than the five surrounding properties.

Table 3-4 presents a summary of pumping rates developed for each of the source areas. These pumping rates include both overburden and bedrock pumping. For the initial screening, 20-50 flush volumes have been assumed for the source areas and 10-20 flush volumes for the central area of the site (see Appendix C). In addition to the pumping rates, Table 3-4 shows the estimated average contaminant concentration in the groundwater plume for each of the properties. These concentrations were used to develop preliminary sizing and cost estimates for the various treatment technologies. For all alternatives, maintenance of the Riley Tannery production well pump rate is assumed as further discussed in Appendix C.

For costing purposes, a single 30 year restoration period has been assumed for all source area pumping. In addition, for costing purposes for MOM-4 alternatives a 10 year restoration period has been assumed for the central area. As discussed in Appendix C, actual aquifer restoration periods may differ from these values.

The MOM alternatives based on the pumping and treatment of contaminated groundwater areas, were developed as follows:

Alternative MOM-1	No Action
Alternative MOM-2	Pump and Treat the Source Areas (Five Areas)
Alternative MOM-3	Pump and Treat at the Central Area (Wells G and H)

TABLE 3-4

SUMMARY OF ESTIMATED PUMPING RATES AND INFLUENT CONCENTRATIONS FOR VARIOUS MOM ALTERNATIVES

Alternative	Pumping Rate (gpm) (1)	Influent VOCs (ug/l) (2)
MOM-2: Pump and Treat Source Areas		
o Separate Treatment Plants:		
- W.R. Grace	65	2,445
- Olympia Nominee Trust	50	1,080
- Wildwood Conservation Corporation	300	52,255
- New England Plastics	21	195
- Unifirst Corporation	80	3,925
o Central Treatment Plant	516	30,860
MOM-3: Pump and Treat Central Area	540	155
MOM-4: Pump and Treat Source Areas and Central Area		
o Separate Treatment Plants		
- W.R. Grace	65	2,445
- Olympia Nominee Trust	50	1,080
- Wildwood Conservation Corporation	300	52,255
- New England Plastics	21	195
- Unifirst Corporation	80	3,925
- Central Area	540	155
o Central Treatment Plant	1,056	15,160
MOM-5: Pump and Treat at Southern Boundary	500	155

(1) The Riley Tannery production well on the Wildwood property has been assumed to pump at an average rate of 270 gpm throughout all alternatives.

(2) See Appendix D for details.

Alternative MOM-4 Pump and Treat the Source Areas and the Central Area

Alternative MOM-5 Pump and Treat at Southern Boundary Area

MOM alternatives 1 through 5 present a range of groundwater alternatives. Alternatives MOM 2 to 4 represent those that actively pursue most or all the remedial objectives for groundwater discussed in Section 1.0. Alternative MOM-5 primarily addresses the migration of contaminants downgradient but would not actively clean up contaminated groundwater. The alternatives are differentiated by the areas from which groundwater is extracted. The pumping/extraction rates were developed with the aid of a computer model (see Appendix C). The pumping rates are not presented as absolute values but rather as a mechanism to compare and cost the alternatives. It is expected that pumping rates for different areas of the site and specific well configurations including numbers and locations of wells will be specifically defined during the remedial design.

The anticipated flushing times presented for groundwater cleanup to MCLs are estimated values based upon calculations presented in Appendix C. As with the pumping rates, these flushing times are intended as a mechanism for evaluation of alternatives. It is expected that more definative flushing time estimates will be developed during the remedial design.

Alterative MOM-1 is the No-Action alternative which represents natural cleanup of the site under existing hydrogeological conditions (without Wells G and H pumping) and under the assumption of continuous pumping of the Riley well.

Alternative MOM-2 involves pumping groundwater from the five source (high concentration) areas while not actively pumping the contaminated groundwater in the central area. Alternative MOM-3 involves pumping groundwater from the central area at Wells G and H for treatment with no pumping at the five source areas (i.e., contaminants from the source areas are assumed to migrate to Wells G and H where they are removed and treated). Alternative MOM-4 involves pumping and treating both the source areas and central area simultaneously. Alternative MOM-5 involves pumping and treating the groundwater downgradient (at the Southern Boundary) to prevent contaminant migration beyond the site boundary and also provide groundwater restoration. This alternative of pumping along the southern boundary of the site does not eliminate the potential for contaminant discharge to the river.

As discussed in Section 1.0, groundwater at both the source areas and the central area is contaminated with volatile organics (primarily TCE, PCE, and DCE). In addition, elevated iron and manganese concentrations exist in significant portions

of the aquifer of concern. Pretreatment to remove iron and manganese would be required to maintain an efficient operation for volatile organic removal by processes such as air stripping and carbon adsorption in most of the areas. Also, pretreatment would be required to meet AWQC requirements for discharges to the Aberjona River. Feasible remedial technologies for volatile organic removal from groundwater include air stripping, ultraviolet photolysis (UV/chemical oxidation), and carbon adsorption. Therefore, the viable treatment schemes for the groundwater remediation alternatives include:

Treatment Scheme A - Pretreatment and Air Stripping;

Treatment Scheme B - Pretreatment and UV/Chemical Oxidation; and

Treatment Scheme C - Pretreatment and Carbon Adsorption.

Based on capital and operations and maintenance cost considerations, treatment options include a separate treatment plant for each source area or a central treatment plant for all areas. The MOM alternatives based on the treatment plant locations would include a pretreatment and volatile organics removal process for both options (separate treatment plants or a central treatment plant) as follows:

Treatment Plant Arrangement - (i) - Pretreatment and volatile organics removal at separate treatment plants

Treatment Plant Arrangement - (ii) - Pretreatment and a volatile organics removal at a central treatment plant

Table 3-5 summarizes the MOM alternatives which have been developed. A total of nineteen feasible alternatives (including one No Action Alternative) were developed for further screening to achieve groundwater remediation. Because one central treatment location is employed for the MOM-3 and MOM-5 alternatives, the option for separate treatment does not exist for these alternatives.

A single unit treatment process is insufficient for groundwater treatment at the site because of presence of certain inorganics primarily iron and manganese. The treatability study performed on groundwater samples from the Wildwood Conservation Corporation and south of Unifirst Corporation areas discussed and presented in the Supplemental RI report (Ebasco, 1988) was also used in the development of these groundwater treatment schemes. It is assumed in this initial screening that the same treatment scheme will be used at each property to pretreat the groundwater primarily for removal of iron and manganese, and subsequently to treat the water for removal of volatile organics.

TABLE 3-5

ALTERNATIVES CONSIDERED FOR MANAGEMENT OF MIGRATION

1. MOM-1 - No Action

MOM-2 Pump and Treat Source Areas

2. MOM-2A (i) - Pretreatment and Air Stripping at Separate Treatment Plants

3. MOM-2A (ii) - Pretreatment and Air Stripping at a Central Treatment Plant

4. MOM-2B (i) - Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants

5. MOM-2B (ii) - Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

6. MOM-2C (i) - Pretreatment and Carbon Adsorption at Separate Treatment Plants

7. MOM-2C (ii) - Pretreatment and Carbon Adsorption at a Central Treatment Plant

MOM-3 Pump and Treat Central Area

8. MOM-3A - Pretreatment and Air Stripping at a Central Treatment Plant

9. MOM-3B - Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

10. MOM-3C - Pretreatment and Carbon Adsorption at a Central Treatment Plant

MOM-4 Pump and Treat at Source Areas and Central Area

11. MOM-4A (i) - Pretreatment and Air Stripping at Separate Treatment Plants

12. MOM-4A (ii) - Pretreatment and Air Stripping at a Central Treatment Plant

13. MOM-4B (i) - Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants

TABLE 3-5 (Cont'd)

ALTERNATIVES CONSIDERED FOR MANAGEMENT OF MIGRATION

14. MOM-4B (ii) - Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

15. MOM-4C (i) - Pretreatment and Carbon Adsorption at Separate Treatment Plants

16. MOM-4C (ii) - Pretreatment and Carbon Adsorption at a Central Treatment Plant

MOM-5 Pump and Treat at Southern Boundary Area

17. MOM-5A - Pretreatment and Air Stripping at a Central Treatment Plant

18. MOM-5B - Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

19. MOM-5C - Pretreatment and Carbon Adsorption at a Central Treatment Plant

Figure 3-3 shows the three groundwater treatment schemes considered in this initial screening.

3.2.1 Pretreatment

The treatment scheme shown in Figure 3-4 was selected for pretreatment based on the treatability studies performed as mentioned above. The pretreatment process would consist of equalization, chemical coagulation, flocculation, clarification, recarbonation and filtration.

Equalization involves receiving extracted groundwater and equalizing the flow and the concentration to be treated. Chemical coagulation, flocculation and clarification using lime and polymer compounds would be employed to precipitate and remove metals (primarily iron and manganese). Recarbonation using carbon dioxide would be used to adjust pH and precipitate excess lime used during chemical precipitation. Filtration would be the final step in pretreatment and would be used to remove fine suspended solids and make groundwater suitable for further treatment for organic removal. Pretreatment sludge resulting from the treatment process would be dewatered using a vacuum filter. This would remove excess water and form a sludge cake suitable for transport and off-site disposal. The filtrate would be recycled back to the equalization tank for additional treatment.

3.2.2 Alternative MOM-1: No Action

Key Components:

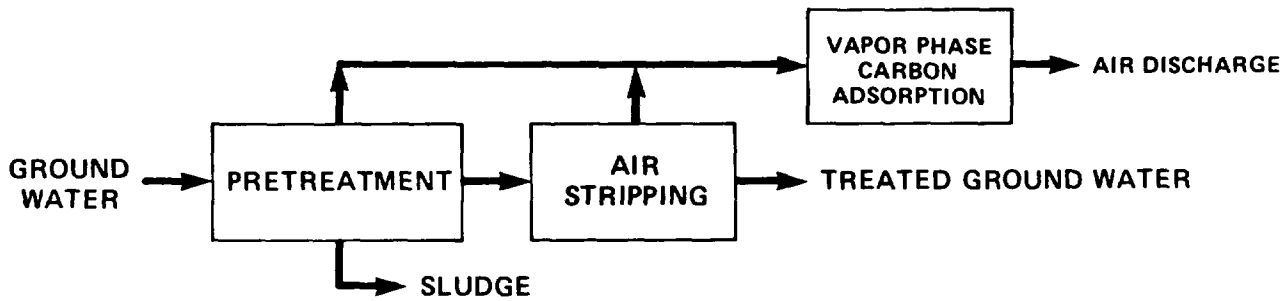
- Post warning signs
- Restrict groundwater use by institutional control
- Sample existing monitoring wells
- Conduct public education programs
- Evaluate natural attenuation and migration of groundwater contaminants

Screening Evaluation

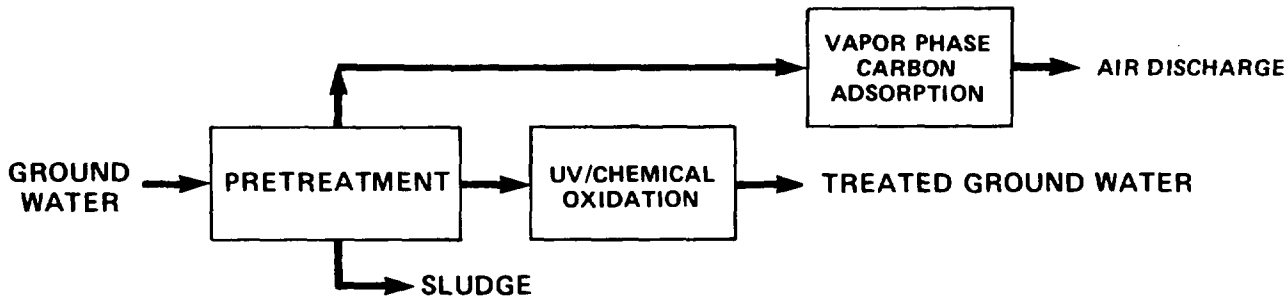
Effectiveness: Modeling data presented in Appendix C indicate that natural attenuation of contaminant concentrations to MCLs in the groundwater is estimated to take in excess of 100 years for the overburden aquifer. It is uncertain how much of the existing bedrock contamination would be reduced and how much residual contamination would remain in the bedrock after MCLs are achieved in the overburden. In addition, it is possible that residual contamination in the bedrock could continue to move up into the overburden aquifer and might extend the time necessary for natural attenuation of the overburden. A reduction in contaminant concentrations would probably be achieved through natural degradation, dispersion, and dilution. However, the volume of the contaminated aquifer plume would likely increase. This remedial alternative would not achieve

FIGURE 3-3
TREATMENT SCHEMES FOR MANAGEMENT OF MIGRATION ALTERNATIVES

SCHEME A — PRETREATMENT AND AIR STRIPPING



SCHEME B — PRETREATMENT AND UV/CHEMICAL OXIDATION



SCHEME C — PRETREATMENT AND CARBON ADSORPTION

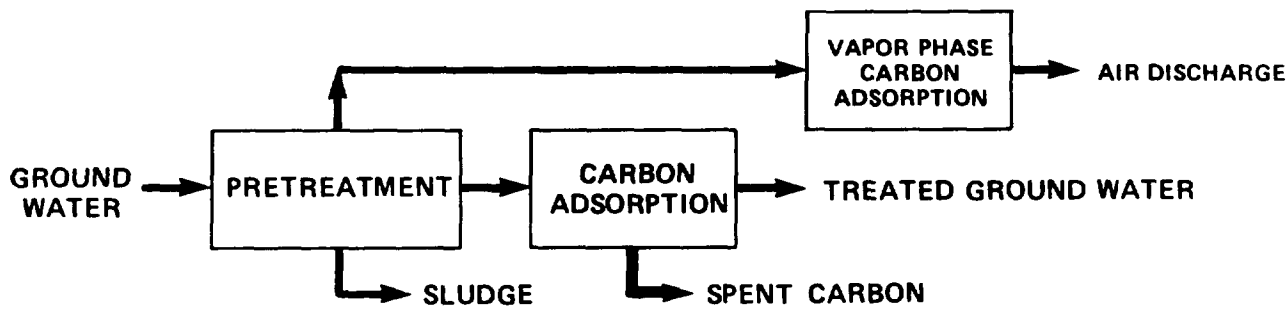
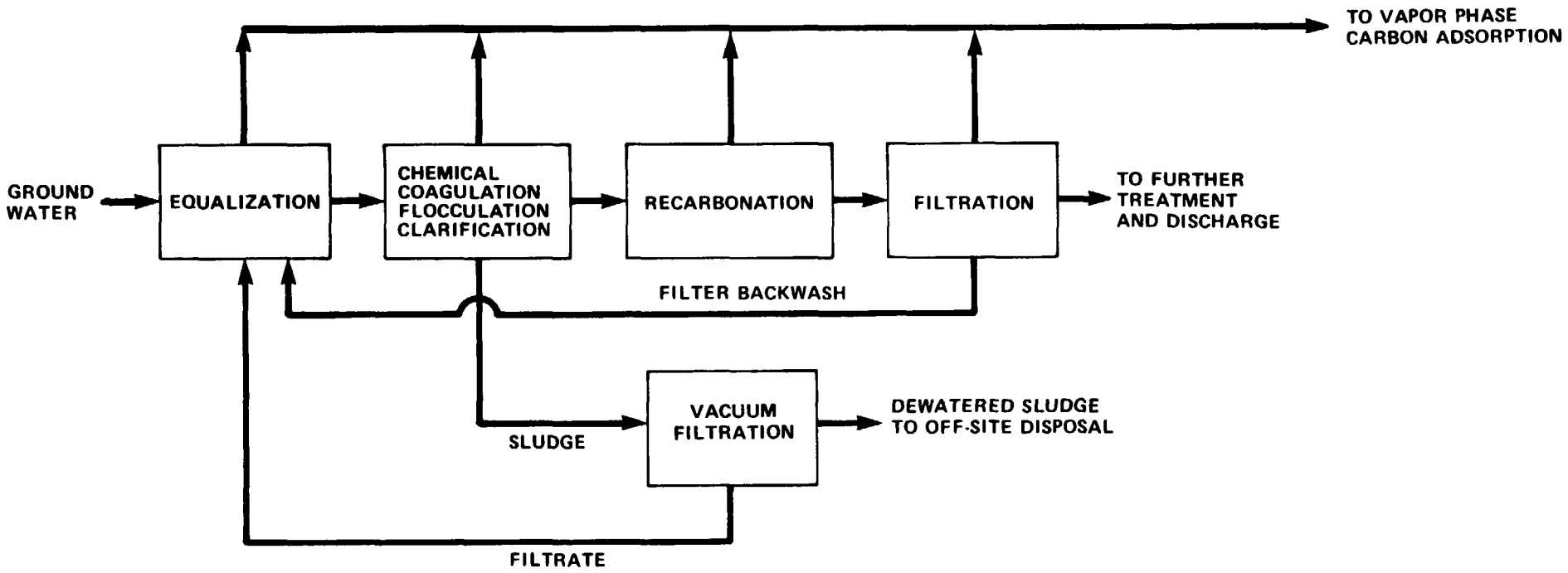


FIGURE 3-4
PRETREATMENT SCHEME FOR MANAGEMENT OF MIGRATION ALTERNATIVES



any immediate significant reduction in toxicity, mobility, or volume of the contaminants. The No Action alternative would not ensure the long term protection of public health and the environment. Even with continued use of alternative water supplies, groundwater contaminant migration would continue throughout the aquifer and downgradient from the site.

Implementability: Existing monitoring wells would be used for sampling in this alternative. Groundwater monitoring technologies are well developed and readily available. This alternative is highly feasible, reliable, and groundwater monitoring technologies are readily available. Long-term institutional restriction on groundwater use is not, however, highly reliable.

Cost: Existing wells would be used for monitoring. An annual operation and maintenance cost of $25,000 is estimated. The present worth cost is estimated to be $0.38 million at 5% interest over a 30 year period.

Summary: This alternative is retained for detailed analysis. It provides a baseline comparison with other remedial alternatives that would achieve aquifer restoration in a shorter time frame. This alternative would not achieve the remedial response objectives established for the site.

- Conclusion: The No-Action alternative is retained for detailed evaluation.

3.2.3 Alternative MOM-2: Pump and Treat at Source Areas

3.2.4 Alternative MOM-2A (i): Pretreatment and Air Stripping at Separate Treatment Plants

Key Components:

- Pumping systems would include wells, pipes and pumps
- Treatment of groundwater would include pretreatment and air stripping at 5 separate treatment plants
- Collection of emissions from air strippers and pretreatment systems would be accomplished using vapor phase carbon adsorption
- Treated water would be discharged to the Aberjona River
- Pretreatment sludge would be disposed at an off-site location
- In situ regeneration of vapor phase carbon would be accomplished using a thermal regeneration system

Screening Evaluation

Effectiveness: Pumping at source areas would reverse the spread of contaminants and reduce contamination in the overburden and bedrock aquifers. The proposed treatment technologies would permanently destroy the contaminants removed from the groundwater. The pretreatment and treatment technologies would achieve a removal efficiency of approximately 99.9% for the VOCs and the treated water would be expected to meet the applicable surface water discharge and MCL requirements. Permanent destruction of contaminants would be achieved during carbon regeneration in the vapor phase adsorption system. Thus, this alternative provides significant reduction of toxicity, mobility, and volume of the volatile organics.

Under this alternative source areas would be pumped for approximately 20-50 years with the objective of remediating groundwater to MCLs (see Appendix C). Pumping at the Riley well and natural attenuation would remediate the central area to MCLs over an anticipated total period of approximately 22 years (see Appendix C) assuming no additional introduction of contaminants from the source areas. Long term bedrock pumping may be needed after the projected restoration period (at each source area) if monitoring indicates that contaminants (including dense non-aqueous phase liquid-DNAPL) continue to migrate from the bedrock to the overburden.

This groundwater restoration alternative would provide adequate protection to public health and the environment by extracting and treating the contaminated groundwater in the source areas to control the migration to the central area and the wetlands.

Implementability: Design and construction of a groundwater pumping system and treatment plants at the individual properties would be feasible. However, administrative monitoring and controlling of five different treatment plants is very difficult and resource intensive. Pumping techniques have been demonstrated to be reliable and effective in controlling migration and collecting groundwater. Treatment units could be obtained through commercial vendors, and these technologies are well developed. Therefore, the implementability of this alternative is very high with respect to technical feasibility, reliability, and availability. Monitoring and maintenance would be required during the operation of the pumping and treatment systems. As with other groundwater treatment alternatives, this pump and treat system would be expected to require long term management to remove and treat all contaminated groundwater on-site to desired concentration levels. This alternative would require institutional management for the long term monitoring, operations and maintenance activities.

Cost: Capital cost for this alternative is estimated at $4.2 million. The annual operations and maintenance cost is estimated to be 4.0 million dollars. The present worth cost for this alternative would be approximately $65.7 million based on 5% interest rate and a 30 year remediation period for the source areas. For cost evaluation purposes the central area remediation (22 years) is assumed at occur at no additional cost.

Summary: The proposed individual source treatment plants would essentially remove all volatile organics, as well as iron and manganese from the groundwater. This alternative would result in a reduction of toxicity, mobility, and volume of contaminants. It would be relatively easy to implement. The alternative would involve secondary waste management considerations. The proposed system does not include direct pumping and treatment of the aquifer in the central area and only slow remdiation would occur in this area. Therefore this alternative does not achieve all of the remedial response objectives established for the site.

- Conclusion: This altenative is retained for detailed evaluation.

3.2.5 Alternative MOM-2A (ii): Pretreatment and Air Stripping at a Central Treatment Plant

Key Components:

- This alternative would be essentially the same as MOM-2A (i) except that there is one central treatment plant only
- Pumping wells would be located at each of the individual properties
- Pumping systems would include wells, pipes and pumps
- Groundwater would be pumped to a central treatment plant where it would be pretreated to remove metals and then air stripped to remove volatile organics
- The treatment plant would be located in the general area of the abandoned Wells G and H with the exact location to be determined in design.
- Collection of emissions from the air stripper and pretreatment system would be accomplished by using vapor phase carbon adsorption

- In situ regeneration of vapor phase carbon would be accomplished using a thermal regeneration system

- Pretreatment sludge would be disposed at an off-site location

- Treated water would be discharged to the Aberjona River.

Screening Evaluation

Effectiveness: This alternative would reduce the toxicity, mobility, and volume of contaminants similar to Alternative 2A (i) Under this alternative source areas would be pumped for approximately 20-50 years with the objective of remediating groundwater to MCLs (see Appendix C). Pumping at the Riley well and natural attenuation are anticipated to remediate the central area to MCLs over an anticipated total period of approximately 22 years assuming no additional contamination (see Appendix C). Long term bedrock pumping may be needed after the projected 20-50 year overburden restoration period (at each source area) if monitoring indicates that contaminants (including dense non-aqueous phase liquids-DNAPLs) continue to migrate from the bedrock to the overburden.

Groundwater transfer pipelines would have to cross the environmentally sensitive areas such as wetlands. However, care would be taken to minimize any damage to the environment. Upon completion, this remedial action would protect public health and the environment by reducing contamination in groundwater to MCLs eventually and by controlling migration.

Implementability: The construction of one large centralized treatment plant would be generally simpler and easier than the construction of five separate plants. A central treatment plant would require a piping transmission system with construction of longer pipelines and higher pumping pressure. The construction of the piping transmission system could encounter more problems than that required for separated plants due to the river and road crossings and the need to pipe contaminated groundwater across the wetland areas.

This alternative would be easier to operate and maintain than MOM 2A(i) since only one treatment plant instead of five would have to be maintained. Administrative monitoring of one central treatment plant would be easier than for five plants. Long term bedrock pumping might be needed after 20-50 years as discussed previously.

Cost: The preliminary cost estimates indicate that a central treatment plant would require relatively lower capital cost and lower annual operations and maintenance cost than required for Alternative 2A (i) - separate treatment plants. Capital costs for this alternative are estimated at $3.3 million. The annual operations and maintenance cost is estimated to be $1.5 million at 5% over a 30 year period. The present worth of this alternative is approximately $26.4 million.

Summary: This alternative appears to be more cost effective and administratively more efficient than Alternative 2A (i) and provides essentially the same degree of effectiveness. Implementability may be more difficult due to potential construction and environmental problems in the wetlands. The alternative would provide a centralized control for the operation and maintenance of the groundwater pumping and treatment system. No direct pumping and treatment is provided for the aquifer in the central area resulting in a longer remediation period in this area. Therefore, similar to Alternative MOM 2A(i) this alternative does not achieve all of the remedial objectives established for the site, however, it will significantly reduce the toxicity, mobility and volume of contamination in the aquifer.

- Conclusion: This alternative is retained for detailed evaluation.

3.2.6 Alternative MOM-2B (i): Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants

Key Components:

- Pumping systems which would include wells, pipes and pumps
- Treatment of groundwater would include using pretreatment to remove metals and UV/chemical oxidation to remove volatile organics. There will be five separate treatment plants
- Collection of potential volatile organic emissions from the pretreatment system would be accomplished using vapor phase carbon adsorption
- In situ regeneration of vapor phase carbon would be accomplished using a thermal regeneraton system
- Treated water would be discharged into Aberjona River

Screening Evaluation

Effectiveness: The effectiveness of this alternative would be similar to MOM-2A(i). Under this alternative source areas would be pumped for 20-50 years with the objective of remediating

groundwater to MCLs, (see Appendix C). Pumping at the Riley well and natural attenuation are anticipated to remediate the central area to MCLs over a period of approximately 22 years assuming no additional contamination (see Appendix C). Long term bedrock pumping may be needed after the projected 20-50 year overburden restoration period (at each source area) if monitoring indicates that contaminants (including dense non-aqueous phase liquids-DNAPLs) continue to migrate from the bedrock to the overburden.

On-site workers, the public and the environment would be protected during the implementation of this alternative. This groundwater restoration alternative would protect public health and the environment by reducing contamination in groundwater to MCLs eventually, and by controlling migration.

Implementability: This alternative requires an ultraviolet light system and a chemical feed system for hydrogen peroxide, and may require additional power to be brought to the site. The UV/chemical oxidation system is an innovative technology and is commercially available from only a very limited number of vendors. The UV/chemical oxidation system has been demonstrated to provide a cost-effective destruction of low concentration volatile organics in aqueous waste. However, for a high concentration of VOCs (higher than 5 ppm) contaminated groundwater, multiple stages, or a longer reaction time would be required. Design and construction of this groundwater pumping and treatment system at the site would be feasible, but the reliability and availability are uncertain due to lack of data on full scale operations and the limited number of vendors.

Cost: The cost for this alternative, particularly for the chemical requirements and the necessary electric power are very sensitive to contaminant concentrations. The capital cost for this alternative is estimated at 5.7 million dollars while annual operations and maintenance costs are estimated to be 5.5 million dollars. The present worth of this alternative is approximately 90.2 million dollars based on a 5% interest rate and a 30 year period of operation.

Summary: The UV/chemical oxidation technology is a developing innovative technology with a relatively new application to hazardous waste treatment. This alternative would be expected to attain treatment objectives. The O&M costs are relatively high compared to the other available technologies. As with other MOM-2 alternatives, no direct pumping and treatment of the aquifer in the central area would occur. Therefore, this alternative would not achieve MCLs in this area in a rapid time frame.

- Conclusion: This alternative is retained for detailed evaluation.

3.2.7 Alternative MOM-2B (ii): Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

Key Components:

- A pumping system which would include wells, pipes and pumps
- Treatment of groundwater at one central treatment plant would include using pretreatment to remove metals and UV/chemical oxidation to remove volatile organics
- Collection of potential volatile organic emissions from pretreatment would be accomplished using vapor phase carbon adsorption
- In situ regeneration of vapor phase carbon would be accomplished using a thermal regeneration system
- Pretreatment sludge would be disposed at an off-site location
- Treated water would be discharged into the Aberjona River

Screening Evaluation

Effectiveness: This alternative would reduce toxicity, mobility, and volume of contaminants similar to Alternative MOM-2B (i). As with the preceding MOM-2 alternatives, source areas would be pumped for 20-50 years with the objective of remediating groundwater to the MCLs within this time frame. The groundwater collection and transfer system would have a higher potential for adverse environmental impacts than the individual source area treatment alternatives because force mains would need to be constructed across the Aberjona river and wetlands. Long term pumping of residual contamination in the bedrock may be required after the estimated 20-50 year remediation period.

Implementability: As discussed in Section 3.2.5, (Alternative MOM-2A (ii)), the construction of one large centralized treatment plant is generally simpler and easier than the construction of five separate plants. A central treatment plant would require a piping transmission system with construction of longer pipelines and higher pumping pressure. The construction of the piping transmission system could, however, encounter problems due to the river and road crossings and the need to pump contaminated groundwater across the wetland areas.

Administratively, this alternative would be easier to operate and maintain and monitor since only one treatment plant instead of five would have to be maintained. Long term bedrock pumping may be needed after 20-50 years as discussed previously.

Cost: The capital cost for this alternative is estimated at $3.8 million. Annual operations and maintenance cost is estimated to be $2.5 million. The present worth for this alternative is approximately $42.2 million. These estimates are based on a 5% interest rate and a 30 year period of remediation.

Summary: The UV/chemical oxidation technology is a developing innovative technology with a relatively new application to hazardous waste treatment. This alternative would be expected to attain treatment objectives although O&M costs are expected to be relatively high. This alternative would provide centralized control for the operation and maintenance of the groundwater pumping and treatment system. It would result in control of contaminant migration as well as reduction of toxicity and volume. No direct pumping and treatment is provided for the aquifer in the central area.

- Conclusion: This alternative is retained for detailed evaluation.

3.2.8 Alternative MOM-2C (i): Pretreatment and Carbon Adsorption at Separate Treatment Plants

Key Components:

- Pumping systems which would include wells, pipes and pumps
- Treatment of groundwater using pretreatment to remove metals and carbon adsorption to remove volatile organics. There will be five separate treatment plants
- Regeneration of spent granular carbon and disposal of pretreatment sludge at an off-site treatment facility
- Treated water would be discharged to the Aberjona River

Screening Evaluation

Effectiveness: Under expected operating conditions, activated carbon adsorption would not be as effective as air stripping or UV/chemical oxidation for treating high concentration volatile organics in the contaminated groundwater. Activated carbon adsorption may not yield an effluent that would meet the MCLs nor provide consistent protection to public health and the environment, nor consistently reduce the toxicity, mobility, and volume of the contaminants. Long term bedrock pumping may be required as discussed previously.

Implementability: The groundwater pumping techniques are reliable and effective for collecting groundwater from the overburden aquifer. The underlying fractured bedrock is non-homogeneous and the extraction efficiency of the pumping system for it is uncertain. In general, carbon adsorption is a widely used and proven technology for relatively low concentrations of volatile organics. The carbon adsorption

process is not well-suited for high concentrations of volatile organics as a primary treatment process, particularly at the Wildwood Property due to the following operation and maintenance difficulties:

- Activated carbon has a relatively low capacity to adsorb volatile organics;

- The process operation requires frequent replacement of spent activated carbon; and

- There is a high potential for carbon filter breakthrough resulting in inadequate treatment.

Carbon adsorption systems are commercially available for system implementation. Long-term monitoring and maintenance would be required during the operation of pumping and treatment systems. Spent carbon and pretreatment sludge would be removed for off-site regeneration/disposal. This alternative would also require institutional administration and management for long-term operation and maintenance activities.

Cost: Capital cost for this alternative is estimated at 4.4 million dollars while annual operations and maintenance cost is estimated to be 4.7 million dollars. The present worth for this alternative would be approximately 76.7 million dollars based on a 5% interest rate for a 30 year period.

Summary: Activated carbon adsorption would not be as effective as air stripping or UV/chemical oxidation for the high concentrations of volatile organics in site groundwaters, and would require frequent replacement of spent carbon with significant operations and maintenance difficulties. This alternative would have relatively lower reliability for achieving consistent effluent concentrations.

- o Conclusion: This alternative is eliminated from detailed evaluation.

3.2.9 Alternative MOM-2C (ii): Pretreatment and Carbon Adsorption at a Central Treatment Plant

Key Components:

- o A pumping system which includes wells, pipes and pumps

- o Treatment of groundwater using pretreatment to remove metals and carbon adsorption to remove volatile organics. There would be one central treatment plant

- o Regeneration of spent granular carbon and disposal of pretreatment sludge at an off-site treatment facility

- Collection of potential volatile organic emissions from the pretreatment system would be accomplished using vapor phase carbon adsorption

- In situ regeneraton of vapor phase carbon using a thermal regeneration system

- Treated water would be discharged to the Aberjona River

Screening Evaluation:

Effectiveness: As discussed in Alternative MOM-2C (i), the carbon adsorption system may not be reliable for treating the groundwater from highly contaminated source areas for volatile organics. The system may not produce treated water that meets the surface water discharge requirements, not adequately reduce the toxicity, mobility, and volume of volatile organics from the source areas. Adequate protection would be provided to on-site workers, the public and the environment during the implementation of this alternative. However, this alternative would not provide consistent long-term protection to public health or the environment.

Implementability: The central carbon adsorption treatment plant would simplify the general operation and maintenance in one plant, and the technology is readily available, but it would not significantly change the treatment processes and effluent quality compared with Alternative MOM-2C(i). This alternative would not be considered highly feasible as a primary treatment process for high concentrations of volatile organics. Also this system is not highly reliable in view of the operations and maintenance requirements as discussed in Alternative MOM-2C (i).

Cost: Capital cost for this alternative is estimated at $3.3 million while annual operations and maintenance cost is estimated to be $2.0 million. The present worth for this alternative is approximately $34.0 million based on a 5% interest rate for a 30 year period.

Summary: This alternative would have relatively low effectiveness and reliability in treating the groundwater from source areas highly contaminated with volatile organics.

- Conclusion: This alternative is eliminated from detailed evaluation.

3.2.10 Alternative MOM-3: Pump and Treat the Central Area

Key Components:

- Pump groundwater at Wells G and H

- Treatment of groundwater at a central treatment plant using one of the three treatment schemes (i.e. MOM-3A Pretreatment and air stripping, MOM-3B pretreatment and UV/chemical oxidation or MOM-3C pretreatment and carbon adsorption)

- Disposal of pretreatment sludge at an off-site location

- Collection of potential volatile organic emissions from pretreatment system would be accomplished using vapor phase carbon adsorption

- In situ regeneration of vapor phase carbon using a thermal regeneration system

- Discharge of treated water to Aberjona River

Screening Evaluation

Effectiveness: This alternative would require construction of one treatment plant. The three groundwater treatment technologies discussed in previous sections (Alternative MOM-2A (i) pretreatment and air stripping, MOM-2B, (i) pretreatment and UV/chemical oxidation, and MOM-2C (i) pretreat and carbon adsorption) are generally applicable for this alternative. The groundwater in the central area contains approximately 155 ppb of VOCs which is much lower than the concentrations at the source areas which range from approximately 195 to 52,255 ppb. All three treatment schemes are effective and reliable for removing the low concentration VOCs. Therefore, the three pump and treat alternatives, (MOM-3A, MOM-3B and MOM-3C) would provide:

- Treated water that meets surface water discharge (AWQC) requirements;

- Reduction of the toxicity, mobility, and volume of contaminants; and

- Protection of public health and the environment.

Workers and community would require protection during construction. Under this alternative the entire site would be pumped for in excess of 60 years from the central area location of Wells G and H (see Appendix C). No direct pumping of the source areas or the bedrock in the source areas would occur. Based on the calculations of Appendix C a time frame of in excess of 60 years would be required to achieve MCLs throughout the site. In addition, the migration of contaminants from the source areas to the aquifer in the central area would result in only very slow remediation in this area.

Implementability: Wells G and H were pumped for a total of approximately 1,200 gpm for water supply service prior to their contamination. Since this total pumping rate has been proven and demonstrated, there should be no problem in pumping 540 gpm from the central area at Wells G and H. There appears to be sufficient land area available at the center of the site for construction of the groundwater treatment plant.

Because the treatment technologies with the exception of UV/chemical oxidation are all conventional treatment technologies, the feasibility, reliability, and availability are high. These alternatives have been well demonstrated. No major problems related to installation, operations, and maintenance are expected to be encountered during the implementation of this alternative. The UV/chemical oxidation technology is considered innovative because it has not been proven at Superfund sites. It would also require significantly more electrical power than the other treatment systems.

Cost: The estimated capital, operations, and maintenance costs and the associated present worth for Alternatives MOM-3A, 3B, and 3C are presented below:

Alternative	Capital Costs x 10^6	Annual Operations and Maintenance Costs x 10^6	Present Worth x 10^6
MOM-3A	2.2	1.8	29.1
MOM-3B	2.3	2.8	44.6
MOM-3C	2.0	2.5	40.4

The present worth figures were estimated based on a 5% interest rate over a 30 year period of operation. As in the other alternatives, the air stripping alternative has the lowest present worth and the UV/chemical oxidation has the highest present worth. However, these differential costs are within the cost estimate accuracy guidelines of -50% to +100% for alternatives screening.

Summary: Since the groundwater in the central area is contaminated with low concentrations of volatile organics, all three treatment technologies (air stripping, UV/chemical oxidation, and carbon absorption) are effective and implementable. The anticipated remediation time for aquifer at the site to achieve MCLs is in excess of 60 years. In addition the effectiveness of these alternatives in remediating the bedrock aquifer is very uncertain. Therefore, these alternatives would not meet all of the remedial objectives established for the site.

- These alternatives are retained for detailed evaluation.

3.2.11 Alternative MOM-4: Pump and Treat at the Source Areas and the Central Area

Key Components:

- This alternative combines Alternative MOM-2 and MOM-3 for simultaneous pumping and treatment of both source areas and the central area.

- As shown in Table 3-4 this alternative consists of six alternatives based on the groundwater treatment schemes A) air stripping B) UV/chemical oxidation and C) carbon adsorption and the two treatment plant location options i) separate treatment plants or ii) a central treatment plant

- The treated water would be discharged to the Aberjona River.

Effectiveness: This group of alternatives would simultaneously pump and treat all contaminated groundwater from both source areas and the central site area, and would be the most effective alternative to expedite the groundwater restoration for both overburden and bedrock aquifers. Under this alternative the central area of the site would be pumped for 10 years and the source areas for 20-50 years with objective of achieving MCLs (see Appendix C). Some uncertainty does exist regarding the effectiveness of remediation in the bedrock. This approach does, however provide a larger capture area for contaminated groundwater than the MOM-2 or MOM-3 alternatives and would also be the most effective alternative to prevent any further downgradient migration of contaminants. In general, the effectiveness of pumping at the sources and in the central area would be greater than the individual alternatives and would more quickly attain the remedial response objectives throughout the overburden and bedrock aquifers.

The effectiveness of separate treatment plant alternatives (MOM-2A (i), MOM-2B (i) and MOM-2C (i)) discussed in previous sections are applicable to alternative MOM-4A (i), MOM-4B (i), and MOM-4C (i), respectively. The individual treatment alternatives of air stripping and UV/chemical oxidation are feasible and effective for the site management of migration, but the separate carbon adsorption treatment plant alternative (MOM-4C (i)) would not be effective or reliable for treating the source areas contaminated with high level VOCs (as discussed in alternative MOM-2C (i)).

Since the combined groundwater from the source areas and the central area could contain a high level of VOCs (approximately 15,160 ppb), the central carbon adsorption treatment plant, alternative MOM-4C (ii) would not be effective. All of the remaining four alternatives (MOM-4A (i), 4A (ii), 4B (i), and 4B (ii) would provide:

- A reduction of toxicity, mobility and volume of contaminants to MCLs; and

- Protection of public health and the environment.

Implementability: The implementability of this alternative (pump and treat at the sources and in the central area) is essentially the same as alternatives MOM-2 and MOM-3 which include the same pumping and treatment technologies. As discussed in the previous sections, the implementability of this alternative could be summarized as follows:

1. Air stripping is a conventional treatment technology and is commercially available. Feasibility, reliability, and availability for this alternative would be generally high.

2. The UV/chemical oxidation technology has been demonstrated for volatile organic destruction. Its availability would be relatively low and would be limited to a few vendors.

3. The feasibility and reliability of carbon adsorption in treating high level VOCs (>5000 ppb) would be generally low and would require frequent replacement of spent carbon causing significant operational difficulties.

4. The construction and operation of one large centralized treatment plant would be generally simpler and easier than six separate treatment plants. The design and construction of the groundwater piping systems through wetlands and across the river may present construction problems for a central treatment plant.

Cost: The estimated capital, annual operation and maintenance and associated present worth costs for alternatives MOM-4A (i), MOM-4A (ii), MOM-4B (i), MOM-4B (ii), MOM-4C (i), and MOM-4C (ii) are presented below:

Alternative	Capital Costs x $\$10^6$	Annual Operations and Maintenance Costs x $\$10^6$		Present Worth x $\$10^6$
MOM-4A (i)	7.8	5.8 (1-10 years)	4.0 (11-30 yrs)*	83.2
MOM-4A (ii)	5.1	2.5 (1-10 years)	1.8 (11-30 yrs)*	37.8
MOM-4B (i)	9.1	7.0 (1-10 years)	4.3 (11-30 yrs)*	95.7
MOM-4B (ii)	5.5	4.0 (1-10 years)	3.0 (11-30 yrs)*	59.3
MOM-4C (i)	7.3	6.0 (1-10 years)	4.0 (11-30 yrs)*	84.2
MOM-4C (ii)	5.1	3.0 (1-10 years)	2.0 (11-30 yrs)*	43.5

* O&M cost for source areas once central area is remediated.

The present worth figures were estimated based on a 5% interest rate for 10 years of operation with respect to pumping the central area and 30 years of pumping in the source areas. As with the other alternatives, the air stripping alternatives have the lowest present worth and the UV/chemical oxidation alternatives have the highest present worth. The central treatment plant alternatives have a lower present worth than the separate treatment plant alternatives. However, these differential costs are within an order of magnitude and the cost estimate accuracy of -50% to +100%.

Summary: Four pump and treat alternatives (MOM-4A (i), MOM-4A (ii), MOM-4B (i), and MOM-4B (ii)) under this main alternative would be effective at controlling contaminant migration downgradient by providing good capture of the downgradient migration of contaminants. These alternatives would control the contaminant migration in the fractured bedrock better than the other alternatives. However, alternatives MOM-4C (i) and MOM-4C (ii) would not be as effective because carbon adsorption is not as viable a treatment option at high concentrations of VOCs.

- Conclusion: Retain MOM-4A (i), MOM-4A (ii), MOM-4B (i), and MOM-4B (ii) for detailed evaluation. Eliminate MOM-4C (i) and MOM-4C (ii) from further evaluation.

3.2.12 Alternative MOM-5: Pump and Treat at the Southern Boundary Area

Key Components:

- Pump groundwater using a series of extraction wells at the southern boundary of the site
- Treat water on or near the Wells G and H area
- Treatment would consist of one of the three treatment schemes 1) pretreatment and air stripping 2) pretreatment and UV/chemical oxidation 3) pretreatment and carbon adsorption
- Disposal of pretreatment sludge at an off-site location
- Collection of potential volatile organic emissions from the pretreatment system would be accomplished using vapor phase carbon adsorption
- In situ regeneration of vapor phase carbon using a thermal regeneration system
- Discharge treated water to the Aberjona River

Effectiveness: These alternatives would require construction of one treatment plant. Protection of workers and the community would be required during construction. This group of alternatives would control the migration of contaminants downgradient of the site by intercepting the groundwater contamination and treating it prior to discharge to the river. Treatment would result in reduction of toxicity, volume and mobility of contaminants. These alternatives would be expected to meet required treatment efficiencies, but their effectiveness in controlling the contamination in the fractured bedrock is uncertain. These alternatives would require a lower pumping rate of approximately 500 gpm from a series of six wells. The groundwater contaminant concentrations would be initially low but would increase with time as the contaminants migrate to the extraction wells.

The effectiveness of this group of alternatives would be relatively low when compared with the other alternatives based on the following reasons:

1. These alternatives would not provide an effective groundwater restoration alternative because some contaminants might discharge to the river upstream from the line of pumping wells and ultimately migrate off-site . Also this approach would require a very long remediation period (greater than 100 years) to attain MCLs throughout the aquifer. Thus, these alternatives (MOM-5A, MOM-5B, and MOM-5C) would not achieve all of the remedial response objectives established for the site.

2. These pump and treat alternatives would not create a large cone of depression to actively extract contaminants, but would mainly depend on the natural migration of contaminants, i.e., from the source areas to the central area and then downgradient of the central area. Based on the site hydrogeological conditions, this alternative would intercept the overburden aquifer flow, but would not control the contaminant migration in the bedrock aquifer.

Implementability: The implementability of these alternatives including MOM-5A pretreatment and air stripping, MOM-5B pretreatment and UV/chemical oxidation, and MOM-5C pretreatment and carbon adsorption would be similar to alternatives MOM-3A, MOM-3B, and MOM-3C, respectively. These alternatives are implementable at the site and the treatment schemes have been previously demonstrated and proven for the contaminants present. The pumping and treatment facilities are commercially available. The availability of UV/chemical oxidation systems is limited to a few vendors. The availability of land for pumping and the treatment plant would need to be determined. Sufficient land exists within the site for location of the treatment plant.

Cost: The estimated capital, operation and maintenance cost and associated present worth figures for alternatives MOM-5A, MOM-5B, and MOM-5C are presented below:

Alternative	Capital Costs x $\$10^6$	Annual Operations and Maintenance Costs x $\$10^6$	Present Worth x $\$10^6$
MOM-5A	2.0	1.5	25.1
MOM-5B	2.1	2.5	40.5
MOM-5C	1.9	2.0	32.6

The present worth costs were estimated based on a 5% interest rate over a 30 year period of operation. As with the other alternatives, the air stripping alternative has the lowest present worth and the UV/chemical oxidation alternative has the highest present worth. However, these differential costs are within the cost estimate accuracy of -50% to +100%.

Summary: These alternatives, including MOM-5A, MOM-5B and MOM-5C, do not provide an effective groundwater restoration alternative to meet the response objectives. It would require a significantly longer time frame than the other alternatives. This alternative would be effective for controlling downgradient contaminant migration in the overburden. However, its effectiveness for remediating contaminants in the fractured bedrock would be highly uncertain.

- Conclusion: Eliminated from detailed evaluation.

3.2.13 Summary of Management of Migration Alternative Screening

Based on the results of the initial screening discussed above, Alternatives MOM-2C(i), MOM-2C(ii), MOM-4C(i), MOM-4C(ii), MOM-5A, MOM-5B and MOM-5C have been eliminated from further consideration. All other alternatives, i.e., MOM-1, MOM-2A(i), MOM-2A(ii), MOM-2B(i), MOM-2B(ii), MOM-3A, MOM-3B, MOM-3C, MOM-4A(i), MOM-4A(ii), MOM-4B(i) and MOM-4B(ii) are retained for the detailed evaluation of remedial alternatives in Section 4.0 of this report. Table 3-6 presents a summary of the cost breakdown for these alternatives.

3.3 SUMMARY OF INITIAL SCREENING OF REMEDIAL ALTERNATIVES

A total of 11 Source Control and 19 Management of Migration alternatives have been screened and 9 Source Control and 12 Management of Migration Alternatives will be retained for detailed analysis in Section 4.0. Table 3-7 presents a listing of the remedial alternatives that were evaluated in the initial screening and indicates those that are retained for the detailed analysis.

TABLE 3-6

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL MANAGEMENT OF MIGRATION ALTERNATIVES

Potential Management of Migration Alternatives	Major Remediation Components	Capacity	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
1. MOM-1 No Action	1. Sampling Monitoring and Reporting		0	25,000 (1-30 years)
2. MOM-2 Pump and Treat Source Areas				
2a. MOM-2A (i) Pretreatment and Air Stripping at Separate Treatment Plants	1. Collection	Total 516 gpm*	800,000	
	2. Pretreatment		2,000,000	
	3. Air Stripping and Vapor Phase Activated Carbon Adsorption		1,300,000	
	4. Control Buildings		144,000	
		Total	4,244,000	4,000,000 (1-30 years)
2b. MOM-2A(ii) Pretreatment and Air Stripping at Central Treatment Plant	1. Collection	516 gpm	1,313,000	
	2. Pretreatment		1,030,000	
	3. Air Stripping and Vapor Phase Activted Carbon Adsorption		500,000	
	4. Control Building		450,000	
		Total	3,293,000	1,500,000 (1-30 Years)
2c. MOM-2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants	1. Collection	Total 516 gpm*	800,000	
	2. Pretreatment		2,000,000	
	3. Chemical Oxidation and Vapor Phase Carbon Adsorption		1,720,000	
	4. Control Building and Utilities		1,144,000	
		Total	5,664,000	5,500,000 (1-30 years)
2d. MOM-2B(ii) Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	1. Collection	516 gpm	1,313,000	
	2. Pretreatment		1,030,000	
	3. Chemical Oxidation and Vapor Phase Carbon Adsorption		700,000	
	4. Control Building and Utilities		750,000	
		Total	3,793,000	2,500,000 (1-30 years)

* 516 gpm = 300 gpm (Wildwood) + 50 gpm (Olympia) + 65 gpm (W.R.Grace) + 80 gpm (Unifirst) + 21 gpm (New England Plastics)

TABLE 3-6 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL MANAGEMENT OF MIGRATION ALTERNATIVES

Potential Management of Migration Alternatives	Major Remediation Components	Capacity	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
2e. MOM-2C(i) Pretreatment and Carbon Adsorption at Separate Treatmenat Plants	1. Collection	Total 516 gpm*	800,000	
	2. Pretreatment		2,000,000	
	3. Carbon Adsorption (Liquid & Vapor)		1,500,000	
	4. Control Building		144,000	
		Total	4,444,000	4,700,000 (1-30 years)
2f. MOM-2C(ii) Pretreatment and Carbon Adsorption at Central Treatment Plant	1. Collection	516 gpm	1,313,000	
	2. Pretreatment		1,030,000	
	3. Carbon Adsorption (Liquid & Vapor)		470,000	
	4. Control Building		450,000	
		Total	3,263,000	2,000,000 (1-30 years)
3. MOM-3 Pump and Treat Central Area				
3a. MOM-3A Pretreatment and Air Stripping at Central Treatment Plant	1. Collection	540 gpm	141,000	
	2. Pretreatment		1,075,000	
	3. Air Stripping and Vapor Phase Carbon Adsorption		500,000	
	4. Control Building		450,000	
		Total	2,166,000	1,750,000 (1-30 years)
3b. MOM-3B Pretreatment and U/V Chemical Oxidation at Central Plant	1. Collection	540 gpm	141,000	
	2. Pretreatment		1,075,000	
	3. UV/Chemical Oxidation and vapor phase carbon adsorption		420,000	
	4. Control Building and Utilities		650,000	
		Total	2,286,000	2,750,000 (1-30 years)
3c. MOM-3C Pretreatment and Carbon Adsorption at Central Treatment Plant	1. Collection	540 gpm	141,000	
	2. Pretreatment		1,075,000	
	3. Carbon Adsorption (Liquid & Vapor)		320,000	
	4. Control Building		450,000	
		Total	1,986,000	2,500,000 (1-30 years)

TABLE 3-6 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL MANAGEMENT OF MIGRATION ALTERNATIVES

Potential Management of Migration Alternatives	Major Remediation Components	Capacity	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
4. MOM-4 Pump and Treat Source Areas and Central Area				
4a. MOM-4A(i) Pretreatment and Air Air Stripping at Separate Treatment Plant	1. Collection	Total 1,056 gpm**	900,000	
	2. Pretreatment		3,000,000	
	3. Air Stripping and Vapor Phase Carbon Adsorption		1,950,000	
	4. Control Building		1,930,000	
		Total	7,780,000	5,750,000 (1-10 years) 4,000,000 (11-30 years)***
4b. MOM-4A(ii) Pretreatment and Air Stripping at Central Treatment Plant	1. Collection	1,056 gpm	1,450,000	
	2. Pretreatment		1,830,000	
	3. Air Stripping and Vapor Phase Carbon Adsorption		990,000	
	4. Control Building		790,000	
		Total	5,060,000	2,500,000 (1-10 years) 1,750,000 (11-30 years)***
4c. MOM-4B(i) Pretreatment and UV/ Chemical Oxidation at Separate Treatment Plants	1. Collecton	Total 1,056 gpm**	900,000	
	2. Pretreatment		3,300,000	
	3. UV/Chemical Oxidation and Vapor Phase Carbon Adsorption		2,140,000	
	4. Control Building and Utilities		3,070,000	
		Total	9,110,000	7,000,000 (1-10 years) 4,250,000 (11-30 years)***
4d. MOM-4B(ii) Pretreatment and UV/ Chemical Oxidation at Central Treatment Plant	1. Collection	1,056 gpm	1,450,000	
	2. Pretreatment		1,830,000	
	3. UV/Chemical Oxidation and Vapor Phase Carbon Adsorption		1,400,000	
	4. Control Building and Utilities		790,000	
		Total	5,470,000	4,000,000 (1-10 years) 3,000,000 (11-30 years)***

** 1056 gpm = 300 gpm (Wildwood) + 50 gpm (Olympia) + 65 gpm (W.R.Grace) + 80 gpm (Unifirst) + 21 gpm (New England Plastics)+ 540 gpm (Central Area)

***O&M is reduced after central area is remediated after 10 years.

TABLE 3-6 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL MANAGEMENT OF MIGRATION ALTERNATIVES

Potential Management of Migration Alternatives	Major Remediation Components	Capacity	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
4e. MOM-4C(i) Pretreatment and Carbon Adsorption at Separate Treatment Plants	1. Collection	Total 1,056 gpm**	900,000	
	2. Pretreatment		3,000,000	
	3. Carbon Adsorption (Liquid & Vapor)		1,450,000	
	4. Control Building		1,930,000	
		Total	7,280,000	6,000,000 (1-10 years) 4,000,000 (11-30 years)***
4f. MOM-4C(ii) Pretreatment and Carbon Adsorption at Central Treatment Plants	1. Collecton	1,056 gpm**	1,450,000	
	2. Pretreatment		1,830,000	
	3. Carbon Adsorption (Liquid & Vapor)		1,000,000	
	4. Control Building		790,000	
		Total	5,070,000	3,000,000 (1-10 years) 2,000,000 (11-30 years)***
5. MOM-5 Pump and Treat Southern Boundary Area				
5a. MOM-5A Pretreatment and Air Stripping at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. Air Stripping and Vapor Phase Carbon Adsorption		450,000	
	4. Control Building		410,000	
		Total	2,010,000	1,500,000
5b. MOM-5B Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. UV/Chemical Oxidation and Vapor Phase Carbon Adsorption		380,000	
	4. Building Control and Utilities		610,000	
		Total	2,140,000	2,500,000
5c. MOM-5C Pretreatment and Carbon Adsorption at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. Carbon Adsorption (Liquid & Vapor)		290,000	
	4. Building Control		410,000	
		Total	1,850,000	2,000,000

** 1056 gpm = 300 gpm (Wildwood) + 50 gpm (Olympia) +65 gpm (W.R.Grace) + 80 gpm (Unifirst) + 21 gpm (New England Plastics) + 540 gpm (Central Area)
***O&M is reduced after central area is remediated after 10 years.

8498b

TABLE 3-6 (Cont'd)

PRELIMINARY CONCEPTUAL COST ESTIMATION OF POTENTIAL MANAGEMENT OF MIGRATION ALTERNATIVES

Potential Management of Migration Alternatives	Major Remediation Components	Capacity	1988 Dollars Capital Cost	1988 Dollars Annual O&M Cost
4e. MOM-4C(i) Pretreatment and Carbon Adsorption at Separate Treatment Plants	1. Collection	Total 1,056 gpm**	900,000	
	2. Pretreatment		3,000,000	
	3. Carbon Adsorption (Liquid & Vapor)		1,450,000	
	4. Control Building		1,930,000	
		Total	7,280,000	6,000,000 (1-10 years) 4,000,000 (11-30 years)***
4f. MOM-4C(ii) Pretreatment and Carbon Adsorption at Central Treatment Plants	1. Collecton	1,056 gpm**	1,450,000	
	2. Pretreatment		1,830,000	
	3. Carbon Adsorption (Liquid & Vapor)		1,000,000	
	4. Control Building		790,000	
		Total	5,070,000	3,000,000 (1-10 years) 2,000,000 (11-30 years)***
5. MOM-5 Pump and Treat Southern Boundary Area				
5a. MOM-5A Pretreatment and Air Stripping at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. Air Stripping and Vapor Phase Carbon Adsorption		450,000	
	4. Control Building		410,000	
		Total	2,010,000	1,500,000
5b. MOM-5B Pretreatment and UV/ Chemical Oxidation at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. UV/Chemical Oxidation and Vapor Phase Carbon Adsorption		380,000	
	4. Building Control and Utilities		610,000	
		Total	2,140,000	2,500,000
5c. MOM-5C Pretreatment and Carbon Adsorption at Central Treatment Plant	1. Collection	500 gpm	170,000	
	2. Pretreatment		980,000	
	3. Carbon Adsorption (Liquid & Vapor)		290,000	
	4. Building Control		410,000	
		Total	1,850,000	2,000,000

** 1056 gpm = 300 gpm (Wildwood) + 50 gpm (Olympia) +65 gpm (W.R.Grace) + 80 gpm (Unifirst) + 21 gpm (New England Plastics) + 540 gpm (Central Area)

***O&M is reduced after central area is remediated after 10 years.

8498b

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

This section presents a detailed evaluation of each remedial alternative listed in Table 4-1 that passed the initial screening in Section 3.0.

This detailed analysis of alternatives consists of the following components and processes:

- Further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies.

- Assessment and summary of each alternative against the nine evaluation criteria as defined by OSWER Directive No. 9355.0-21.

- Comparative analysis among alternatives to assess the relative performance of each alternative with respect to each evaluation criterion.

The detailed description of each remedial alternative emphasizes the technology used, specific components, and (where appropriate) preliminary sizing. Anticipated work activities are also summarized and, when applicable, figures depict the alternative or components. The remedial alternatives are examined with respect to requirements stipulated in CERCLA as amended, OSWER Directive No. 9355.0-19 ("Interim Guidance on Superfund Selection of Remedy", December 24, 1986), statutory factors described in OSWER Directive No. 9355.0-21 ("Additional Interim Guidance for FY'87 Records of Decision", July 24, 1987) and the March 1988 Draft FS Guidance. Each remedial alternative is evaluated with respect to the nine criteria for evaluating alternatives, as described in the following sections. At the completion of all detailed analyses, a summary section is included, whereby the statutory factors and criteria described in OSWER Directive No. 9355.0-21 and the March 1988 FS Guidance are reviewed for each alternative to assist in the remedy selection process.

4.2 ALTERNATIVE ANALYSIS

The criteria developed to address the CERCLA/SARA requirements and statutory considerations and which are used to evaluate the alternatives are:

- Short-term effectiveness
- Long-term effectiveness and permanence

TABLE 4-1

LIST OF ALTERNATIVES FOR DETAILED ANALYSIS

Source Control Alternatives (SC)

SC-1	No Action (Source Control)
SC-3	Excavation/On-Site Incineration/Backfill On-Site
SC-4	Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
SC-5	Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site
SC-7	Excavation/On-Site Supercritical Fluid Extraction/ Backfill On-Site
SC-8	Excavation/On-Site Enhanced Volatilization/On-Site Incineration/Backfill On-Site
SC-9	Excavation/On-Site Enhanced Volatilization/Off-Site Incineration/Backfill With Treated and Clean Off-Site Soil
SC-10	In Situ Volatilization/Excavation/On-Site Incineration/ Backfill On-Site
SC-11	In Situ Volatilization/Excavation/Off-Site Incineration/ Backfill With Clean Off-Site Soil

Management of Migration Alternatives (MOM)

MOM-1	No Action (Management of Migration)
MOM-2	Pump and Treat Source Areas
-2A(i)	Pretreatment and Air Stripping at Separate Treatment Plants
-2A(ii)	Pretreatment and Air Stripping at a Central Treatment Plant
-2B(i)	Pretreatment and UV/Chemical oxidation at Separate Treatment Plants
-2B(ii)	Pretreatment and UV/Chemical oxidation at a Central Treatment Plant
MOM-3	Pump and Treat Central Area
-3A	Pretreatment and Air Stripping at Central Treatment Plant

TABLE 4-1 (Cont'd)

LIST OF ALTERNATIVES FOR DETAILED ANALYSIS

-3B	Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant
-3C	Pretreatment and Carbon Adsorption at a Central Treatment Plant
MOM-4	Pump and Treat Source Areas and Central Area
-4A(i)	Pretreatment and Air Stripping at Separate Treatment Plants
-4A(ii)	Pretreatment and Air Stripping at a Central Treatment Plant
-4B(i)	Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
-4B(ii)	Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- State acceptance
- Community acceptance

These analysis criteria serve as the basis for conducting the detailed analyses of alternatives during the FS and for subsequently selecting an appropriate remedial action. The last two criteria, state acceptance and community acceptance will be evaluated by the USEPA in the Record of Decision and not in this document. Each of the remaining seven evaluation criteria is further described below.

Short-Term Effectiveness: This addresses the impacts of the alternative during the construction and implementation phase until remedial response objectives are met. This includes protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts resulting from the implementation, and time required to achieve protection.

Long-Term Effectiveness and Permanence: This addresses the risk remaining at the site after the response objectives have been met. The factors to be evaluated include the magnitude of remaining risk as measured by numerical standards such as cancer risk levels, adequacy and suitability of controls used to manage treatment residuals or untreated wastes, and the long-term reliability of management controls for providing continued protection from residuals, i.e., the assessment of potential failure of the technical components.

Reduction of Toxicity, Mobility or Volume: This examines the ability of the alternative to remove or stabilize the contaminants, reduce the contaminant's mobility, or reduction of total volume of contaminants. The factors to be evaluated include the treatment process employed, the amount of hazardous material destroyed or treated, the degree of reduction in toxicity, mobility, or volume expected, the degree to which treatment is irreversible, and the type and quantity of treatment residuals.

Implementability: This addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The factors used to evaluate technical feasibility include construction and operation difficulties; reliability of technology; ease of undertaking additional remedial action, and the ability to monitor the

effectiveness of the remedy. The factors used to evaluate administrative feasibility include the time required to coordinate with other agencies. The factors used to evaluate availability of services and materials include the availability of treatment, storage, and disposal services with required capacities, the availability of equipment and specialists, and the availability of prospective technologies for competitive bid.

Cost: The cost estimate includes capital costs, operation and maintenance costs, costs of five year reviews where required, and the present worth of capital, O&M, and potential future remedial action costs. Capital costs consist of direct and indirect costs. Direct costs include expenditures for the land and site development, equipment, labor, buildings and services, relocation expenses, disposal, and materials necessary to implement remedial actions. Indirect costs include expenditures for engineering expenses, legal fees, license or permit fees, startup and shakedown, and contingency allowances. Annual O&M costs include operating labor, maintenance materials and labor, auxiliary materials and energy, disposal of residues, purchased services, administrative costs, insurance, taxes and license costs, maintenance reserve and contingency funds, rehabilitation costs, and costs of periodic site reviews.

The costs of remedial alternatives are reported on the basis of present worth. The present worth analysis allows remedial alternatives to be compared on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. A 30-year performance period is assumed for the No Action baseline comparison present worth which is a function of the discount rate and time. Estimated time frames for site remediation have been used herein in the calculation of present worth costs. A discount rate of 5 percent is used in the calculation. The cost estimate for the alternatives are intended to reflect actual costs with an accuracy of -30 to +50 percent.

A cost sensitivity analysis assesses the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate and effective life of an alternative can have on the estimated cost, if there is sufficient uncertainty concerning specific assumptions. A sensitivity analysis may include risk-based target levels, effective life span, O&M costs, duration of cleanup, volume of contaminated material, size of the treatment system and discount rate. Sensitivity of the costs to target risk levels and duration of cleanup (i.e. aquifer restoration time frame) will be presented.

Compliance with ARARs: Each alternative is examined to see whether or not it will comply with applicable or relevant and appropriate Federal and State requirements (ARARs) as defined in CERCLA Section 121. Each alternative is evaluated for:

- Compliance with chemical-specific ARARs (e.g., MCLs),
- Compliance with action-specific ARARs (e.g., RCRA minimum technology standards),
- Compliance with location-specific ARARs (e.g., preservation of wetlands areas),
- Compliance with appropriate "to be considered" (TBC) criteria, advisories, and guidances, which are not ARARs.

The results of these evaluations are presented in summary tables for both the source control and management of migration alternatives.

Overall Protection of Human Health and the Environment: This evaluation criterion provides an overall assessment of protection, based on a composite of factors and other evaluations such as long-term and short-term effectiveness, and compliance with ARARs. Evaluations of the overall protectiveness address:

- How a specific site alternative achieves protection over time,
- How site risks are reduced (exposure and hazard),
- How each source of contamination is eliminated, reduced, or controlled for each alternative.

Note: In order to assist in differentiating between the various technologies under review with respect to their abilities to achieve target levels, the following qualitative terminology has been utilized.

- The phrase "would achieve" target levels has been applied to treatment technologies for which it is highly probable that target levels would be achieved. For these technologies there is generally demonstrated applicable field data indicating that specific contaminant target levels can be achieved.
- The phrase "is expected to" achieve target levels has been applied to treatment technologies for which it is believed that target levels would be achieved but for which there may currently exist only limited field or laboratory data. For these technologies, additional treatability studies would be required to confirm their ability to achieve target levels.

- The phrase "may" achieve target levels has been applied to treatment technologies for which, due to limited applicable laboratory/field information, substantial uncertainty exists with respect to the ability to achieve target levels (10^{-6}). For these technologies more extensive treatability testing would be required to confirm their ability to achieve target levels.

4.3 SOURCE CONTROL REMEDIAL ALTERNATIVES

Source Control (SC) as discussed in Section 3.0 is the remediation of contaminated soil. Each SC alternative is discussed in a separate subsection of Section 4.4. Each subsection includes a description and evaluation of alternatives relative to the evaluation criteria.

As previously discussed in Section 3, OSWER Directive No. 9355.0-19 recommends the development of SC alternatives ranging from a No Action alternative to alternatives involving treatment technologies to reduce the mobility, toxicity, or volume of contaminants. A No Action (source control) alternative is included in the range of SC alternatives. The range of SC alternatives was initially developed and screened in Section 3.0.

The No Action alternative under Source Control, SC-1, falls at one end of the spectrum of remedial action requiring minimal action. This alternative involves limiting access to the site, conducting public education programs, and instituting site-use restrictions. This alternative does not involve any treatment or containment of contaminated soils. The eight treatment alternatives evaluated include four (4) that use a single treatment technology (i.e., Alternatives SC-3, SC-4, SC-5 and SC-7) and four (4) that use a combination of two treatment technologies (i.e., Alternatives SC-8, SC-9, SC-10 and SC-11). The remedial technology alternatives that include two technologies were developed due to the nature of the contamination present in the soil.

Alternatives SC-3, Excavation/On-site Incineration/Backfill On-Site, and SC-4, Excavation/Off-site Incineration/Backfill with clean off-site Soil, include thermal destruction technologies which eliminate the need for significant long-term management at the site and achieve permanent destruction of contaminants for all the contaminated soil at the various properties. Treated soil would be backfilled on-site. Scrubber water would be disposed of at an off-site facility or be treated on-site. SC-4 would also destroy contaminants, but would require transporting all the contaminated soil to an off-site facility. Alternative SC-5 uses on-site high temperature enhanced volatilization to remove the volatile organics, cPAHs,

PCBs and chlordane from the mixed contaminant soil to an off-gas treatment system. Alternative SC-7 uses Supercritical Fluid Extraction to remove the organic contaminants from soil by chemical extraction.

The remaining alternatives include dual technologies, one for the soils contaminated only with volatile organics (i.e., on-site enhanced or in-situ volatilization) and one for the soils contaminated with some combination of volatile organics, PCBs, cPAHs and chlordane (on-site or off-site incineration). Alternative SC-8, Excavation/On-site Enhanced Volatilization and On-site Incineration, utilizes thermal processes which eliminate the need for significant long-term management at the site and achieve permanent destruction of contaminants. This alternative would treat the contaminated soil areas separately by isolating the soil contaminated with volatile organics only from soil contaminated with mixed contaminants (volatile organics, PCBs, cPAHs and chlordane). The technology used to treat those soils contaminated with volatile organics only would be enhanced volatilization while incineration would be used to treat soils contaminated with mixed contaminants. Alternative SC-9 includes on-site enhanced volatilization and off-site incineration, Alternative SC-10 includes in-situ volatilization and on-site incineration and Alternative SC-11 includes in-situ volatilization and off-site incineration.

4.3.1 Alternative SC-1: No Action (Source Control)

4.3.1.1 Description

Under this alternative, no treatment or containment of contaminated soils will be provided. Long-term groundwater monitoring of the site would be performed to evaluate the performance of this No Action alternative. This would consist of an annual inspection of the site, as well as sampling groundwater and soil every year for 30 years to monitor contaminant concentrations and migration. It is assumed that soil samples would be collected yearly and analyzed for VOCs, cPAHs, PCBs and chlordane. Because this alternative would result in contaminants remaining on-site, CERCLA as amended by SARA requires that the site must be reviewed every five years. If justified by the review, remedial actions may be implemented at that time to remove or treat contaminated soils. Education programs, including public meetings and presentations, may also be undertaken to increase public awareness.

The major work items associated with this No Action alternative are as follows:

- issue institutional controls limiting access and site use, and withdrawal of groundwater for potable and municipal usage,

- conduct site inspection and soil sampling to monitor contaminant concentrations and migration,
- conduct groundwater sampling to monitor contaminant concentrations and migration at downgradient wells,
- conduct educational programs, including public meetings and presentations, to increase public awareness,
- perform site reviews every five years.

For this alternative, volatile organics in the soil would continue to be a source of groundwater contamination. However, other contaminants such as cPAHs, PCBs and chlordane would remain strongly adsorbed to the soil for long periods of time due to their chemical characteristics.

4.3.1.2 Assessment

Short-Term Effectiveness: The No Action alternative would provide only the restriction of site access and use. No substantial construction would be involved. There are no short-term threats to neighboring communities and no significant impacts on public health during the implementation activities. However, wildlife would continue to be exposed to contaminated soil. Workers performing sample collection and site inspection would be exposed to contaminated soil. Workers would require personal protection equipment, and therefore, the risks through direct contact would be minimized. Education programs, including public meetings and presentations, would be undertaken to increase public awareness of the site.

Failure of the alternative to restrict access to the site could result in the exposure to contaminants by the public resulting in excess risk as discussed in Section 1.3 of this report. This alternative would not result in substantial improvement over current conditions. Contaminants such as PCBs, cPAHs and chlordane would persist at the site for many years while volatile organics would volatilize and leach to the groundwater with time.

Long-Term Effectiveness: This No Action alternative would not result in immediate attainment of target clean-up levels. Although it is not possible to estimate the time required for natural attenuation or degradation without comprehensive contaminant modeling it is estimated that more than 30 years would be required before natural degradation and transport mechanisms significantly reduce the toxicity and concentration of contaminants such as PCBs in the soil.

This alternative would be designed to prevent ingestion, inhalation and/or direct contact with the contaminated soils by restricting access to the site. The long-term effectiveness of the alternative in minimizing baseline human health risks through the potential exposure pathways would depend on its success in preventing access to the site use. However, inhalation of airborne dust would continue. The wildlife at the site would continue to be impacted by contaminated soil through many possible pathways.

This alternative would neither remove contaminated soils nor treat them. Contaminants are expected to move through soil and groundwater. There are no direct engineering controls to prevent exposure to contaminated soil. Since the existing perimeter fence at Wildwood is susceptible to vandalism, annual inspection and repair is required. Contaminated soil may become airborne and continue to be a health threat. This alternative is not considered to be effective in achieving the remedial objectives discussed in Section 2.0.

Reduction of Toxicity, Mobility or Volume: This alternative would not involve any containment, removal, treatment or disposal but would leave the contaminated soils intact. Migration of contaminants in soil and into groundwater would continue by natural processes. Therefore, this alternative would not result in any immediate reduction in the toxicity, mobility or volume of contaminants. In fact, the volume of contaminated soil might increase with time due to the mobility of the contaminants into other areas of the site as well as into the deeper fractures in the bedrock aquifer.

Implementability:

- Technical Feasibility: Sampling of soils and monitoring wells is a relatively simple task which could be performed by local contractors. Little difficulty would be involved in the implementation of these tasks and the work could be completed within a relatively short period of time.

  No treatment is employed in this alternative, hence reliability depends mainly on institutional control. Direct monitoring of the effectiveness of the alternative may be difficult, since it is practically impossible to determine if complete access restriction is achieved. Public awareness would increase the effectiveness of this alternative because the community would be informed of potential hazards on-site. Regular surveillance would deter access violations. Periodic monitoring of soil and ground water will be required to track the migration of contamination in soil and groundwater. Additional remedial action can be easily undertaken, if necessary.

- Administrative Feasibility: Implementation of this alternative would require institutional controls to restrict site access and use of land and groundwater. Long-term institutional management would be associated with this alternative since contaminants would remain on-site and review would be necessary every five years. Annual inspections, sampling and public education programs (e.g., public meetings, workshops) would demand administrative and regulatory attention.

- Availability of Services and Materials: This alternative does not involve any treatment, storage or disposal services. Equipment and specialists for sampling soil and groundwater are locally available and more than one vendor is available for competitive bids for sampling and analysis.

Cost: The total present worth of this alternative is estimated at $0.80 million and includes an annual operation and maintenance cost of $50,200. No capital cost is required for this alternative. (Table 4-2). Annual operation and maintenance costs include: replacing missing signs, fence repair, sampling and analyses of soils and groundwater, and implementing an initial public awareness program (e.g., public meetings, newspaper advertising, and literature distribution). Operation and maintenance is the largest category of expenditure for this alternative. The five year reviews would include evaluation of sampling data, reassessment of human health and environmental risks, and addressing public compliance with the institutional controls.

Compliance With ARARs: The compliance of the SC-1 No Action Alternative with action- and location-specific ARARs and TBCs is summarized in Table 4-3.

Overall Protection of Human Health and the Environment: The No Action alternative would not entail removal or other on-site containment and treatment of the contaminated soil and groundwater. It would not, therefore, provide adequate protection of human health and the environment since there would not be any immediate reduction in the toxicity, mobility or volume of the contaminants. The risk of direct contact with contaminated soils and ingestion of contaminated groundwater would be controlled by restricting site access and groundwater use restrictions and public education programs.

4.3.2 Alternative SC-3: Excavation/On-Site Incineration/ Backfill On-Site

4.3.2.1 Description

This alternative includes excavation of contaminated soil at the various properties for on-site incineration at the Wildwood

TABLE 4-2

COST ESTIMATE FOR
ALTERNATIVE SC-1
NO ACTION

	Item	Cost (1988 Dollars)	
I.	CAPITAL COST	0	
II.	ANNUAL OPERATING AND MAINTENANCE COST		
	1-30 YRS	50,200	
III.	PRESENT WORTH OF O&M*	771,700	
IV.	FIVE YEAR REVIEWS (PER REVIEW)	10,000	5, 10, 15, 20, 25 and 30th year
V.	PRESENT WORTH OF REVIEWS	27,800	
VI.	TOTAL PRESENT WORTH	799,500	

*Present Worth Analysis based on 30 year period and 5% discount rate.

TABLE 4-3

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-1:
NO ACTION (SOIL)
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Long-term soil and groundwater monitoring and will be executed in accordance with this re-requirement. All workers will be properly trained.
o RCRA - Groundwater Protection (40 CFR 264 Subpart F)[2]	o Groundwater protection requirements outline monitoring program requirements.	o Long-term groundwater monitoring program will be developed in accordance with RCRA requirements.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure of hazardous waste facilities.	o This alternative is not expected to attain this ARAR because the waste will neither be completely removed nor contained with an impermeable cap. Contaminants may continue to leach to groundwater, and contaminant levels will remain above groundwater quality.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentrations for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to monitor the groundwater wells.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
None Identified		

TABLE 4-3 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-1:
NO ACTION (SOIL)
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
3) Location-Specific ARARs		
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. Remedial alternatives that involve construction must include all practicable means of minimizing harm to wetlands. Wetlands protection considerations must be incorporated into the planning of remedial alternatives.	o The No-Action alternative would not be protective of wetlands because it leaves contaminated soil in the area.
4) Location-Specific TBCs		
o EPA Groundwater Protection Strategy	o EPA classifies groundwater into three categories depending on current, past or potential use. This serves as a guide for protection of the resource.	o Wells G&H aquifer is a Class IIB aquifer-potential usable aquifer. Under this alternative, contaminants in soil would continue to leach into the aquifer, imparing it to the extent that Class IIB criteria could not be met.

[1]Applicable

[2]Relevant and Appropriate

property, which contains most of the soil to be treated. Approximately 9,500 cubic yards of contaminated soil exceed the target levels as discussed in Section 3.0 of this report.

This alternative can be subdivided into the following major work items:

- mobilize/demobilize a mobile incinerator and supporting facilities
- sample soils where applicable
- excavate and transport the contaminated soils to an incinerator staging and feed area
- incinerate soil on-site using the mobile incinerator,
- transport decontamination and scrubber water to the off-site RCRA facility for treatment and/or disposal
- perform EP toxicity and TCLP tests for treated soil
- backfill treated soil on-site
- grade and restore the site

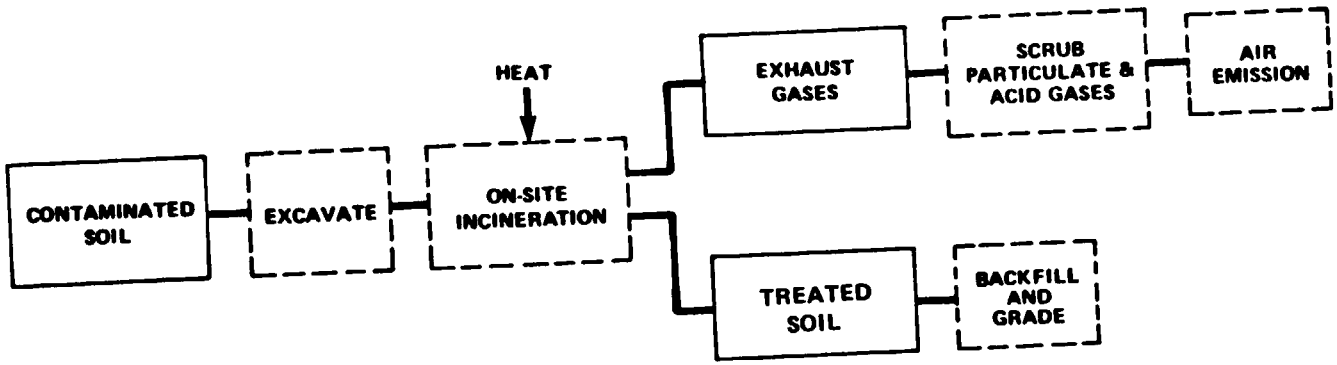
The descriptions of technologies associated with these work items were presented in Section 2.0 of this report. Figure 4-1 shows the schematic diagram for this alternative. Preliminary sizes and quantities for major facilities and construction components are presented in Appendix A. Typical mobile incinerators treat approximately 100-120 tons of soils per day. Soil sampling would be conducted before and during the remedial action, to establish a accurate estimate of the required excavation quantities relative to selected target levels and their exact locations. Incineration would destroy organic contaminants and reduce their concentration to below target levels. On-site mobile incinerators which have been demonstrated successfully at hazardous waste sites are the rotary kiln, infrared, and fluidized bed incinerators. Treated soil would be backfilled along with the clean makeup soil brought from off-site, graded to match existing terrain, revegetated, and trees would be planted to restore the site.

4.3.2.2 Assessment

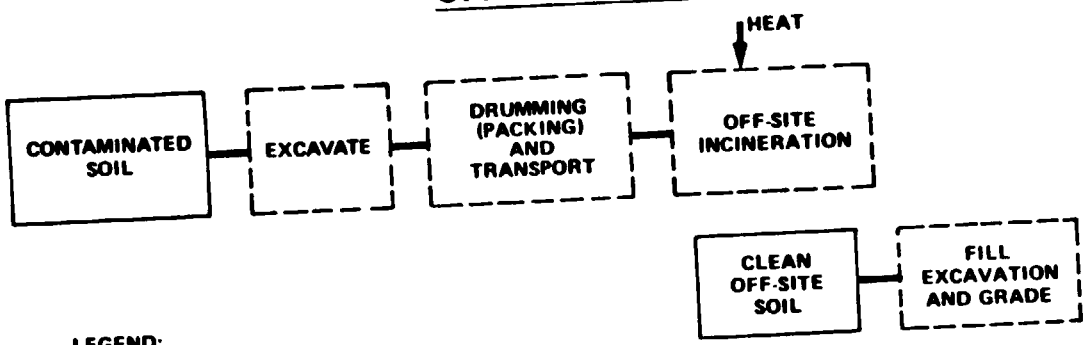
Short-Term Effectiveness: The potential public health threats to area residents and workers would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, soil handling, and incineration. The incinerator would be equipped with an afterburner (secondary combustion chamber) to combust off-gases and air pollution control devices to minimize emissions. The incinerator should meet the performance specification of 99.9999% required by TSCA for PCBs in soil, however, test burns would be required to confirm the performance during remediation. The incineration process would generate scrubber water. The area would be secured and access would be restricted to authorized personnel only.

FIGURE 4-1
FLOW DIAGRAM FOR CONTAMINATED SOIL TREATMENTS

ON-SITE INCINERATION



OFF-SITE INCINERATION



LEGEND:

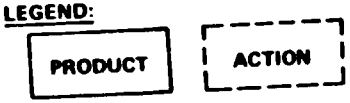
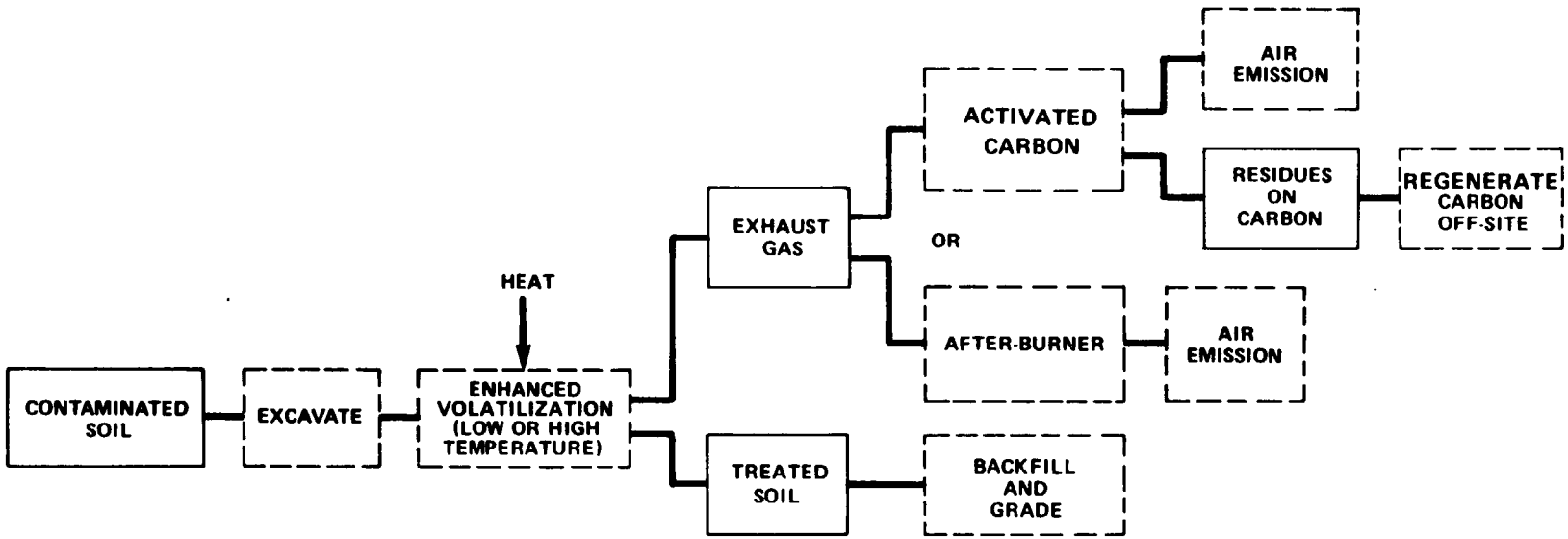


FIGURE 4-1
FLOW DIAGRAM FOR CONTAMINATED SOIL TREATMENTS
(Cont'd)

ON-SITE ENHANCED VOLATILIZATION (low or high temperature)



SUPERCRITICAL FLUID EXTRACTION

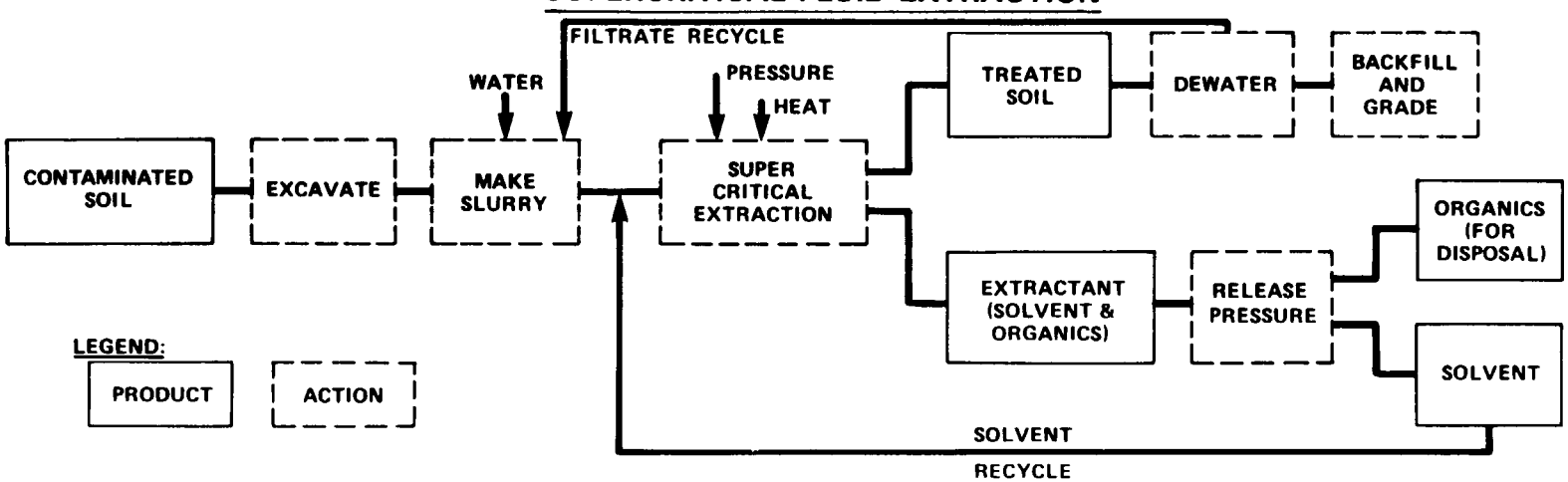
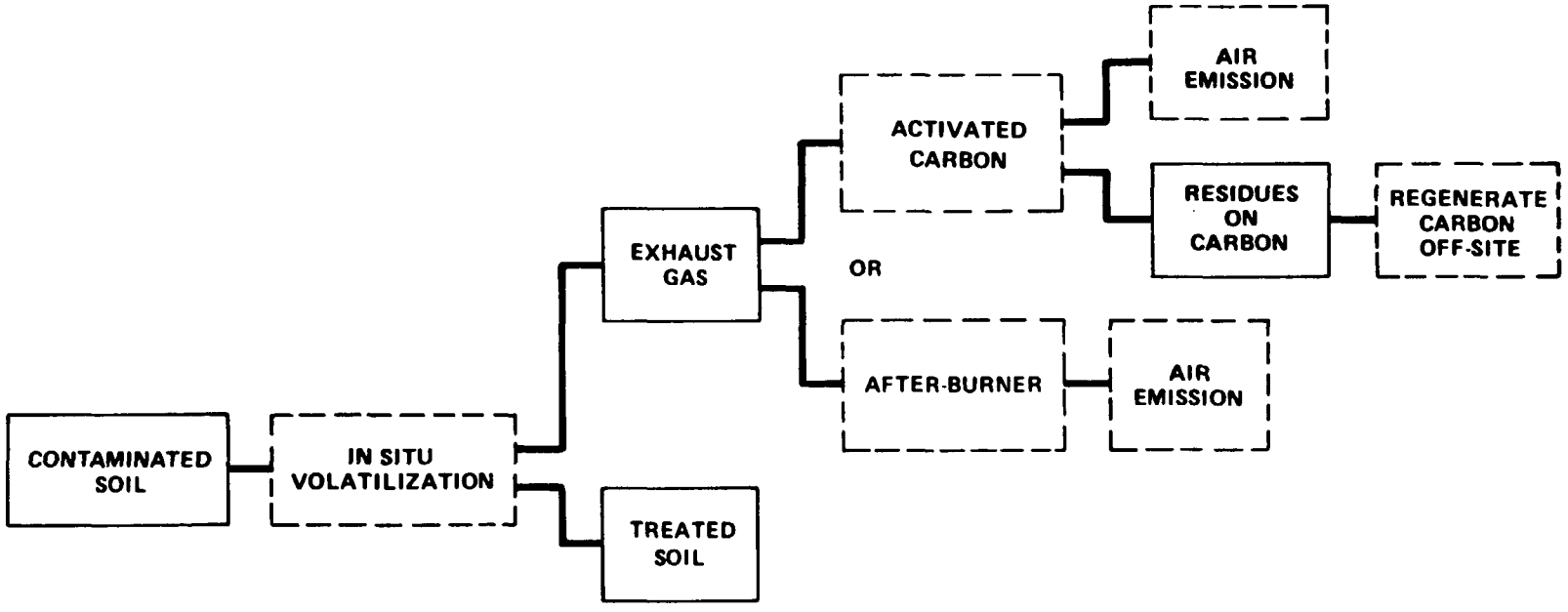


FIGURE 4-1
FLOW DIAGRAM FOR CONTAMINATED SOIL TREATMENTS
(Cont'd)

IN SITU VOLATILIZATION



only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emission from the excavation. Air monitoring of particulates and organic vapors would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Operators would be well trained to observe OSHA regulations.

Short-term impacts on the environment may result from removal of trees, plants, and vegetation and destruction of habitat in the soil. Impacts would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 4 years including remedial design and testing, bidding, selecting a contractor, on-site incineration and site restoration is estimated for this alternative. The actual remediation time is estimated to be 15 months.

Long-Term Effectiveness: The contaminants (VOCs, cPAHs, PCBs, and chlordane) would be reduced to target levels by this alternative. Treated soil from the incinerator would be expected to pass EP Toxicity and TCLP tests. Scrubber water and decontamination water would be either transported to an off-site RCRA facility for treatment and/or disposal or treated on-site in a mobile system during the soil remediation. No long-term management of treated soil would be required.

Reduction of Toxicity, Mobility or Volume: Incineration can treat all organic contaminants of concern in the soil including volatile organics, cPAHs, PCBs and chlordane and substantially reduce the source of groundwater contamination. Incineration is a thermal treatment which would result in permanent reduction of toxicity, mobility and volume of contaminants to target levels. The exhaust gases from the secondary combustion process would pass through a scrubbing system prior to venting thus reducing emissions to the atmosphere.

Implementability:

- Technical Feasibility: All the components of this alternative are well developed and commercially available to implement at the site. On-site mobile incinerators have been demonstrated and proven for soil contaminated with volatile organics, cPAHs, PCBs and chlordane.

Sufficient land (approximately 2 acres) is available for operation of a mobile incinerator system plus supporting facilities. Test burns would be required during remediation to determine actual performance on the contaminated soil and to generate treated soil samples for EP Toxicity and TCLP tests to confirm that the treated soil would be acceptable for backfill at the site.

Incineration is a highly reliable technology. No major technical problems leading to schedule delays are expected and the possibility of failure would be minimal. Since this alternative would provide a permanent remedy, it would not require continuous operation, maintenance and long-term post remedial monitoring. This alternative would be expected to meet the target levels for treated soil. This alternative is not anticipated to need any major additional future remedial actions. If the need arises to treat more soils than originally determined, it could be handled by extending the remediation period. Air exposure pathways during treatment could be adequately monitored. Process efficiency could also be easily monitored.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site and restricted land use during the remediation process. The proposed location at the Wildwood property is already restricted for access with a fence and security guard. Consultation with federal and state agencies would be required to excavate areas adjacent to the wetland area and to incinerate hazardous soil on-site. Coordination with state and local agencies would be required during remediation but no further coordination is expected once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for permits would have to be satisfied.

- Availability of Services and Materials: Adequate treatment capacity is available. A number of vendors have mobile incinerators which can handle 100 to 120 tons of contaminated soils per day. The rate, of excavation could be adjusted to match the incineration rate, if necessary or the excavated soil can be stockpiled for incineration. Necessary equipment and specialists are readily available and availability is expected to increase with time. Many vendors are available for competitive bidding. Mobile infrared incinerators are available from Haz-Tech (Westinghouse), O.H. Materials, Reidel Environmental Services, Ecova and MAE Corporation. Mobile rotary kiln incinerators are available from Roy F. Weston, ENSCO, Vesta Technology and I.T. Corporation. Fluidized bed systems

are available from Ogden Services. Excavation and earth moving equipment such as backhoes and bulldozers are provided by numerous vendors and would be readily available for lease or purchase.

Cost: The total present worth of this alternative is estimated at $7.5 million as summarized in Table 4-4. O&M costs are included in the incineration capital costs. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARs: The compliance of the SC-3 Alternative with action- and location-specific ARARs and TBCs is summarized in Table 4-5.

Overall Protection of Human Health and Environment: Excavation and on-site incineration of contaminants would reduce the public health risks associated with direct contact and leaching of contaminants from soil into groundwater and subsequent ingestion. Treated soil is expected to pass EP Toxicity and TCLP tests and suitable for on-site backfill. This alternative would reduce the toxicity, mobility and volume of the hazardous contaminants in the on-site soils to target levels. This alternative would result in overall protection of human health and the environment.

4.3.3 Alternative SC-4: Excavation/Off-Site Incineration/ Backfill With Clean Off-Site Soil

4.3.3.1 Description

Alternative SC-4 is similar to SC-3 except that incineration of contaminated soil would be performed off-site in a commercial incineration facility. Approximately 9,500 cubic yards of contaminated soil would be remediated by off-site incineration. This alternative can be subdivided into the following major work items:

- mobilize/demobilize supporting facilities
- sample soils where applicable
- excavate the contaminated soils and transport to staging/packing area.
- pack contaminated soil in fiber pack drums
- transport and incinerate contaminated soils at an off-site facility for incineration
- backfill excavation with clean off-site soil and provide grading and restoration of the site
- transport decontamination water to an off-site RCRA facility for treatment and/or disposal.

TABLE 4-4

COST ESTIMATE FOR ALTERNATIVE SC-3
EXCAVATE/ON-SITE INCINERATION/BACKFILL ON-SITE

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	245,900
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	275,000
D. Incineration	4,486,000
E. Backfill and Temporary Storage for Treated Soil	27,900
F. Off-Site Disposal	155,900
G. Site Restoration	109,900
H. Utilities	35,000
TOTAL DIRECT CONSTRUCTION COST	5,491,600
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	1,977,000
TOTAL CAPITAL COST	7,468,600
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	7,468,600

TABLE 4-5

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-3:
EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o On-site incineration activities will be designed and operated in compliance with Subpart O.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedure (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2), (b).[1]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Appropriate technology will be employed to achieve the 99.9999 percent PCB destruction requirement.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to each drum shipment.
o TSCA - Records and Reports (40 CFR 761.18 - 761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.

TABLE 4-5 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-3:
EXCAVATION/ON-SITE INCINERATION/BACKFILL ON SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Decontamination and scrubber water management and off-site disposal will proceed in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Treatment facilities will be designed and operated to allow site-specific RCRA delisting of material.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT-Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o These regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soils, treatment sludges, and other materials will follow these standards.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and othe dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or dust suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide a comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCC and CO emissions also controlled.	o On-site incineration activities will be designed and operated to comply with DEQE air emission requirements.
o DEQE Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.

TABLE 4-5 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-3:
EXCAVATION/ON-SITE INCINERATION/BACKFILL ON SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; traiing; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
2) Action-Specific TBCs		
None Identified		
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse affects on human health and the environment would result if washout occurred.	o It is assumed that the on-site incinerator will be located outside a 100-year flood plain. Any temporary staging and remediation facilities located in the floodplain will be designed for quick mobilization out of the area and such that damage from initial floodwaters is minimized.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation activities after excavation of contaminated soil in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated under this scenario and incinerated. There is a practicable alternative to excavation and placement of fill, therefore this ARAR is not met under this scenario.

TABLE 4-5 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-3:
EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities. Any wetlands/floodplains that are destroyed must be replaced.	o It is anticipated that less than 5,000 sq. ft. of wetlands must be excavated. The replacement performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve. (See 310 CMR 10.55(4)(6)).
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation to wetlands, and preserve and enhance natural and beneficial values of wetlands. In addition, practicable alternatives must be chosen which have less impact on wetlands.	o This alternative does not comply with this Executive Order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR will not be met under this scenario.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize the impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o The excavation and filling are temporary disruptions, and the filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values, and this ARAR will be met under this scenario.
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

The description of technologies associated with these work items were presented in section 2.0 of this report.

Major work items stated above are the same as Alternative SC-3 except for packing soil in drums for transportation and off-site incineration in place of on-site incineration. Preliminary sizes and quantities for major facilities and construction components are presented in Appendix A. Figure 4-1 shows the schematic diagram for this alternative. Soil sampling would be conducted before and during remedial action, to establish a accurate estimate of the required excavation quantities relative to selected target levels and their locations. Packing of contaminated soil would be done using 20 gallon fiber pack drums. This operation is labor intensive and would take a major portion of the project time schedule. Once packed properly, these drums will be loaded onto trucks and hauled to an off-site incineration facility. Clean soil from nearby locations would be brought to fill the excavated area. Grading to match existing terrain, revegetation and planting of trees to restore the site would also be included.

4.3.3.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, and soil handling. There would be no air emissions from a treatment system in this alternative since no on-site treatment is employed. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emission resulting from excavation. Air monitoring for particulates and organic vapors would be conducted, throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Semi-automated packing of contaminated soil for off-site incineration would reduce workers exposure to contaminants. Operators would be well trained to observe OSHA regulations. Short-term impacts on the environment may result from removal of trees, plants, and vegetation and destruction of habitat in the soil. Impacts would be temporary and be mitigated by seeding the area with grass and planting trees

after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff.

The short-term impacts on the environment would be essentially the same as SC-3 with an increase in traffic and noise pollution resulting from hauling of excavated soil to an off-site incineration facility and bringing new soil in for backfill. Transportation of excavated soils may introduce short-term risks with the possibility of spillage along the transport route. A total period of 3.5 years is estimated for this remedial alternative for design and testing, bidding, selecting a contractor, and remediation of soil. The actual remediation period is estimated to be one year.

Long-Term Effectiveness: The excavation and removal of contaminated soil from the site would reduce the potential human health risks associated with direct contact with contaminated soils, the inhalation of volatilized soil contaminants, and the leaching of contaminants into groundwater to target levels. Excavated soil would be replaced by clean soil brought from off-site. The soil following the remediation at the site would not require any long-term management and monitoring.

Reduction of Toxicity, Mobility or Volume: Excavation and off-site incineration constitutes a treatment which would result in a permanent remedy. Excavated organic contaminants in the soil would be completely removed from the site and destroyed in the incinerator. Hence this treatment alternative would reduce the toxicity, mobility and volume of contaminants to target levels. In addition, further contamination of groundwater would be eliminated because the leaching of contaminants from the soil to groundwater would be minimized.

Implementability:

- Technical Feasibility: All the components of this alternative are well developed and commercially available, however, the available capacity of off-site incineration facilities could be a potential problem since there are only a few currently in operation in the country. Furthermore, the contaminated soils would have to undergo a series of analyses prior to acceptance for treatment at the off-site facility. Sufficient land is available at the Wildwood property for packing of the soil. Excavation, packing (drumming), transportation to an off-site incinerator, and restoration of the site can be done with no difficulty.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site during the remediation process. Procurement of an

off-site incineration facility to handle the type and volume of soil on site would be required. Coordination with state and local agencies would be required. The transportation of hazardous waste to an off-site facility would require appropriate permits and coordination with the Department of Transportation (DOT) and local traffic department. Traffic control plans would be required before remediation. The off-site incineration facility selected for incineration would have to be in compliance with appropriate permit conditions.

- Availability of Services and Materials: Commercial off-site incineration facilities are currently operating near capacity. The disposal firms have a steady stream of industrial clients, which has been increasing due to the proposed ban on land disposal of hazardous material. Available capacity of existing commercial facilities may decrease in the foreseeable future. The number of commercial facilities is likely to increase in the near future; however, severe limitations imposed by the current permitting process may make it difficult to predict availability of proposed new facilities. Existing commercial facilities are generally not designed to handle large volumes of inert contaminated material, such as soil. Unavailability of capacity could lead to schedule delays. Excavation and transportation should not pose any problems. There is no commercial RCRA approved facility within 250 miles of the Wells G&H site, therefore transportation costs would be high.

Cost: The total present worth of this alternative is estimated at $22.1 million as summarized on Table 4-6. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARs

The compliance of the Alternative SC-4 with action- and location-specific ARARs and TBCs is summarized in Table 4-7.

Overall Protection of Human Health and Environment: The excavation and removal of contaminated soil from the site would significantly reduce the potential human health risks associated with direct contact with contaminated soils, and prevent leaching of contaminants into groundwater. This alternative involves treatment which would reduce the toxicity, mobility and volume of hazardous contaminants in the on-site soil. No secondary waste management will be required on-site except for some

TABLE 4-6

COST ESTIMATE FOR ALTERNATIVE SC-4
EXCAVATE/OFF-SITE INCINERATION/BACKFILL WITH
CLEAN OFF-SITE SOIL

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	124,400
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	275,000
D. Incineration (Off-Site)	12,820,000
E. Off-Site Disposal	155,900
F. Site Restoration	218,500
G. Utilities	25,000
H. Packing/Transportation	2,511,700
TOTAL DIRECT CONSTRUCTION COST	16,286,500
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	5,863,200
TOTAL CAPITAL COST	22,149,700
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	22,149,700

TABLE 4-7

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-4:
EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o Excavated material will be sent to an off-site incinerator that meets Supart O requirements.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2),(b).[2]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Appropriate technology will be employed by the off-site incinerator to achieve the 99.9999 percent PCB destruction requirement.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to drum shipment.

TABLE 4-7 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-4:
EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o TSCA - Records and Reports (40 CFR 761.18 - 761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o RCRA - Generator and Transporter (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Decontamination and scrubber water management and off-site disposal will proceed in accordance with RCRA requirements. Packing and accumulation facility for excavated soil is to be constructed and operated in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Off-site incineration facilities will be designed and operated in accordance with standards to allow land disposal after a site-specific RCRA delisting of incinerator ash.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT-Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soils, treatment sludges, and other materials will follow these standards.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).

TABLE 4-7 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-4:
EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCC and CO emissions also controlled.	o Excavated materials will be sent to an off-site incinerator that meets DEQE air emission standards.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00 - 8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or dust suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
None Identified		
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain.	o It is assumed that the packing and accumulation facility will be located outside of wetland and floodplain areas. Any temporary staging and remediation facilities that are located in the floodplain will be designed for quick mobilization and such that damage from initial floodwaters is minimized.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation after excavation of contaminated soil activities in Aberjona River wetlands triggers Section 404 jurisdiction, The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated and backfilled under this scenario and then the excavated material incinerated. There is a practicable alternative to excavation and placement of fill, therefore this ARAR is not met under this scenario.

TABLE 4-7 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-4:
EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o It is anticipated that less than 5,000 square feet of wetlands must be excavated. The performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve. (See 310 CMR 10.55(4)(6)).
o Wetlands Executive Order (EO 11900)[1]	o Under this Executive Order, federal agencies are required to minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. In addition, practicable alternatives must be chosen which have less impact on wetlands.	o This alternative does not comply with this Executive Order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR will not be met under this scenario.
o Floodplains Executive Order (EO 11888)[1]	o Federal Agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Excavation and filling are temporary disruptions, and the filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values, and this ARAR will be met under this scenario.
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

decontamination water from cleaning of equipment and personnel. This alternative would result in overall protection of human health and the environment.

4.3.4 Alternative SC-5: Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site

4.3.4.1 Description

This alternative includes excavation of contaminated soil at the various properties for treatment by high temperature enhanced volatilization. Approximately 9,500 cubic yards of contaminated soil at the site require remediation to attain target levels.

This alternative can be subdivided into the following major work items:

- mobilize/demobilize mobile high temperature enhanced volatilization unit and supporting facilities
- sample soils where applicable
- excavate and transport the contaminated soils to the high temperature enhanced volatilization staging and feed area
- high temperature volatilization of soil on-site using a mobile unit
- transport decontamination and scrubber water to an off-site RCRA facility for treatment and/or disposal
- perform EP toxicity and TCLP tests for treated soil
- backfill treated soil on-site
- grade and restore the site.

The descriptions of technologies associated with these work items were presented in Section 2.0 of this report. Figure 4-1 shows the schematic diagram for this alternative. Preliminary sizes and quantities for major facilities and construction components are presented in Appendix A. Soil sampling would be conducted before and during the remedial action, to establish a more accurate estimate of the required excavation quantities relative to selected action levels and their exact locations.

The mobile high temperature enhanced volatilization unit can treat approximately 200-240 tons (150-175 cy) of soils per day. Treated soil would be backfilled along with the clean makeup soil brought from off-site. Grading to match existing terrain, revegetation and planting of trees to restore the site would also be included.

4.3.4.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with

contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, soil handling, and high temperature volatilization activities. The high temperature enhanced volatilization unit would be equipped with an afterburner to combust off-gases and air pollution control devices to minimize emissions. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emissions resulting from excavation. Air monitoring for particulates and organic vapors would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Operators would be well trained to observe OSHA regulations.

Short-term impacts on the environment may result from the removal of trees, plants, and vegetation and the destruction of habitats in the soil. This would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 3 years including remedial design and testing, bidding, selecting a contractor, on-site high temperature enhanced volatilization and site restoration is estimated for this alternative. The actual remediation period is estimated to be 9 months.

Long-Term Effectiveness: The contaminants including VOCs, cPAHs, PCBs and chlordane are expected to be reduced by this alternative. However, it is uncertain as to whether all contaminant target levels for cleanup would be achieved. Treated soil from the high temperature enhanced volatilization would be expected to pass EP Toxicity and TCLP tests. The high temperature enhanced volatilization process would generate scrubber water. No long-term management of treated soil would be required.

Reduction of Toxicity, Mobility or Volume: High temperature enhanced volatilization can treat all organic contaminants in the soil including volatile organics, cPAHs, PCBs and chlordane and reduce the source of groundwater contamination. High temperature enhanced volatilization is a treatment which is expected to result in permanent irreversible reduction of toxicity, mobility and volume of contaminants. The exhaust

gases from the afterburner would pass through a scrubbing system prior to venting, thus reducing emission of contaminants to the atmosphere. Scrubber water would be treated on-site or transported off-site for treatment and/or disposal.

Implementability:

- Technical Feasibility: All the components of this alternative are well developed and commercially available to implement at the site. On-site mobile high temperature enhanced volatilization units have been demonstrated for sludges contaminated with volatile organics and PCBs. Data is however, lacking with respect to the effectiveness of this technology to achieve target levels for chlordane and cPAHs. Sufficient land (approximately 0.5 acres) is available at the Wildwood property for operation of a mobile high temperature enhanced volatilization system plus supporting facilities. There is some uncertainty that the high temperature enhanced volatilization would achieve the target levels in the treated soil for cPAHs and chlordane and treatability studies would be required to determine this. Tests would be required to determine actual performance on the contaminated soil and to generate treated soil samples for EP Toxicity and TCLP tests to confirm that the treated soil would be acceptable for backfill at the site.

  High temperature enhanced volatilization is a reliable technology. No major technical problems leading to schedule delays are expected. Since this alternative would provide a permanent remedy, it will not require continuous operation, maintenance and long-term post remedial monitoring. The possibility of failure would be minimal. No major additional future remedial actions are anticipated. If need arises to treat more soils than originally determined, it can be handled by extending the remediation period. Process efficiency could also be easily monitored.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site and restriction of land use during the remediation process. Consultation with federal and state agencies would be required to excavate areas adjacent to the wetlands and to treat contaminated soil on-site. Coordination with state and local agencies would be required during remediation but no further coordination would be expected once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for permits would have to be satisfied.

- Availability of Services and Materials: Adequate treatment capacity is available. Mobile units can handle 200 to 240 tons of contaminated soils per day. The rate

of excavation can be adjusted to match the processing rate if necessary or the excavated soil can be stockpiled. Necessary equipment and specialists are readily available and availability is expected to increase with time. Several vendors are available for competitive bidding. Mobile high temperature enhanced volatilization units are available from American Toxic Disposal, Inc. (ATD), Kipin Industries, Inc. and Combustion-Engineering Environmental, Inc. Excavation and earth moving equipment such as backhoes and bulldozers are provided by many vendors and would be readily available for lease or purchase.

Cost: The total present worth of this alternative is estimated at $6.6 million as summarized in Table 4-8. O&M costs are included in the capital costs. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARs: The compliance of the Alternative SC-5 with action- and location-specific ARARs and TBCs is similar to that of the SC-3 and SC-4 Alternatives and is summarized in Table 4-9.

Overall Protection of Human Health and Environment: Excavation and high temperature enhanced volatilization of contaminated soil is expected to reduce the potential health risks associated with direct contact, and leaching of contaminants from soil into groundwater and subsequent ingestion. Treated soil is expected to pass EP Toxicity and TCLP tests. This alternative is expected to reduce the toxicity, mobility and volume of the hazardous contaminants in the on-site soils, however, treatability studies would be needed to confirm whether treated soil would achieve target levels. This alternative is expected to result in overall protection of human health and environment.

4.3.5 Alternative SC-7: Excavation/On-Site Supercritical Fluid Extraction/Backfill On-Site

4.3.5.1 Description

Contaminated soil at the various properties would be excavated and brought for treatment to a mobile SCF system. Approximately 9500 cubic yards of contaminated soil would be treated by this alternative to attain the target levels. This alternative can be subdivided into the following major work items:

- mobilize/demobilize mobile supercritical fluid extraction system and supporting facilities
- sample soils where applicable

TABLE 4-8

COST ESTIMATE FOR ALTERNATIVE SC-5
EXCAVATE/ON-SITE HIGH TEMPERATURE ENHANCED VOLATILIZATION/
BACKFILL ON-SITE

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	152,700
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	281,600
D. High Temperature Enhanced Volatilization	3,845,500
E. Backfill and Temporary Storage for Treated Soil	29,100
F. Off-Site Disposal	155,900
G. Site Restoration	95,300
H. Utilities	35,000
I. Treatability Study	80,000
TOTAL DIRECT CONSTRUCTION COST	4,831,100
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	1,712,200
TOTAL CAPITAL COST	6,570,300
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	6,570,300

TABLE 4-9

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-5:
EXCAVATION/ON-SITE HIGH TEMPERATURE ENHANCED VOLATILIZATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Decontamination and scrubber water management and off-site disposal to proceed in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o High temperature enhanced volatilization facilities will be designed and operated to allow site-specific delisting of material.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Postclosure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (47 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All transport, on- and off-site, of excavated soils, treatment sludges, other materials to follow these standards.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.

TABLE 4-9 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-5:
EXCAVATION/ON-SITE HIGH TEMPERATURE ENHANCED VOLATILIZATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specified the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40-761.79)[1]	o 50 ppm storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Gases from thermal aeration will be burned in compliance with the 99.9999% destruction efficiency.
o TSCA - Records and Reports (40 CFR 761.18 - 761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCB.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specified maximum primary and secondary 24-hour concentrations for particulate matter.	Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00 - 8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or dust suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be hazardous waste (310 CMR 30.131 waste #M002).
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[1]	o An unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency in an enhanced volatilization/afterburner facility is expected to meet RACT.

TABLE 4-9 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-5:
EXCAVATION/ON-SITE HIGH TEMPERATURE ENHANCED VOLATILIZATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)(1)	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)(1)	o Establishes rules for dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 3748, February 5, 1987)	This proposal would set performance standards for RCRA treatment facility air emissions.	o Design of enhanced volatilization and other non-incinerators that have air emissions (e.g., air strippers) will meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	o It is assumed that the enhanced volatilization facility will be located outside floodplain areas. Any temporary staging or remediation facilities will be designed to prevent damage from initial floodwaters and for quick mobilization out of the area.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation activities after excavation of contaminated soil in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated under this scenario and treated. There is a practicable alternative to execution and placement of fill, therefore this ARAR is not met under this scenario.
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands.	o This alternative does not comply with this Executive Order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR will not be met under this scenario.

TABLE 4-9 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-5:
EXCAVATION/ON-SITE HIGH TEMPERATURE ENHANCED VOLATILIZATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Floodplains Executive Order (EO 11888)[1]	o Federal Agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains. In addition, practicable alternatives must be chosen that have less impact on wetlands.	o Excavation and filling are temporary disruptions and the filling will match preconstruction topography. Thus, there is no permanent disrpution of floodplain values, and this ARAR will be met under this scenario.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities. Any wetlands/floodplains that are destroyed must be replaced.	o It is anticipated that less than 5,000 sq. ft. of wetlands must be excavated. The replacement performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve (See 310 CMR 10.55(4)(6)).
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

- excavate and transport contaminated soils to treatment area at Wildwood property
- make soil slurry using water to make it pumpable
- treat soils using on-site supercritical fluid extraction treatment system
- perform vapor phase treatment of volatile emission from soil slurry process
- perform EP toxicity and TCLP tests for treated soil
- backfill treated soils on-site after dewatering
- grade and restore the site
- transport spent extractant and contaminated water from dewatering to off-site RCRA facility for treatment and/or disposal.

The description of technologies associated with these work items were presented in section 2.0 of this report. Figure 4-1 shows the schematic diagram for this alternative. Preliminary sizes and quantities for major facilities and construction components are presented in Appendix A.

Supercritical fluid extraction is an innovative technology in which liquified gases such as carbon dioxide or propane under high pressure (150-3000 psi) are utilized to dissolve and separate organics resulting in a relatively small volume of highly concentrated contaminants in the extractant. The commercial scale SCF system has mainly been used for the treatment of sludges with PCBs and oil from oil refinery wastewater treatment systems and has potential applicability to contaminated soils at this site.

Soil sampling would be conducted before and during the remedial action, to establish a more accurate estimate of the required excavation quantities relative to selected action levels and their locations. The proposed mobile supercritical fluid extraction system would treat approximately 100-200 tons (75 to 150 cy) of soils per day. Treated soil after dewatering would be backfilled along with the clean makeup soil brought from off-site. Grading to match existing terrain, revegetation and planting of trees, to restore of the site would also be provided.

4.3.5.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, soil

handling, and slurry making activities. Any volatile organic emissions during the slurry making process would be captured and adsorbed in activated carbon for off-site disposal. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emissions resulting from excavation. Air monitoring for particulates and organic vapors would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. The SCF system is a closed-loop and totally enclosed unit operating at 70 to 100°F and 150 to 3000 psi. The facilities would be designed in compliance with the applicable OSHA industrial requirements to minimize the probability of leakages, spills and explosions. The final extractant liquid volume from SCF would be a very small quantity (approximately 200 gallons) compared to the contaminated soil volume but would be highly concentrated in nature. Operators would be well trained for health and safety requirements to observe OSHA regulations.

Short-term impacts on the environment may result from removal of trees, plants, and vegetation and destruction of habitats in the soil. Impacts would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contamination soil to surface waters via stormwater runoff. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 3.5 years including remedial design and testing, bidding, selecting a contractor, on-site supercritical extraction and site restoration is estimated for this alternative. The actual remediation period is estimated to be one year.

Long-Term Effectiveness: The contaminants including VOCs, cPAHs, PCBs and chlordane should be removed by this alternative. However, it is uncertain as to whether contaminant target levels for clean-up would be achieved. Treated soil from the supercritical extraction system would be expected to pass the EP Toxicity and TCLP test. The SCF system would generate a concentrated extractant which would be transported to an off-site RCRA incineration facility for disposal.

Reduction of Toxicity, Mobility or Volume: This alternative may eliminate the source of groundwater contamination at the Wells G&H site. These processes would remove contaminants and reduce toxicity, mobility and volume of contaminants.

Contaminants would be ultimately destroyed during secondary waste management of extracted organics (approximately 200 gallons) from the SCF process in an off-site incineration facility.

The SCF system unit can be designed or modified to handle waste with low organic concentrations utilizing shorter extraction times or organic-rich materials over a longer extraction time by controlling the flow rate and the capacity of the unit. A bench and pilot-scale treatability study would be needed to develop the design criteria, particularly for the volatile organics and the non-oily dry soil.

Implementability

- Technical Feasibility: The SCF system technology is developed and proven for refinery oily wastewater and sludge only. Further development and modification suitable for the non-oily dry soil at the Wells G&H site would be required. A pilot scale unit to treat contaminated soil is being designed and constructed under the SITE Program. There is presently no full-scale treatment system commercially available. There is some uncertainty that the treated soil would meet target levels and treatability studies would be required to confirm this. The small quantity (approximately 200 gallons) of concentrated organic extractant generated from the SCF system can be disposed of at an off-site RCRA incineration facility.

  Sufficient land (approximately 0.5 acres) is available at the Wildwood property for operation of a mobile super-critical fluid extraction system plus supporting facilities. Since the unit has to be designed and modified to handle soils, there is uncertainty that the process could reliably achieve the designated treatment efficiencies and performance goals in the near future. The construction, operation and maintenance of the equipment for this alternative would not be expected to cause any problems, if the SCF system is properly designed based on bench- and pilot-scale testing results.

  Technical difficulties leading to schedule delays would be likely since there is currently no full scale system available to handle soils and design and fabrication of the equipment would have to be performed. Therefore, the possibility of implementation failure exists. Test runs would be required to determine actual performance on the contaminated soil and to generate treated samples for EP toxicity and TCLP test to confirm that the treated soil would be acceptable for backfill at the site.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site and land use restriction during the remediation process. Consultation with federal and state agencies would be required to excavate adjacent to the wetland area and to treat by supercritical extraction on-site. Coordination with state and local agencies would be required during remediation but no further coordination is expected once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for the permits would have to be satisfied. Off-gas emission from the soil slurrying process would be required to meet the applicable air pollution control requirements. Most implementation activities would be performed within the site area except the off-site disposal of the organic extractants. RCRA-manifesting, recordkeeping and reporting (40 CFR 264.70-264.77) would be required for transportation and incineration of the the residual organic extractant at an off-site RCRA incineration facility.

  The increase in local traffic would be limited within the construction site between the excavation and backfill areas. No significant assistance would be required for traffic control from the local authorities.

- Availability of Services and Materials: Critical Fluid Systems (CFS) Corporation has commercialized a SCF process unit with a capacity ranging from 5 to 100 gpm mainly for the treatment of wastewater and oily sludge from refineries. The current full-scale continuous extraction process operates with the feed material pumped into the extractor either as a liquid or slurry. As discussed, a full-scale system is in development for extraction of dry soils contaminated with hazardous organics. In the case of soil, water must be added to the soil to generate a pumpable slurry. In the case of volatile and/or semi-volatile organics other than refinery oily wastes, certain modifications would be required to the currently available SCF units. CF Systems is currently the sole manufacturer, and there are no other vendors to provide competitive bidding.

  Excavation and earth moving equipment are available from a number of vendors for lease or purchase. The soil pre-treatment system to make soil slurry and vapor phase activated carbon adsorption are traditional industrial waste treatment processes which can be installed with "off-the-shelf" equipment.

Cost: The total present worth of this alternative is estimated at $7.5 million as summarized in Table 4-10. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

TABLE 4-10

COST ESTIMATE FOR ALTERNATIVE SC-7
EXCAVATE/ON-SITE SUPERCRITICAL FLUID
EXTRACTION/BACKFILL ON-SITE

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	152,700
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	275,000
D. Super Critical Fluid Extraction	4,486,400
E. Backfill and Temporary Storage for Treated Soil	27,900
F. Off-Site Disposal	155,900
G. Site Restoration	95,300
H. Utilities	45,000
I. Treatability Study	150,000
TOTAL DIRECT CONSTRUCTION COST	5,544,200
CONTINGENCY/ENGINEERING/ TREATABILITY STUDY/ LEGAL & ADMINISTRATIVE COST	1,995,900
TOTAL CAPITAL COST	7,540,100
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	7,540,100

Compliance with ARARs: The compliance of the Alternative SC-7 with action- and location-specific ARARs and TBCs is summarized in Table 4-11.

Overall Protection of Human Health and Environment: This alternative may reduce the public health risks associated with direct contact and leaching of contaminants from soil into groundwater and subsequent ingestion. Treated soil may pass EP toxicity and TCLP tests. This treatment alternative may reduce toxicity, mobility and volume of the contaminants in the on-site soils to target levels. As is implied, however, some uncertainty exists due to unknown aspects of treating soils with the SCF system. Treatability studies would be required to determine if action levels can be achieved in the treated soil. This alternative may result in overall protection of human health and environment.

4.3.6 Alternative SC-8: Excavation/On-Site Enhanced Volatilization/On-Site Incineration/Backfill On-Site

4.3.6.1 Description

Alternative SC-8 utilizes both enhanced volatilization and incineration to treat the contaminated soil on-site. Enhanced volatilization would be used to remediate soil contaminated only with volatile organics. Incineration would be used to remediate mixed contaminant soil. The amount of soil to be treated by on-site enhanced volatilization is approximately 7,600 cy and the amount of soil to be treated by on-site incineration is 1,900 cy.

This alternative can be subdivided into the following major work items:

- mobilize/demobilize mobile enhanced volatilization and incineration units and supporting facilities
- sample soils where applicable
- excavate and treat soils contaminated with VOC using a mobile enhanced volatilization unit. Preliminary soil preparation may be needed before feeding to the enhanced volatilization unit
- excavate and treat mixed contaminant soils from other areas using a mobile incineration unit

TABLE 4-11

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-7:
EXCAVATION/ON-SITE SUPERCRITICAL FLUID EXTRACTION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Accumulation and off-site transport of spent extractant and contaminated water from dewatering will be sent to off-site RCRA facility for treatment and disposal.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Supercritical fluid extraction facilities will be designed and operated to allow site-specific RCRA delisting of material.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.

TABLE 4-11 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-7:
EXCAVATION/ON-SITE SUPERCRITICAL FLUID EXTRACTION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o RCRA - Tank Requirements (40 CFR 264 Subpart J)[2]	o Provide design and operating requirements for RCRA waste treatment facilities utilizing tanks.	o Design and operation of super-critical extraction facilities will adhere to these requirements.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soils, treatment sludges, other materials will follow these standards.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide a comprehensive monitoring, storing, recordkeeping, etc. program at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60-761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. This alternative can treat PCBs to the 99.9999% destruction efficiency of incinerators.
o TSCA - Records and Reports (40 CFR 761.18 - 761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.

TABLE 4-11 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-7:
EXCAVATION/ON-SITE SUPERCRITICAL FLUID EXTRACTION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Air Quality Air Pollution (310 CMR 6.00 - 8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or dust suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE Air Pollution Control New Source Approvals (310 CMR 7.00)(1)	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)(1)	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
None Identified		
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	o It is assumed that the supercritical fluid extraction facility will be located outside a floodplain. Any temporary staging or remediation facilities located in a floodplain area will be designed for quick mobilization and to prevent damage from initial floodwaters.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation after excavation of contaminated soil activities in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated under this scenario and treated. There is a practicable alternative to excavation and placement of fill. Therefore this ARAR is not met under this scenario.

TABLE 4-11 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-7:
EXCAVATION/ON-SITE SUPERCRITICAL FLUID EXTRACTION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities. Any wetlands/floodplains that are destroyed must be replaced.	o It is anticipated that less than 5,000 sq. ft. of wetlands must be excavated. The replacement performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve (See 310 CMR 10.55(4)(6)).
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. In addition, practicable alternatives must be chosen that have less impact on wetlands.	o This alternative does not comply with this Executive order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR will not be met under this scenario.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Excavation and filling are temporary disruptions, and the filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values, and this ARAR will be met under this scenario.
o Protection of Archaeological Resources (32 CRF 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

- o treat exhaust gases from treatment units using after-burners
- o perform EP toxicity and TCLP tests for treated soil
- o backfill excavation with treated soil on-site
- o grade and restore the site
- o transport decontamination and scrubber water from the incinerator and enhanced volatilization units to off-site RCRA facility for treatment and/or disposal

The descriptions of technologies associated with these work items were presented in section 2.0 of this report. Sizes and quantities for major facilities and construction components are presented in Appendix A. Soil sampling would be conducted before and during remedial action to establish a more accurate estimate of the required excavation quantities relative to selected target levels and their exact locations.

The enhanced volatilization process (Figure 4-1) has been applied successfully to soil contaminated with volatile organics. Soil particle size, organic content, and water content influence the temperature and residence time required to strip organic contaminants from the soil. Incineration would destroy organic contaminants to target levels. On-site mobile incinerators which have been demonstrated successfully at hazardous waste sites are the rotary kiln, infrared and fluidized bed incinerators.

The mobile enhanced volatilization unit would treat approximately 200-240 tons (150-175 cy)of soils per day while the incinerator would treat at 100-120 tons (75-90 cy) of soils per day. Treated soil from both the enhanced volatilization and incinerator units would be backfilled along with the clean makeup soil brought from off-site, graded to match existing terrain, revegetated, and trees would be planted to restore the site.

4.3.6.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, enhanced volatilization and incineration activities. The incinerator and enhanced volatilization units would be equipped with after-burners to combust off-gases and air pollution control devices to minimize emissions. The area would be secured and access would be restricted to authorized personnel only. Dust control

measures such as wind screens and water sprays would be used to minimize fugitive dust resulting from excavation. Air monitoring for particulates and organic vapors would be conducted.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Operators would be trained to observe OSHA regulations.

Short-term impacts on the environment may result from removal of trees, plants, and vegetation and destruction of habitat in the soil. This would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 4 years including remedial design and testing, bidding, selecting a contractor, and remediation of soil is estimated for this alternative. The actual remediation period is estimated to be 16 months.

Long-Term Effectiveness: The contaminants including VOCs, cPAHs, PCBs and chlordane would be reduced to the target levels by incineration in this alternative. VOCs are expected to be reduced to target levels by enhanced volatilization. Treated soil is expected to pass the EP Toxicity and TCLP test. Treatability tests would be required to confirm the long term effectiveness of enhanced volatilization with respect to acheiving target levels. The enhanced volatilization and incineration processes will generate scrubber water. Scrubber water and decontamination water would be treated on-site or transported to an off-site RCRA facility for treatment and/or disposal. No long-term management of treated soil is expected to be required.

Reduction of Toxicity, Mobility or Volume: Incineration of contaminated soils would achieve permanent irreversible destruction of organic contaminants and reduce the toxicity, volume, and overall mobility of the contaminants. However, it is uncertain as to whether enhanced volatilization can attain target levels. Exhaust gases from secondary combustion and the afterburner would be passed through a scrubbing system prior to venting, thus eliminating any discharge of contaminants to the atmosphere. Secondary waste management of scrubber water and decontamination water would be required.

Implementability:

- Technical Feasibility: All the components of this alternative are well developed. Mobile incineration technology is demonstrated and proven for soil contaminated with volatile organics, cPAHs, PCBs and chlordane. Enhanced volatilization technology is demonstrated effective for VOCs removal. Sufficient land (approximately 2.5 acres) is available at the Wildwood property for enhanced volatilization and incineration plus supporting facilities. It is preferable to perform the incineration and enhanced volatilization processes sequentially rather than simultaneously to reduce the area required and the environmental impacts such as clearing of bushes and trees needed to set up two treatment systems at one time. Test burns would be required to determine the actual performance of the incinerator on the contaminated soil and to generate treated samples for EP Toxicity and TCLP test to confirm that the treated soil would be acceptable for backfill. Both enhanced volatilization and incineration technologies are demonstrated to be reliable and no problems leading to schedule delays are expected. Since this alternative would provide permanent removal of contaminants it would not require long-term post remedial monitoring and management. There is some uncertainty that enhanced volatilization would achieve the target levels in the treated soil and treatability studies would be required to determine this. No major additional future remedial actions are anticipated. If the need arises to treat more soils than originally determined, this could be handled by extending the remediation period. Exposure pathways can be adequately monitored. Process efficiencies could be easily monitored by normal process monitoring.

- Administrative Feasibility: Implementation of this alternative would require institutional controls to restrict access to the site during the remediation process. Consultation with state and local agencies would be required to excavate and to treat contaminated soil by enhanced volatilization and incineration on-site. Coordination with state and local agencies would be required during remediation but no future coordination is expected to be required once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for permits would have to be satisfied.

- Availability of Services and Materials: As described in Alternative SC-3 mobile incinerators are available from a number of vendors. Mobile treatment units for enhanced volatilization are available from a number of vendors

including Canonie, Roy F. Weston and C-E Environmental. Capacities range from 7 to 20 tons (5 to 15 cy) per hour. Sufficient specialists are available for this alternative. As stated earlier, excavation equipment is readily available from a number of vendors for lease or purchase.

Cost: The total present worth of this alternative is estimated at $6.2 million as summarized in Table 4-12. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARs: The compliance of Alternative SC-8 with action- and location-specific ARARs and TBCs is summarized in Table 4-13.

Overall Protection of Human Health and Environment: This alternative is expected to reduce the potential public health risks associated with direct contact, and reduce leaching of contaminants from soil into groundwater. Treated soil is expected to pass EP Toxicity and TCLP tests. Treatment by incineration would be expected to reduce the toxicity, mobility and volume of the hazardous contaminants in the on-site soils to target levels. However, treatability tests would be required to confirm that the enhanced volatilization technology can achieve the desired target levels based on the leaching model. This alternative is expected to result in overall protection of human health and environment.

4.3.7 Alternative SC-9: Excavation/On-Site Enhanced Volatilization and Off-Site Incineration/Backfill With Treated and Clean Off-Site Soil

4.3.7.1 Description

Alternative SC-9 utilizes both enhanced volatilization and off-site incineration to treat the contaminated soil. The soil contaminated only with VOCs at various properties would be excavated and brought to the Wildwood property to be treated by enhanced volatilization. The mixed contaminant soil would be excavated, packed, transported, and treated at an off-site incineration facility. The amount of soil to be treated by on-site enhanced volatilization is approximately 7,600 cy and the amount of soil to be treated by off-site incineration is 1,900 cy (2,570 tons) to attain target levels.

TABLE 4-12

COST ESTIMATE FOR ALTERNATIVE SC-8
EXCAVATE/ON-SITE ENHANCED VOLATILIZATION/ON-SITE
INCINERATION/ON-SITE BACKFILL

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	245,900
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	281,600
D. Incineration	900,100
E. Enhanced Volatilization	2,561,600
F. Backfill and Temporary Storage for Treated Soil	29,100
G. Off-Site Disposal	155,900
H. Site Restoration	109,900
I. Utilities	35,000
J. Treatability Study	70,000
TOTAL DIRECT CONSTRUCTION COST	4,545,100
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	1,636,300
TOTAL CAPITAL COST	6,181,400
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	6,181,400

TABLE 4-13

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-8:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o On-site incineration activities will be designed and operated in compliance with Subpart O.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2),(b)[1]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Appropriate technology will be employed to achieve the 99.9999 percent PCB destruction requirement.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Incinerator and enhanced volatilization unit, operation decontamination, scrubber water management and off-site disposal will proceed in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Incinerator and enhanced volatilization unit will be designed and operated to allow site-specific RCRA delisting of material.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.

TABLE 4-13 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-8:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (47 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soils, treatment sludges, other materials will follow these standards.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and o procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (40 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency in an enhanced volatilization/afterburner facility is expected to meet RACT.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm PCB storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to drum shipment.

TABLE 4-13 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-8:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o TSCA - Records and Reports (40 CFR 761.18-761.185)[1]	o This regulation outlines the requirements for recordkeeping sor storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or dust suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCL and CO emissions also controlled.	o On-site incineration activities to be designed and operated in compliance with requirements.
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)(1)	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)(1)	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 374B, February 5, 1987)	o This proposal would set performance standards for RCRA treatment facility air emissions.	o Design of enhanced volatilization and other non-incinerators which have air emissions (e.g., air strippers) will meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated and maintained to	o It is assumed that the remediation facilities will be located in upland areas outside of floodplain. Any temporary staging and remediation facilities located in the floodplain area will be designed to allow quick mobilization and to prevent damage from initial floodwaters.

TABLE 4-13 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-8:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement of fill pursuant to remediation activities after excavation of contaminated soil triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated under this scenario and treated. There is a practicable alternative to excavation and placement of fill, therefore this ARAR is not met under this scenario.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities. Any wetlands/floodplains that are destroyed must be replaced.	o It is anticipated that less than 5,000 sq. ft. of wetlands must be excavated. The replacement performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve (See 310 CMR 10.55(4)(6)).
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. In addition, a practicable alternative must be chosen that has less impact on wetlands.	o This alternative does not comply with this Executive Order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR will no be met under this scenario.

TABLE 4-13 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-8:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Excavation and filling are temporary disruptions and the filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values, and this ARAR will be met under this scenario.
o Protection of Archaeological Resources (32 CRF 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeological staff.

[1]Applicable

[2]Relevant and Appropriate

This alternative can be subdivided into the following major work items:

- mobilize/demobilize a mobile enhanced volatilization unit and supporting facilities
- sample soils where applicable
- excavate and treat soils contaminated with VOCs using a mobile enhanced volatilization unit.
- treat exhaust gases from the enhanced volatilization unit using after burners
- perform EP toxicity and TCLP tests for treated soil
- excavate and transport mixed contaminant soils from other areas to staging/packing area
- pack contaminated soil in fiber pack drums
- transport and incinerate mixed contaminant soils at an off-site incineration facility
- backfill excavation with treated soil supplemented with clean off-site soils
- transport decontamination and scrubber water from enhanced volatilization unit to off-site RCRA facility for treatment and/or disposal
- grade and restore the site

The description of technologies associated with these work items were presented in Section 2.0 of this report. Sizes and quantities for major facilities and construction components are presented in Appendix A. Soil sampling would be conducted before and during remedial action to establish a more accurate estimate of the required excavation quantities relative to selected target levels and their exact locations.

The enhanced volatilization process (Figure 4-1) has been applied successfully to soil contaminated with volatile organics. Soil particle size, organic content, and water content influence the temperature and residence time required to strip organic contaminants from the soil. Off-site incineration can be used to remove organic contaminants completely from the site. Packing of contaminated soil will be done using 20 gallon fiber pack drums. This operation is labor intensive and will take major portion of the project time schedule. Once packed properly, these drums will be loaded onto trucks and hauled to an off-site incineration facility.

The mobile enhanced volatilization unit would treat approximately 200-240 tons (150-175 cy) of soil per day. The throughput of the off-site incineration process would depend on the availability of an off-site commercial facility and also the ease of packing (drumming) and transportation of contaminated soil to the off-site facility. Treated soil from the enhanced volatilization process would be backfilled along with clean makeup soil for the amount incinerated off-site, graded to match existing terrain, revegetated, and trees would be planted to restore the site.

4.3.7.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, enhanced volatilization, and packing and transportation activities. The enhanced volatilization unit would be equipped with an afterburner to combust off-gases and air pollution control devices to minimize emissions. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust resulting from excavation. Air monitoring of particulates and organic vapors would be conducted.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Operators would be well trained to observe OSHA regulations.

Short-term impacts on the environment may result from removal of trees, plants, and vegetation and destruction of habitat in the soil. This would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Traffic and noise pollution would be expected to increase from site activities and transportation of contaminated soils to the off-site incineration facility and clean off-site soil for backfill. Transportation of excavated soils may introduce short-term risks associated with the handling and transportation of soils such as the possibility of spillage along the transport route. A total remediation period of approximately 3.5 years including remedial design and testing, bidding, selecting a contractor, and remediation of soil is estimated for this alternative. An actual remediation period of 10 months is estimated.

Long-Term Effectiveness: The contaminants including VOCs, cPAHs PCBs, and chlordane would be reduced to target levels by off-site incineration. Treatment by enhanced volatilization is expected to reduce VOCs to target levels. Treated soil from on-site enhanced volatilization would be expected to pass EP Toxicity and TCLP tests. Treatability studies would be required to confirm the ability of enhanced volatilization to achieve target levels. The enhanced volatilization process would generate scrubber water but the off-site incineration would not generate any secondary waste on site. Scrubber water and decontamination water would be transported to an off-site RCRA facility for treatment and/or disposal. No long-term management of treated soil would be required.

Reduction of Toxicity, Mobility or Volume: This alternative would achieve permanent and irreversible removal of organic contaminants. The toxicity, mobility and volume of contaminants would be reduced by treatment. However, some uncertainty exists as to whether enhanced volatilization would reduce VOCs to target levels. Exhaust gases would be passed through an afterburner and scrubbing system prior to venting, thus eliminating any discharge of contaminants to the atmosphere. Secondary waste management of scrubber water and decontamination water would be required.

Implementability:

- Technical Feasibility: Both enhanced volatilization and off-site incineration technologies have been demonstrated to be reliable and no problems leading to schedule delays are expected. All the components of this alternative are well developed and commercially available, however, the availability of off-site incineration facilities is uncertain since there are only a few in the country. Sufficient land is available at the site for enhanced volatilization and off-site incineration.

  Test burns for incineration would be required to determine actual performance on the contaminated soil and to generate treated samples for EP toxicity and TCLP tests to confirm that the treated soil would be acceptable for backfill at the site. As discussed previously, there is some uncertainty that enhanced volatilization can achieve the target levels for VOCs. Treatability studies would be required to demonstrate this. The enhanced volatilization and off-site incineration may be conducted sequentially in order to minimize the area requirements.

  Excavation, packing (drumming) and transportation could be done with no difficulty. Since this alternative would provide permanent removal of contaminants it would not require long-term post remedial monitoring and management. No major additional future remedial actions are

anticipated. If need arises to treat more soils than originally determined they could be handled by extending the remediation period. Process efficiencies could be easily monitored by normal process monitoring.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site during the remediation process. Coordination with state and local agencies would be required during remediation but no further coordination is expected once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for approval would have to be satisfied.

  Appropriate permits and coordination with Department of Transportation (DOT) and local traffic department would be required during the transportation of hazardous waste to the off-site facility. Traffic control plans would be required before remediation. The off-site incineration facility selected for incineration would have to be in compliance with appropriate permits.

- Availability of Services and Materials: Commercial off-site incineration facilities are currently operating near capacity. The disposal firms have a steady stream of industrial clients, which has been increasing due to the proposed land ban. The available capacity of existing commercial facilities may decrease in the foreseeable future. The number of commercial facilities is likely to increase in the near future; however, severe limitations imposed by the current permitting process may make it difficult to predict availability of proposed new facilities. Existing commercial facilities are generally not designed to handle large volumes of soil. Inavailability of capacity may lead to schedule delays. Excavation and transportation should not pose any problems. There is no commercial RCRA approved incineration facility within 250 miles of the Wells G&H site. Therefore transportation costs will be high.

  Mobile treatment units for enhanced volatilization are available from Canonie, Roy F. Weston, OHM and C-E Environmental. Capacities range from 7 to 20 tons (5-15 cy) per hour. Pilot tests will be required for selecting the most suitable system for this case. As stated earlier excavation equipment is readily available from a number of vendors for lease or purchase.

Cost: The total present worth of this alternative is estimated at $9.0 million as summarized in Table 4-14. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

TABLE 4-14

COST ESTIMATE FOR ALTERNATIVE SC-9
EXCAVATE/ON-SITE ENHANCED VOLATILIZATION/OFF-SITE
INCINERATION/BACKFILL WITH TREATED AND CLEAN OFF-SITE SOIL

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	152,700
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	281,600
D. Incineration	2,561,600
E. Enhanced Volatilization	2,572,000
F. Backfill and Temporary Storage for Treated Soil	23,800
G. Off-Site Disposal	155,900
H. Site Restoration	120,800
I. Utilities	35,000
J. Packing/Transportation	503,600
K. Treatability Study	70,000
TOTAL DIRECT CONSTRUCTION COST	6,633,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	2,387,900
TOTAL CAPITAL COST	9,020,900
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	9,020,900

Compliance with ARARs: The compliance of Alternative SC-9 with action- and location-specific ARARs and TBCs is summarized in Table 4-15.

Overall Protection of Human Health and Environment: Removal of contaminants by off-site incineration and destruction of contaminants by enhanced volatilization is expected to reduce the public health risks associated with direct contact and leaching of contaminants from soil into groundwater. Treated soil is expected to pass EP toxicity and TCLP tests. This alternative is expected to reduce toxicity, mobility and volume of the hazardous contaminants in the on-site soils to target levels, however, treatability studies would be required to confirm whether enhanced volatilization can achieve the required performance goals. This alternative is expected to result in overall protection of human health and environment, provided the enhanced volatilization process meets target levels.

4.3.8 Alternative SC-10: In Situ Volatilization/Excavation/On-Site Incineration/Backfill On-Site

4.3.8.1 Description

Alternative SC-10 utilizes both in situ volatilization and incineration to treat the contaminated soil on-site. In situ volatilization would be used to remediate soil contaminated with only with volatile organics without the need for excavation. Incineration would be used to remediate mixed contaminant soil. The amount of soil to be treated by in situ volatilization is approximately 7400 cy and amount of soil to be treated by on-site incineration is 2100 cy. (In situ volatilization would only be applied to Wildwood soils.) The mixed contaminant soil from various properties would be excavated and brought to the Wildwood property which contains most of the soil to be treated by incineration. This alternative can be subdivided into the following major work items:

- mobilize/demobilize and/or construct an in situ volatilization system and mobile incineration units and supporting facilities
- sample soils where applicable
- perform in situ treatment of soil contaminated with VOCs
- excavate and transport mixed contaminant soils to incinerator staging and feed area.
- incinerate mixed contaminant soils using mobile incinerator
- transport decontamination and scrubber water to off-site RCRA facility for treatment and/or disposal

TABLE 4-15

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-9:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/OFF-SITE INCINERATION/BACKFILL WITH TREATED AND CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o Excavated material will be sent to an incinerator designed and operated in compliance with Subpart O.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2),(b)[1]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Appropriate technology will be employed by the off-site incineration to achieve the 99.9999 percent PCB destruction requirement.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Decontamination and scrubber water from enhanced volatilization, packing and accumulation of excavated soil will be executed in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Design and operation of off-site incineration and on-site enhanced volatilization facility will occur to allow land disposal of treated material by site-specific delisting.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.

TABLE 4-15 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-9:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/OFF-SITE INCINERATION/BACKFILL WITH TREATED AND CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site, transport of excavated soils, treatment sludges, other materials will follow these standards.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide a comprehensive monitoring, storing, recordkeeping, etc. program at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency in an enhanced volatilization/afterburner facility is expected to meet RACT.
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCL and CO emissions also controlled.	o Treated materials will be sent to an incinerator designed and operated in compliance with requirements.
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.

TABLE 4-15 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-9:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/OFF-SITE INCINERATION/BACKFILL WITH TREATED AND CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
o TSCA - Marking of PCBs and PCB Items (40 CPR 761.40 - 761.79)[1]	o 50 ppm PCB storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to drum shipment.
o TSCA - Records and Reports (40 CFR 761.18-761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 3748, February 5, 1987)	o This proposal would set performance standards for RCRA treatment facility air emissions.	o Enhanced volatilization and other non-incinerators that have air emission (e.g., air strippers) will be designed to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to	o It is assumed that remediation facilities will be located outside floodplains. Any temporary staging areas and remediation facilties located in a floodplain area will be designed to allow quick mobilization and to prevent damage caused by initial floodwaters.

TABLE 4-15 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-9:
EXCAVATION/ON-SITE ENHANCED VOLATILIZATION/OFF-SITE INCINERATION/BACKFILL WITH TREATED AND CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement of fill pursuant to remediation activities after excavation of contaminated soil in the Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o A small area of wetlands would be excavated under this scenario and treated. There is a practicable alternative to execution and placement of fill, of fill, therefore this ARAR will not be met under this scenario.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities. Any wetlands/floodplains that are destroyed must be replaced.	o It is anticipated that less than 5,000 sq. ft. of wetlands must be excavated. The replacement performance standards can be met, except that the replication of wildlife habitat will be difficult to achieve (See 310 CMR 10.55(4)(6)).
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance beneficial values of wetlands. In addition, a practicable alternative must be chosen that has less impact on wetlands.	o This alternative does not comply with this Executive Order. There is a practicable alternative to excavation of contaminated wetland and placement of fill, so this ARAR is not yet under this scenario.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Excavation and filling are temporary disruptions, and the filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values, and this ARAR will be met under this scenario.
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

- perform EP Toxicity and TCLP tests for treated soil
- backfill treated soils from incinerator
- grade and restore the site.

The descriptions of technologies associated with these work items were presented in section 2.0 of this report. Sizes and quantities for major facilities and construction components are presented in Appendix A. Soil sampling would be conducted before and during remedial action to establish a more accurate estimate of the required excavation quantities relative to selected target levels and their exact locations.

The in situ volatilization technology can achieve VOC removal efficiency greater than 99.9 percent. Incineration would reduce organic contaminant concentration to target levels. On-site mobile incinerators which have been demonstrated successfully at hazardous waste sites are the rotary kiln, infrared and fluidized bed incinerators.

An in situ volatilization system such as vapor extraction can treat soils to leaching based target levels in approximately 200 to 300 days. The incinerator would treat at 100-120 tons (75-150 cy) of soils per day. The treated soil from the incinerator would be backfilled along with any clean makeup soil brought from off-site. No backfilling would be needed for the in situ treatment. The site would be restored by grading to match existing terrain, revegetating and planting trees.

4.3.8.2 Assessment

Short-Term Effectiveness: The potential public health threats to workers and area residents would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, incineration and in situ volatilization activities. Fugitive dust will be minimized because in situ volatilization does not require excavation. Volatile organics stripped from the soil by the in situ volatilization system would be collected in the pipe and vent system and adsorbed in a carbon adsorption treatment system. The incinerator would be equipped with an afterburner to combust off-gases and air pollution control devices to minimize emissions. The area will be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust resulting from excavation. Air monitoring for particulates and organic vapors would be conducted.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with

contaminated soil and inhalation of fugitive dust and volatile organics. Operators would be trained to observe OSHA regulations. Risks to workers would be minimized in this alternative because in situ volatilization does not require excavation and soil handling.

Short-term impacts on the environment may result from removal of trees, plants and vegetation and destruction of habitat in the soil. This would be temporary and will be mitigated by seeding the area with grass and planting trees after remediation. Destruction of vegetation and other environmental impacts would be minimized because in situ volatilization (which would be used to treat the bulk of the contaminated soil) does not require removal of vegetation and trees. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Some increase in traffic and noise pollution would be expected from site activities. A remediation period of approximately 4 years including remedial design and testing, bidding, selecting a contractor and remediation of soil is estimated for this alternative. The actual remediation period is estimated to be 16 months for this alternative. There is, however, some uncertainty in the length of time required for in situ volatilization because the efficiency of the process depends on site conditions.

Long-Term Effectiveness: This alternative would reduce contaminants to target levels. Treated soil from in situ volatilization and incineration would be expected to pass the EP toxicity and TCLP test. The on-site incineration process would generate scrubber water while the volatilization unit would generate spent carbon. Scrubber water and decontamination water would be transported to off-site RCRA facility for treatment and/or disposal. Activated carbon from in situ volatilization would be regenerated or disposed of at off-site facility. No long-term management of treated soil would be required.

Reduction of Toxicity, Mobility or Volume: Incineration can treat all organic contaminants in the soil including volatile organics, cPAHs, PCBs and chlordane. In situ volatilization would strip volatile organics from soil and transfer them to activated carbon where they can be adsorbed for subsequent destruction during regeneration. Incineration would result in permanent irreversible reduction of toxicity, mobility and volume of mixed contaminants to target levels. The exhaust gases from the incinerator would pass through a scrubbing system prior to venting, thus reducing contaminants to the atmosphere. In situ volatilization would transfer volatile organics and concentrate them in carbon for ultimate destruction during carbon regeneration. A reduction in toxicity, mobility and volume of volatile organics in the soil to target levels based on leaching model would be achieved.

Implementability:

- Technical Feasibility: All the components of this alternative are well developed. Mobile incineration units are demonstrated and proven for soil contaminated with volatile organics, cPAHs, PCBs and chlordane. In situ volatilization units have been successfully used at a number of Superfund sites for VOC removal. Sufficient land is available at the Wildwood property for in-situ volatilization and incineration plus supporting facilities which require approximately 2.5 acres. However, sequential staging of the in situ volatilization and incineration processes for ease of undertaking and to reduce environmental impact such as clearing of bushes and trees should be further evaluated in the design. Pilot-scale testing would be required for in situ volatilization for full-scale design and optimization. Test burns would be required to determine actual performance of incineration on the mixed contaminant soil and to generate treated samples for EP toxicity and TCLP tests to confirm that the treated soil would be acceptable for backfill at the site.

  Both in situ volatilization and incineration technologies are demonstrated to be reliable and no problems leading to schedule delays are expected. Since this alternative would provide a permanent remedy, it will not require long-term post remedial monitoring. No major additional future remedial actions are anticipated. If need arises to treat more soils than originally determined, it could be handled by extending the remediation period. Exposure pathways could be adequately monitored by air monitoring. Process efficiency could also be easily monitored.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site and restriction of land use during remediation process. Consultation with federal and state agencies would be required to excavate adjacent to the wetland area and to incinerate contaminated soil on-site. Coordination with state and local agencies would be required during remediation and no coordination is expected once the remediation is complete. Although no permits would be required for on-site remediation, substantive requirements for permits would have to be satisfied.

- Availability of Services and Materials: Adequate incineration capacity is available as discussed in Alternative SC-3 and availability is expected to increase with time. Mobile incinerators can handle 50 to 100 tons of contaminated soils per day. Many vendors are available for competitive bid for incineration as discussed in Alternative SC-3. There

There are only two vendors available for in situ volatilization at present. The two vendors are Terravac and Vaportech.

Cost: The total present worth of this alternative is estimated at $3.2 million as summarized in Table 4-16. Detailed supportive data used to derive these estimates are presented in Appendix A and B.

Compliance with ARARs: The compliance of Alternative SC-10 with action- and location-specific ARARs and TBCs is summarized in Table 4-17 and in many respects similar to Alternatives SC-3, 4, 5 and 7.

Overall Protection of Human Health and Environment: This alternative would involve excavation of contaminated soils and incineration resulting in destruction of mixed contaminants to target levels. In Situ volatilization would remove volatile organics from soil to target levels based on the leaching model and transfer them to carbon for ultimate destruction during carbon regeneration. Excavation and destruction of contaminants would reduce the public health risks associated with direct contact and leaching of contaminants from soil into groundwater. This alternative would reduce the toxicity, mobility and volume of the hazardous contaminants in the on-site soil to target levels. This alternative would result in overall protection of human health and the environment.

4.3.9 Alternative SC-11: In Situ Volatilization/Excavation/ Off-Site Incineration/Backfill with Clean Off-Site Soil

4.3.9.1 Description

Alternative SC-11 utilizes both in situ volatilization and off-site incineration to treat the contaminated soil. In situ volatilization would be used to remediate soil contaminated with only volatile organics. Off-site incineration would be used to remediate mixed contaminant soil. The amount of soil to be treated by in situ volatilization is approximately 7400 cy and the amount of soil to be treated by off-site incineration is 2100 cy (2830 tons) (In situ volatilization would only be utilized at the Wildwood site.). The in situ volatilization treats the soil contaminated with volatile organics without excavation. This alternative can be subdivided into the following major work item:

- mobilize/demobilize and/or construct in situ volatilization system and supporting facilities

TABLE 4-16

COST ESTIMATE FOR ALTERNATIVE SC-10
IN SITU VOLATILIZATION/EXCAVATE/ON-SITE
INCINERATION/BACKFILL ON-SITE

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	195,000
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	73,500
D. Incineration	989,900
E. In Situ Volatilization	518,000
F. Backfill and Temporary Storage for Treated Soil	7,000
G. Off-Site Disposal	155,900
H. Site Restoration	89,800
I. Utilities	35,000
J. Treatability Study	100,000
TOTAL DIRECT CONSTRUCTION COST	2,320,100
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	835,200
TOTAL CAPITAL COST	3,155,300
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	3,155,300

TABLE 4-17

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-10:
IN-SITU VOLATILIZATION/EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o On-site incineration activities will be designed and operated in compliance with Subpart O.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2),(b)[1]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Appropriate technology will be employed to achieve the 99.9999 percent TSCA destruction requirement.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Decontamination and scrubber water and carbon adsorption waste management and off-site disposal will proceed in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o On-site incinerators will be designed in accordance with standards to allow site-specific RCRA delisting of material.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soil treatment sludges, and other materials will follow these standards.

TABLE 4-17 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-10:
IN-SITU VOLATILIZATION/EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o RCRA - Tank Requirements (40 CFR 264 Subpart J)	o Provides design and operating requirements for RCRA waste treatment facilities utilizing tanks.	o Design and operation of the in-situ volatilization facility will follow these requirements.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure care of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency in an in-situ volatilization facility by carbon adsorption.

TABLE 4-17 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-10:
IN-SITU VOLATILIZATION/EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCL and CO emissions also controlled.	o On-site incineration activities to be designed and operated in compliance with requirements.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm PCB storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to drum shipment.
o TSCA - Records and Reports (40 CFR 761.18-761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.

TABLE 4-17 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-10:
IN-SITU VOLATILIZATION/EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 374B, February 5, 1987)	o This proposal would set performance standards for RCRA treatment facility air emissions.	o Volatilization facilities and other non-incinerators that have air emissions (e.g., air strippers) will be designed to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[1]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	o It is assumed that remediation facilities will be located outside floodplains. Temporary staging areas or remediation facilities that are located in a floodplain will be a designed to allow quick mobilization out of the area and to prevent damage caused by initial floodwaters.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill following excavation of contaminated soil pursuant to remediation activities in the Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no mitigated practicable alternative exists, impacts must be mitigated.	o Under this alternative no excavation will occur in Section 404 wetlands. Soil contamination in such areas will be remediated using in-situ volatilization which does not require excavation and subsequent filling.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o Under this alternative, no excavation will occur in the regulated wetlands. Excavation of contaminated soil may occur in the wetlands buffer zone. In this case, the alternative will meet performance standards for activities in the buffer zone.

TABLE 4-17 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-10:
IN-SITU VOLATILIZATION/EXCAVATION/ON-SITE INCINERATION/BACKFILL ON-SITE
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to select alternatives that minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands.	o No excavation will occur in Section 404 wetlands. This is the best practicable alternative for treating contaminated wetlands.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains. In addition, practicable alternatives must be selected that have less impact on wetlands.	o Excavation and filling are temporary disruptions, and filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values and the ARAR will be met.
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavation, work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

- sample soils where applicable
- perform in situ treatment of soil contaminated with VOCs
- excavate and transport mixed contaminant soils to incinerator staging and packing area.
- pack mixed contaminant soil in fiber pack drums
- transport and incinerate mixed contaminant soils at off-site incineration facility
- transport decontamination water and spent carbon to off-site RCRA facility for treatment and/or disposal
- backfill excavation with clean soil for the amount of soil treated by off-site incineration
- grade and restore the site.

The description of technologies associated with these work items was presented in section 2.0 of this report. Sizes and quantities for major facilities and construction components are presented in Appendix A. Soil sampling would be conducted before and during remedial action to establish a more accurate estimate of the required excavation quantities relative to selected target levels and their exact locations.

Off-site incineration can be used to remove mixed contaminant soils completely from the site. Packing of contaminated soil will be done using 20 gallon fiber pack drums. This operation is labor intensive and would take major portion of the project time schedule. Once packed properly, these drums would be loaded onto trucks and hauled to an off-site incineration facility.

An in situ volatilization system such as vapor extraction can treat soils to target levels in approximately 200-300 days. The In situ volatilization technology can achieve an organic removal efficiency greater than 99.9 percent for the VOC contaminated soil. The throughput of the off-site incineration process would depend on the availability of the off-site commercial facility and also the ease of packing (drumming) and transportation of contaminated soil to the off-site facility. No backfilling of treated soil would be needed for in situ treatments. Clean off-site soil would be brought in to fill the excavation for incineration treatment, grade to match existing terrain, revegetate, and plant trees to restore the site.

4.3.9.2 Assessment

Short-Term Effectiveness: The potential public health threats to area residents and workers would include direct contact with contaminated soils and inhalation of fugitive dust, organic vapors, and emissions generated during excavation, in situ volatization, and packing and transportation activities. Volatile organics stripped from the soil would be collected in the pipe and vent system and adsorbed by carbon adsorption. No emission would be released on-site from off-site incineration. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust resulting from excavation. Fugitive dust would be minimized because in situ volatilization does not require excavation. Air monitoring for particulates and organic vapors would be conducted.

The risk to workers would be minimized by the use of adequate preventive measures such as enclosed cabs on backhoes and proper personal protection equipment to prevent direct contact with contaminated soil and inhalation of fugitive dust and volatile organics. Risks to workers would be minimal because in situ volatilization does not require excavation and soil handling. Semi-automated packing of contaminated soil for off-site incineration would reduce workers exposure to contaminants. Operators would be trained to observe OSHA regulations.

Short-term impacts on the environment may result from removal of trees, plants and vegetation. This would be temporary and be mitigated by seeding the area with grass and planting trees after remediation. Destruction of trees and other environmental impacts would be minimal because in situ volatilization would not require removal of vegetation and trees and would require excavation in the wetlands area. Erosion and sediment control measures such as silt curtains would be provided during excavation activities to control migration of contaminated soil to surface waters via stormwater runoff. Increase in traffic and noise pollution would be expected from site activities and transportation of contaminated soils to off-site incineration facility and clean off-site soil for backfill. Transportation of excavated soils may introduce short-term risks associated with the handling and transportation of soils such as the possibility of spillage along the transport route. A remediation period of approximately 3.5 years including remedial design and testing, bidding, selecting a contractor and remediation of soil is estimated for this alternative. An actual remediation period of 10 months is estimated. There is some uncertainty in the length of time required for in situ volatilization because it depends on site conditions.

Long-Term Effectiveness: The major benefits associated with this alternative would be that the mixed contaminants would be reduced to target levels by this alternative. The in situ

volatilization process would remove volatile organics from the soil to target levels based on leaching model. The treated soil from in situ volatilization would be expected to pass EP toxicity and TCLP test. The off-site incineration process would generate no secondary waste on-site while the volatilization unit would generate spent carbon. Decontamination water would be transported to off-site RCRA facility for treatment and/or disposal. Activated carbon would be regenerated or disposed of at off-site facility. No long-term management of treated soil would be required.

Reduction of Toxicity, Mobility or Volume: Off-site incineration can remove all organic contaminants in the soil including volatile organics, cPAHs, PCBs and chlordane, and reduce the sources of groundwater contamination. In situ volatilization would reduce soil volatile organics to target levels and transfer the removed VOCs to activated carbon. Off-site incineration would result in permanent removal of toxicity, mobility or volume of contaminants. In situ volatilization would transfer contaminants and concentrate them in carbon for ultimate destruction during carbon regeneration. The overall alternative would provide reduction in toxicity, mobility and volume of contaminants.

Implementability:

- Technical Feasibility: In Situ volatilization would use a mobile treatment unit and all the components of this alternative are well developed and commercially available to implement at the site. Off-site incinerators have been demonstrated and proven to destroy organic contaminants. All components of this alternative are well developed and commercially available. However, the available capacity of an off-site incineration facility could be a potential problem since there are only a few in the country. Furthermore, the contaminated soils would have to undergo a series of analyses prior to their acceptance for treatment at the off-site facility. Sufficient land is available for in situ volatilization and off-site incineration plus supporting facilities, which would require approximately 0.5 acres. Test runs would be required to determine actual performance on the contaminated soil for in situ volatilization and also to optimize operating conditions.

  Excavation, packing (drumming) and transportation can be done with no difficulty. Since this alternative would provide a permanent remedy, it would not require long-term post remedial monitoring and management. The possibility of failure would be minimal and no major additional future remedial actions are anticipated. If need arises to treat

more soils than originally determined, it could be handled by extending the remediation period. Exposure pathways could be adequately monitored by air monitoring. Process efficiency could also be easily monitored.

- Administrative Feasibility: Implementation of this alternative would require restriction of access to the site and restriction of land use during the remediation process. Consultation with federal and state agencies would be required to excavate adjacent to the wetland area and to perform in-situ volatilization of contaminated soil in wetlands. Coordination with state and local agencies would be required during remediation and no coordination is expected once the remediation is complete. Due to transportation of hazardous waste to off-site facility appropriate permits and coordination with department of transportation (DOT) and local traffic department would be required. Traffic control plans would be required before remediation. The off-site incineration facility selected for incineration would have to have appropriate permits.

- Availability of Services and Materials: Commercial off-site incineration facilities are currently operating near capacity. The disposal firms have a steady stream of industrial clients, which has been increasing due to proposed land ban. Available capacity of existing commercial facilities may decrease in the foreseeable future. The number of commercial facilities is likely to increase in the near future; however, severe limitations imposed by the current permitting process may make it difficult to predict availability of proposed new facilities. Existing commercial facilities are generally not designed to handle large volumes of inert contaminated material such as soil. Inavailability of capacity may lead to schedule delays. Excavation and transportation should not pose any problems. There is no commercial RCRA approved facility within 250 miles of Well G&H site therefore transportation costs would be high. Only a few vendors are available for in situ volatilization at present. In Situ volatilization systems are available from Terravac and Vaportech. Many vendors are available for competitive bids for incineration as discussed in Alternative SC-3.

Cost: The total present worth of this alternative is estimated at $6.2 million as summarized in Table 4-18. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

TABLE 4-18

COST ESTIMATE FOR ALTERNATIVE SC-11
IN SITU VOLATILIZATION/EXCAVATE/OFF-SITE
INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	67,800
B. Support Facilities	156,000
C. Soil Excavation and Temporary Storage for Excavated Contaminated Soil	73,500
D. Incineration	2,830,000
E. In Situ Volatilization	518,000
F. Off-site Disposal	155,900
G. Site Restoration	98,600
H. Utilities	35,000
I. Packing/Transportation	553,200
J. Treatability Study	100,000
TOTAL DIRECT CONSTRUCTION COST	4,588,700
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	1,651,700
TOTAL CAPITAL COST	6,239,700
II. ANNUAL OPERATING & MAINTENANCE COST	0
III. TOTAL PRESENT WORTH	6,239,700

Compliance with ARARs: The compliance of SC-11 Alternative with action- and location-specific ARARs and TBCs is summarized in Table 4-19.

Overall Protection of Human Health and Environment: This alternative would involve removal of contaminated soils and off-site incineration resulting in essentially complete destruction of mixed contaminant soils to target levels. In Situ volatilization would remove volatile organics from the soil to target levels based on the leaching model and transfer them to carbon for ultimate destruction during carbon regeneration. Removal and destruction of contaminants would reduce the human health risks associated with direct contact and prevent leaching of contaminants from soil into groundwater. This alternative would reduce the toxicity, mobility and volume the of hazardous contaminants in the soils. This alternative would result in overall protection of human health and environment.

4.4 MANAGEMENT OF MIGRATION ALTERNATIVES

As previously discussed, alternatives were developed and screened in Section 3.0 that address the groundwater remediation objectives. The alternatives that passed that initial screening have been further evaluated against the evaluation criteria. The alternatives that were retained in the initial screening and which need to be addressed in this detailed evaluation are: MOM-1 No Action; MOM-2 Pump and Treat Source Areas; MOM-3 Pump and Treat Central Area; and MOM-4 Pump and Treat Source Areas and Central Area. Treated water will be discharged to the Aberjona River in all alternatives except No Action. Each remedial alternative has a maximum of three alternative treatment schemes, physical treatment by air stripping, chemical treatment by UV/Chemical oxidation, and physical treatment by carbon adsorption. All treatment schemes may require pretreatment to remove suspended solids, iron, and manganese to maintain the efficiency of the treatment processes and to achieve Ambient Water Quality Criteria (AWQC) in the Aberjona River. The pumping rates, remediation periods, preliminary sizes of the treatment units, and discharge conditions are different for all of the alternatives.

Alternatives were developed to provide a range of possible technical approaches to achieve the remedial objectives. The approach taken was to divide the site into six areas (W.R. Grace, New England Plastics, Unifirst Corporation, Olympia Nominee Trust, Wildwood Conservation Corporation and the central area) and to evaluate the effectiveness of pumping different aquifer areas at different rates. If should be noted that the pumping rates used for this report are estimates for feasibility study comparisons with specific rates to be developed during the remedial design. The MOM alternatives were generally compared with respect to their ability to remove ten volumes of groundwater from the central area and 20-50 or more plume volumes from the source areas. The selection of these volumes as a comparative yardstick for clean-up is further

TABLE 4-19

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-11:
IN-SITU VOLATILIZATION/EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA Incineration Requirements (40 CFR 264 Subpart O)[2]	o Principal Organic Hazardous Constituents (POHC) are to be destroyed to 99.99 percent destruction and removal efficiency, stringent particulate and HCL limits are imposed.	o Excavated material will be sent to an incinerator designed and operated in compliance with Subpart O.
o TSCA - PCB Incineration Requirements (40 CFR 761.70(a)(2),(b)[1]	o Contaminated soil in excess of 50 ppm PCB concentration must be incinerated to a 99.9999 percent destruction efficiency.	o Excavated materials will be sent to an off-site incinerator designed and operated to achieve 99.9999%
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Packing and accumulation of excavated soil, and carbon adsorption wastes will be constructed and operated in accordance with RCRA requirements.
o RCRA - Land Disposal Restrictions (40 CFR 268)[2]	o Provide treatment standards and schedules governing land disposal of RCRA wastes and of materials contaminated with or derived from RCRA wastes.	o Excavated waste will be sent to an off-site incinerator facility that is designed and operated to allow site-specific delisting of treated material.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil, treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of excavated soil treatment sludges, other materials will follow these standards.
o RCRA - Tank Requirements (40 CFR 264 Subpart J)[2]	o Provides design and operating requirements for RCRA waste treatment facilities utilizing tanks.	o Design and operation of in-situ volatilization facility will follow these requirements.

TABLE 4-19 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-11:
IN-SITU VOLATILIZATION/EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post closure care of hazardous waste facilities.	o Hazardous waste facilities will be closed in a manner that meets the requirements of the closure regulations.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring and excavation.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediations.
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent in an in-situ volatilization facility.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers soil contaminated in excess of 50 ppm PCBs to be a hazardous waste (310 CMR 30.131, waste #M002).

TABLE 4-19 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-11:
IN-SITU VOLATILIZATION/EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Hazardous Waste Incinerator Air Emisson Requirements 310 CMR 7.08(4)[2]	o Provides air emission requirements for hazardous waste incinerators. Principal Organic Hazardous Constituents (POHCS) destroyed to 99.99 percent, PCBs to 99.9999 percent. Particulate, HCL and CO emissions also controlled.	o Excavated material will be sent to an incinerator designed and operated in compliance with requirements.
o TSCA - Marking of PCBs and PCB Items (40 CFR 761.40 - 761.79)[1]	o 50 ppm PCB storage areas, storage items, and transport equipment must be marked with the M_L mark.	o All storage areas, drums, and transport equipment will carry the appropriate markings displayed in an easily readable position.
o TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)[1]	o This requirement specifies the requirements for storage and disposal/destruction of PCBs in excess of 50 ppm. These PCB-contaminated soils would have to be disposed of or treated in a facility permitted for PCBs, in compliance with TSCA regulations. Treatment must be performed using incineration or some other method with equivalent destruction efficiencies.	o Storage areas for drums containing PCB soils in excess of 50 ppm will be constructed to comply with this requirement. Verification of incinerator compliance will be made prior to drum shipment.
o TSCA - Records and Reports (40 CFR 761.18-761.185)[1]	o This regulation outlines the requirements for recordkeeping for storage and disposal of >50 ppm PCBs.	o Records will be maintained during remedial action in compliance with this regulation for all PCB drums which contain soils in excess of 50 ppm.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.

TABLE 4-19 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-11:
IN-SITU VOLATILIZATION/EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 3748, February 5, 1987)	o This proposal would set performance standards for RCRA treatment facility air emissions.	o Volatilization facilities and other non-incinerators that have air emissions (e.g., air strippers) will be designed to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse affects on human health and the environment would result if washout occurred.	o It is assumed that the carbon adsoprtion facility and the excavated soil packing and accumulation facility will be located outside of the floodplain area. Temporary staging areas or remediation facilities that are located in a floodplain will be designed to allow quick mobilization and to prevent damage caused by initial floodwaters.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill following excavation of contaminated soil pursuant to remediation activities in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o Under this alternative, no excavation will occur in Section 404 wetlands. Soil contamination in such areas will be remediated using in-situ volatilization which does not require excavation and subsequent filling
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o Under this alternative, no excavation will occur in the regulated wetlands. Excavation of contaminated soil may occur in the wetlands buffer zone. In this case, the alternative will meet performance standards for activities in the buffer zone.

TABLE 4-19 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE SC-11:
IN-SITU VOLATILIZATION/EXCAVATION/OFF-SITE INCINERATION/BACKFILL WITH CLEAN OFF-SITE SOIL
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to minimize the destruction, loss or degradation of wetlands, and preserve and enhance beneficial values of wetlands. In addition, a practicable alternative must be chosen that has less impact on wetlands.	o No excavation will occur in wetlands areas. This is the best practical alternative for treating contaminated wetlands.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Excavation and filling are temporary disruptions, and filling will match preconstruction topography. Thus, there is no permanent disruption of floodplain values and the ARAR will be met.
o Protection of Archaeological Resources (32 CFR 229)	o These regulations develop procedures for the protection of archaeological resources.	o If archaeological resources are encountered during excavations work will stop until the area has been reviewed by federal and state archaeologists.

[1]Applicable

[2]Relevant and Appropriate

discussed in Appendix C. It must be recognized that the estimation of the actual remediation time frame is difficult due to following limitations (1) bedrock aquifer contamination, (2) the presence of dense non-aqueous phase liquid (DNAPL) at Unifirst, (3) the heterogeniety of the volume and mass of groundwater contamination at the site and (4) uncertainty regarding soil VOC contamination levels and total organic carbon (TOC) distributions in the saturated zone of the overburden aquifer. In general, all of the MOM alternatives would eventually accomplish the goal of achieving MCLs in the groundwater. However, significant differences exist with respect to the relative time frames required to achieve this goal.

Table 3-6 presents the preliminary pumping rates estimated for the aquifer restoration periods which are used for cost estimation purposes. These pumping rates were used for developing preliminary equipment sizing and costs. The extraction well depths would be different at each of these areas based on the depth of known contamination. In addition, the pump and treat systems at each source area would be affected by differences in contaminant concentrations in the groundwater at each source as described in Section 3.

Treatment effectiveness would also be affected by the capture efficiency of the individual contaminated groundwater areas and the overall remediation time. Estimates of the influent VOC concentrations to the treatment systems for each of the properties are also shown in Table 3-6. The highest concentration of total volatile organics occurs at the Wildwood property where the estimated groundwater VOC concentration used for treatment sizing was 52,255 ppb. Other estimates included: 2,445 ppb at W. R. Grace 3,925 ppb at Unifirst, 1,080 ppb at Olympia, and 195 ppb at New England Plastics. Although concentrations would decrease with time, the treatment plants should be sized to handle the initial anticipated concentrations.

For the detailed evaluations presented in this section, a 20-50 year or more aquifer restoration period has been generally assumed for the source areas and a 10 year restoration period for the central area of the site under MOM-4 alternatives (see Appendix C). However, for costing purposes, a single 30 year restoration period has been assumed for all source areas. Also, for costing purposes for the MOM-4 alternatives a 10 year restoration period has been assumed for the central area.

4.4.1 Alternative MOM-1: No Action (Management of Migration)

4.4.1.1 Description

Under this alternative no treatment/disposal or containment of contaminated groundwater will be provided. Groundwater contamination exists throughout the site in the overburden and bedrock. This contamination would remain and continue to migrate to other areas within the site and downgradient from the site.

Long-term monitoring of the site would be performed to evaluate the performance of this No Action alternative. This would consist of an annual inspection of the site, as well as annual sampling of groundwater for 30 years to monitor contaminant concentrations remaining on-site and migrating downgradient. It is assumed that groundwater samples would be collected at a number of existing monitoring wells. Because this alternative would result in contaminants remaining on-site, the site must be reviewed every five years. If justified by the review, remedial actions would be adjusted to better approach overall objectives.

The major work items associated with this alternative are as follows:

- implement institutional controls to limit withdrawal of groundwater for potable use
- conduct a long-term groundwater sampling and monitoring program
- determine groundwater contaminant concentrations and the amount of migration
- conduct educational programs, including public meetings and presentations, to increase public awareness
- perform a site review every five years

4.4.1.2 Assessment

Short-Term Effectiveness: The No Action alternative would continue to provide restriction of groundwater use. This alternative would have no short-term threats to the neighboring communities. This alternative does not involve substantial construction because existing groundwater monitoring wells could be used. Workers at the site for sample collection and site inspection would be exposed to contaminated soil and groundwater. The exposure risks through direct contact would be minimized using personal protection equipment. Health and safety training would be provided to workers.

Contaminated groundwater would continue to migrate within the site and also downgradient of the site. This alternative relies on natural attenuation for achievement of remedial response objectives. Although it is not possible to develop a time frame to achieve remedial response objectives without extensive contaminant transport modeling, it is estimated that it will take in excess of 100 years to approach these goals. Contaminant concentrations in the bedrock aquifer would be expected to decrease, but would not approach MCL goals in a reasonable time frame.

Long-Term Effectiveness: The No Action alternative would not remove or contain contaminants in the groundwater. This alternative relies on natural attenuation through mechanisms including degradation, sorption, volatilization, dispersion, dilution, and transport. This alternative would not result in the attainment of target clean-up levels in a rapid time frame. Contaminants would continue to migrate downgradient.

This alternative would prevent ingestion, inhalation, and/or direct contact with the contaminated groundwater by restricting groundwater use. The long-term effectiveness of the alternative in minimizing human health risks through the potential exposure pathways would depend on the effectiveness of a program of preventing groundwater use.

This alternative would require long-term sampling and monitoring. As required by SARA a five year review would be required to evaluate site conditions. If justified by the review, remedial actions may be required to pump and treat contaminated groundwater. This alternative is not considered to be effective over the long-term because contaminated ground water would remain on-site and continue to migrate downgradient.

Reduction of Toxicity, Mobility, or Volume: This alternative would not involve any containment, removal, treatment or disposal of contaminated groundwater. The contaminated groundwater would remain on site and continue to migrate downgradient. This alternative does not use treatment and would not result in any immediate reduction in toxicity, mobility, or volume of contaminants. Natural attenuation might take many years (estimated to be in excess of 100 years) to substantially reduce toxicity and mobility. However, natural attenuation is irreversible. In addition, the volume of contaminated groundwater would probably increase with time due to the migration of the contaminants into other areas of the site as well as into the deeper fractures in the bedrock.

Implementability:

- Technical Feasibility: There are many monitoring wells at the Wells G&H site that can be used for groundwater monitoring. Well sampling and analytical procedures are well-established and defined. The technologies associated with this alternative are feasible and readily available. Minimal effort would be required to monitor and maintain the elements of this alternative. Monitoring of migration of contaminants into deep fractured bedrock would be difficult. The effectiveness and reliability of institutional controls would be uncertain because of possible violations. These factors should be recognized in evaluating this alternative and its potential impact on human health. If it is determined by five year reviews that contaminant migration is threatening human health or the environment, the remediation would be reevaluated

- Administrative Feasibility: Implementation of this alternative would require institutional controls to restrict site access and groundwater use. Considerable long-term management would be associated with this alternative since groundwater monitoring would be conducted on an annual basis for 30 years. Site inspections, sampling, and public education programs would require administrative attention. Coordination between state and local authorities would be required to review data and make decisions in the future. This alternative would not involve any discharge permits or off-site activities.

- Availability of Services and Materials: This alternative would not involve any treatment, storage, or disposal. Existing sampling and monitoring wells would be used to monitor migration of contaminated groundwater. Equipment and specialists for sampling, monitoring, and analytical work are locally available and more than one vendor is available for competitive bids.

Cost: Existing facilities would be sufficient for this alternative. It would not involve any capital cost. Annual operation and maintenance cost is estimated to be $26,700. The total present worth of this alternative is estimated at $0.44 million as shown in Table 4-20. Data in support of this estimate are presented in Appendices A and B.

Compliance With ARARs: The compliance of the MOM-1 alternative with ARARs and TBCs is summarized in Table 4-21.

Overall Protection of Human Health and the Environment: The No Action alternative would entail no removal or on-site containment or treatment of the contaminated groundwater. It would not, therefore, contribute to protection of human health or the environment, except through institutional controls, since there would not be any immediate reduction in the toxicity, mobility, or volume of the contaminants. Natural attenuation to reduce the contaminant concentrations to MCLs would take many years and the bedrock contamination may never achieve target goals. The risk of direct contact and ingestion of contaminated groundwater would be controlled by groundwater use restrictions and public education programs. The ability of this alternative to prevent exposure would depend on the effectiveness of institutional controls. The volume of contaminated groundwater is expected to increase with time due to migration of contaminated groundwater to other areas on-site and also downgradient. This alternative is not expected to meet Federal and State ARARs in the near future, and is not considered responsive to the remedial objectives.

TABLE 4-20

COST ESTIMATE FOR
ALTERNATIVE MOM-1 NO ACTION (MANAGEMENT OF MIGRATION)

Item		Cost (1988 Dollars)	
I.	CAPITAL COSTS	0	
II.	ANNUAL OPERATING & MAINTENANCE COSTS FOR 30 YRS	26,700	
III.	TOTAL PRESENT WORTH OF O&M*	410,400	
IV.	FIVE YEAR REVIEWS (PER REVIEW)	10,000	5, 10, 20 25 and 30th year
V.	PRESENT WORTH OF REVIEWS	27,800	
VI.	TOTAL PRESENT WORTH	438,200	

* Present Worth Analysis based on 30 year period and 5% discount rate.

TABLE 4-21

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE MOM-1:
NO ACTION (GROUNDWATER)
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Long-term groundwater monitoring will be executed in accordance with this requirement. All workers will be properly trained.
o RCRA - Groundwater Protection (40 CFR 264 Subpart F)[2]	o Groundwater protection requirements include both concentration standards and monitoring program requirements.	o A long-term groundwater monitoring program will be developed in accordance with RCRA requirements.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized.
o RCRA - Closure and Post-Closure (40 CFR 264 Subpart G)[2]	o This regulation details the specific requirements for closure and post-closure of hazardous waste facilities.	o This alternative is not expected to attain this ARAR because the waste will not be treated. Contaminants may continue to leach to groundwater, and contaminant levels will remain above groundwater quality.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o DEQE - Groundwater Quality Standards (314 CMR 6.00)[1]	o This regulation consists of groundwater classifications which designate and assign uses and water quality criteria necessary to sustain the designated uses.	o All groundwaters of the Commonwealth are Class I, (potable), unless otherwise designated. Class I groundwater quality criteria are not met by this alternative, since the groundwater would not be suitable as a source of potable water under this alternative. 314 CMR 6.06 (1)(aa).

TABLE 4-21 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR ALTERNATIVE MOM-1:
NO ACTION (GROUNDWATER)
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
None Identified		
3) Location-Specific ARARs		
None-identified		
4) Location-Specific TBCs		
o EPA Groundwater Protection Strategy	o EPA classifies groundwater into three categories depending on current, past or potential use. This serves as a guide for protection of the resource.	o Wells G & H aquifer is a Class IIB aquifer-potentially usable aquifer for drinking water. Under the No-Action scenario, nothing would be done to attain the classification criteria. Therefore this alternative would not meet the guidance.

[1]Applicable

[2]Relevant and Appropriate

4.4.2 Alternative MOM-2: Pump and Treat Source Areas

This remedial alternative includes pumping of all the source areas individually for treatment. The treatment system to be used and the location of the treatment systems are described and evaluated as sub-alternatives.

This alternative consists of individual pump and treat systems at each of the groundwater contaminant source areas. Five extraction systems would be included at the following properties: W. R. Grace, Unifirst Corporation, Wildwood Conservation Corporation, Olympia Nominee Trust, and New England Plastics. Anticipated groundwater flows to be treated are 65 gpm, 50 gpm, 300 gpm, 21 gpm, and 80 gpm at W.R. Grace, Olympia, Wildwood, New England Plastics, and the Unifirst areas respectively. Extraction wells would be installed at each property to pump the contaminated groundwater to an on-site groundwater treatment plant located at each property or at one centrally located treatment plant. Treated groundwater would be discharged to the Aberjona River. It is assumed for this detailed evaluation that contaminated groundwater in the overburden would be pumped and treated for all the properties. In all properties except Olympia Nominee Trust, bedrock wells would also be pumped (see Appendix C). During the Remedial Design, the complete extraction system would be developed for each area. In the remedial design additional consideration would be given to the interaction between overburden pumping and bedrock pumping to maximize contaminant collection.

4.4.3 Alternative MOM-2A(i): Pump Source Areas - Pretreatment and Air-Stripping at Separate Treatment Plants

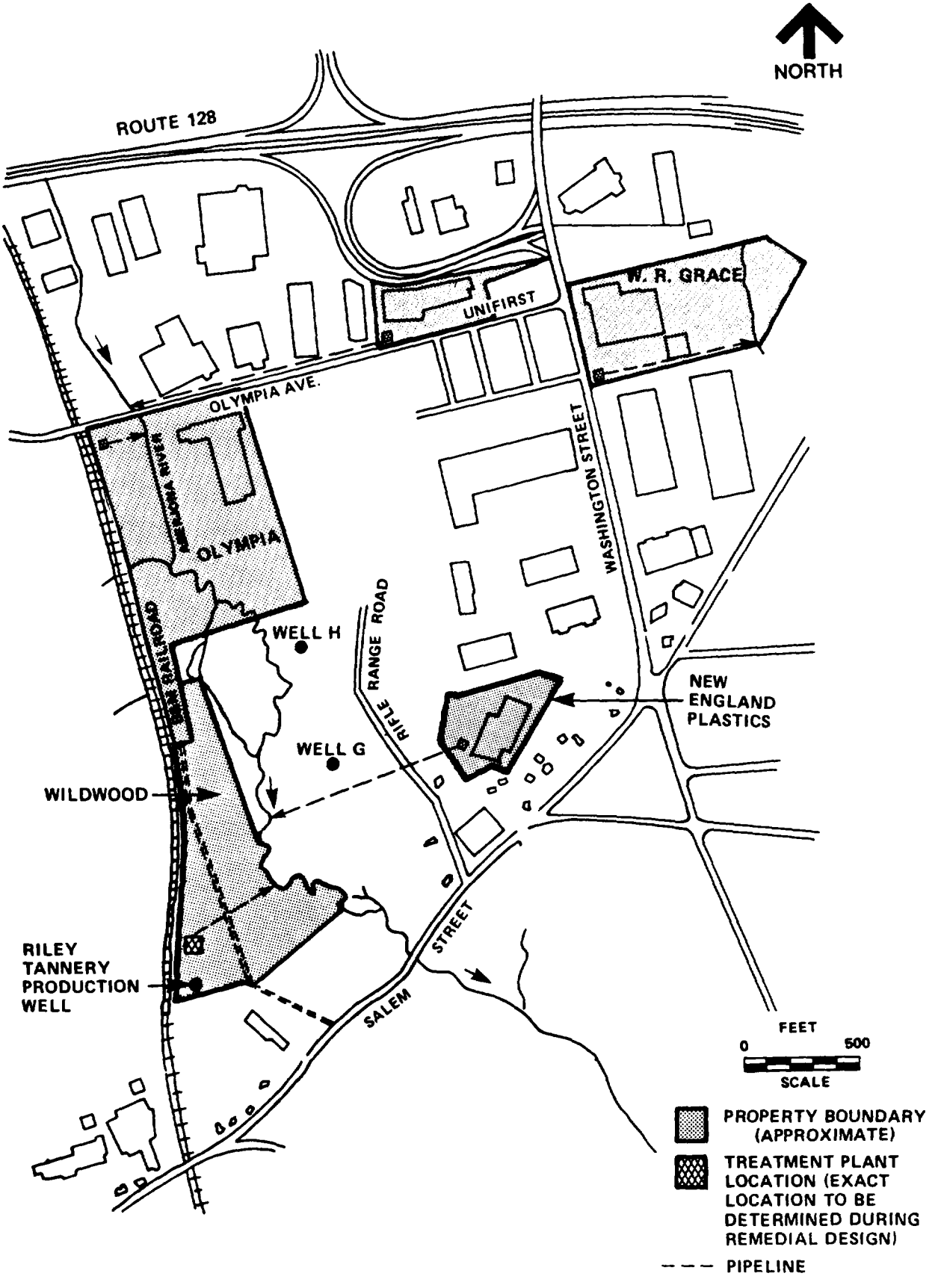
4.4.3.1 Description

This alternative includes extraction of groundwater at the individual source areas and treating the contaminated groundwater by pretreatment and air stripping at separate treatment plants at each of the five individual areas (Figure 4-2).

The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood, and Olympia)
- construct groundwater treatment plants at five locations using pretreatment and air stripping

FIGURE 4-2
MOM-2
PUMP SOURCE AREAS AND TREAT AT SEPARATE TREATMENT PLANTS



- pump groundwater from the extraction wells to individual source area treatment plants
- treat groundwater on-site using pretreatment and air stripping
- discharge treated water to the Aberjona River
- regenerate spent vapor phase adsorption system carbon on-site using thermal treatment
- dispose of pretreatment sludge at an off-site facility
- monitor treatment plant effluent and groundwater to review the remediation efficiencies

Pretreatment by precipitation, coagulation, flocculation, and clarification would remove suspended solids and metals, such as iron and manganese, which are likely to foul the treatment units. Recarbonation and filtration steps would be used to precipitate excess lime added to remove iron and manganese, and adjust pH to a neutral range suitable for discharge into the Aberjona river. Air stripping would transfer volatile organics present in groundwater to the vapor phase for removal by the vapor phase carbon adsorption system.

Both the flow rate and the concentration of specific volatile organics were used to determine the diameter and height of the air stripping tower that would be needed to achieve the required MCL concentrations. Preliminary sizes of the various treatment units are presented in Appendix A. It should be noted that the height of the air stripping tower at Wildwood is estimated at 35 feet which approaches the maximum height of 40 feet for air stripping. This height or an equivalent two stage air stripper (i.e., two towers in series at 18 feet height each) would be required if necessary to achieve the MCLs due to the high groundwater contaminant concentrations at Wildwood. The other individual treatment systems which have lower concentrations of volatile organics would require approximately 20 feet of air stripper tower height.

4.4.3.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist for direct contact with contaminated groundwater, soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure to workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray can be used during the construction phase to suppress fugitive dust. All treatment plants would be

fenced and access would be restricted to authorized personnel which would reduce exposure to the general public. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from the air stripping units. All treatment units would be covered and vapors would be collected and treated by vapor phase activated carbon. As a result air quality concerns would be minimized.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would familiarize them with potential risks and how to avoid them.

No major environmental impacts would be expected from this alternative. Some clearing of trees may be necessary for treatment plant construction at the five source areas. Construction of discharge lines from Wildwood and New England Plastics area to the river would require construction in the wetlands. This construction could have some negative environmental impact on the wetlands temporarily. Discharge of treated water to the Aberjona river would increase the river flow primarily during low flow periods. At a 7 day 10 year low flow of 0.46 cubic feet per second (cfs), the discharge to river flow ratio would be 2.5. But under average flow conditions, the impact on the river is expected to be minimal. Groundwater treatment would be conducted for 20-50 years in the source areas with the objective of achieving MCLs (see Appendix C). However some contaminated water may remain in fractured bedrock at the source areas. It has been estimated to require approximately 22 years to restore the central area aquifer to MCLs (assuming no additional contamination) through a combination of natural attenuation and pumping at the Riley well. This alternative would therefore not completely meet the objective of rapid aquifer restoration.

Long-Term Effectiveness: Eventually, contamination in the groundwater would be reduced by this alternative to within the target ranges throughout the site. Under this alternative source areas would be pumped for 20-50 years with the objective of achieving MCLs. Pumping at the Riley well and natural attenuation is anticipated to remediate the central area to MCLs over a total period of approximately 22 years (see Appendix C). However, a small portion of the contaminant groundwater in this area may migrate offsite. The effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain. Some residual contamination could remain in the bedrock.

Reduction of Toxicity, Mobility, or Volume: The extraction at source areas would significantly reduce the migration of contaminants to the central area of the site. Pretreatment and air stripping processes would directly reduce the toxicity, mobility and volume of contaminants in groundwater. Approximately 99.9 percent VOC removal is expected by the air stripping technology. Regeneration of spent activated carbon would ultimately destroy the adsorbed contaminants. Significant quantities of pretreatment sludge would be generated for disposal at an off-site facility. Widespread low level contamination in the central area would undergo slow attenuation under this alternative. Therefore, for the central area, this alternative would not meet the remedial objective of rapid aquifer restoration to MCLs. This alternative would reduce the toxicity, mobility, and volume of the contaminated groundwater in the overburden. Contaminated groundwater in the bedrock would also be mitigated but to a lesser degree due to non-homogeneity in the bedrock, and the uncertain capture efficiency of the extraction pumping system in the bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been used extensively to treat sanitary, industrial and hazardous wastewaters. The design and construction of treatment plants at source areas at the Wells G&H site would not pose any unique problems. Air stripping can remove the volatile contaminants of concern. The proposed treatment scheme for this alternative would be expected to attain discharge requirements, once system operations were optimized. Overall, it is expected that the removal efficiency for total VOCs would be greater than 99.9 percent under optimum conditions. No major technical problems leading to schedule delays would be expected. If the total volume of groundwater to be treated is higher than originally anticipated, the time of operation of the treatment plants can be extended. All treatment units would be covered and vapors will be collected and treated by vapor phase activated carbon. As a result air quality concerns would be minimized. It may not be possible to pump all the contaminated water from fractured bedrock. Proper operation and routine maintenance of treatment plants would be required to achieve treatment goals. No replacement of technical components would be expected. With every regeneration, some loss of activated carbon is expected in the vapor phase activated carbon system. Replacement or make-up carbon would be required occasionally.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plants. Since the treatment plants would be on-site, they could be installed without obtaining federal, state, or local permits although treatment activities must comply with substantive requirements of the permits. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and require no Massachusetts or NPDES permit. Construction and maintenance of separate treatment plants could strain administrative resources.

- Availability of Services and Materials: Treatment plants at all source areas would be designed to operate at predetermined pumping rates at each plant. All the components of the treatment scheme are readily available from more than one vendor. Competitive bids can be obtained from a number of vendors. Necessary specialists are available for design, construction, and operation of the treatment plants. Treatability studies may be required to optimize the design and operating conditions for each of the source areas since they all have different chemical contaminant mixtures and concentrations.

Cost: The total present worth of this alternative is estimated at $65.2 million as summarized in Table 4-22 and includes a capital cost of $8.1 million, and annual operations and maintenance costs of $3.7 million. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance With ARARs: The compliance of the Alternative MOM-2 with action- and location- specific ARARs is summarized in Table 4-23.

Overall Protection of Human Health and Environment: This alternative would control the migration of contaminated groundwater from the source areas to the central area and beyond thereby preventing further contamination of the aquifer. Extraction and treatment would eventually remove contaminants from the overburden and bedrock groundwater. Volatile organic contaminants removed in this alternative would be ultimately destroyed during carbon regeneration. Iron and manganese removed by pretreatment would be disposed of with pretreatment sludge. Toxicity, mobility, and volume of contaminants in groundwater would be reduced. This alternative is anticipated to require approximately 20-50 years to remediate all the source areas and a total of approximately 22 years to remediate the central area.

TABLE 4-22

COST ESTIMATE FOR ALTERNATIVE MOM-2A(i) PUMP SOURCE AREAS, PRETREATMENT AND AIR STRIPPING AT SEPARATE TREATMENT PLANTS

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	73,000
B. Support Facilities	780,000
C. Pumping/Collection and Piping	688,000
D. Pretreatment Including Equalization	1,252,000
E. Air Strippers	262,000
F. Carbon Adsorbers (Vapor Phase)	1,010,000
G. Discharge System	470,000
H. Buildings	1,009,000
I. Indirect Construction Costs	430,000
TOTAL DIRECT CONSTRUCTION COSTS	5,974,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	2,150,500
TOTAL CAPITAL COSTS	8,124,500
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	3,713,500
III. PRESENT WORTH OF O&M COSTS	57,083,900
IV. TOTAL PRESENT WORTH*	65,208,400

*Present Worth Analysis based on 30 year period and 5% discount rate.

TABLE 4-23

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Pretreatment sludge and carbon adsorption waste management and off-site disposal will proceed in accordance with RCRA requirements.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of excavated soil treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o These regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of treatment sludges, and other materials will adhere to these standards.

TABLE 4-23 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on site and procedures will be followed during groundwater monitoring.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o CWA - National Pollutant Discharge Elimination System (NPDES) (40 CFR 122-125)[1]	o Provides permitting process for surface water body point source discharges.	o Water discharges to the Aberjona River will be treated to ensure that violations of the Clean Water Act do not occur.

TABLE 4-23 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Water Discharge Permit Program Requirements (314 CMR 3.00)[1]	o Provides permitting process for surface water body point discharges. This requirement is generally identical to the CWA-NPDES requirement.	o Water discharge to the Aberjona River will be treated to ensure that violations of the DEQE water discharge limitations do not occur.
o DEQE - Surface Water Quality Standards (314 CMR 4.00)[1]	o This regulation consists of surface water classifications which designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Water discharges to the Aberjona River will be treated to ensure that violations of the DEQE water quality standards for that water body do not occur.
o DEQE - Groundwater Quality Standards (314 CMR 6.00)[1]	o This regulation consists of groundwater classifications that designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Class I groundwater quality criteria will be acheived at end of the remediation process.
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency in air stripping/carbon adsorption facilities.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachussetts considers liquids contaminated with PCBs greater than 50 ppm to be hazardous wastes (#M002).
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)(1)	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.

TABLE 4-23 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 3748, February 5, 1987)	o This proposal would set performance standards for RCRA treatment facility air emissions.	o Volatilization facilities and other non-incinerators that have air emissions (e.g., air strippers) will be designed to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	o There is adequate space to site treatment plants outside a floodplain. Pipes extending from pumping areas and treatment plants through floodplain do not present any risk of washout due to flooding and will not displace the floodplain.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement of fill pursuant to remediation activities in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o There is adequate space to site treatment plants outside Section 404 wetlands. Excavation and subsurface placement of extraction wells and piping to and from source areas and treatment plants will be designed to match preconstruction

TABLE 4-23 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
		bottom contours. These actions meet the terms of the U.S. Army Corps of Engineers Nationwide Permit No. 12 (33 CFR 330.5(a)(12)). This permit provides authorization under Section 404 for discharge of material for backfill or bedding for "utility lines", provided there is no change in preconstruction bottom contours. A "utility line" is defined as a pipe for the transportation of any liquid for any purpose.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o Extraction pipes will be laid underground through regulated wetlands, floodplains, and buffer zones. This will not cause loss of flood storage capacity, and will only temporarily disturb wetlands. The performance standards of the regulations will therefore be achieved. All treatment facilities will constructed above the 100-year flooplain elevation (e.g., 48 feet above sea level).
o Massachusetts Waterways Licenses (310 CMR 9.00)[1]	o Controls dredging, filling, and other work in waters of the Commonwealth.	o Alternatives involving source area pumping and central area treatment require placement of pipes under and across the Aberjona River. Pertinent requirements will be followed regarding dredging methods and management of dredged soil.
o Massachusetts Certification for Dredging and Filling (314 CMR 9.00)[1]	o Establishes water quality-based standards for filling activities (CWA Section 401).	o Alternatives involving source area pumping and central area treatment require placement of pipes under and across the Aberjona River. Proper measures will be taken to avoid contravention of water quality standards (i.e., turbidity) during installation of pipes.

TABLE 4-23 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 2A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3A Pretreatment and Air Stripping at Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4A(i) Pretreatment and Air Stripping at Separate Treatment Plants
- 4A(ii) Pretreatment and Air Stripping at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Inland Wetland Orders (302 CMR 6.00)[2]	o Defines wetland areas, establishes encroachment lines along waterways or floodplain areas, and regulates activities in these areas.	o Some pipes connecting central treatment plants will be laid across the river. In these cases, consultation with DEQE regarding proper construction will occur.
o Operation and Maintenance and Pretreatment Standards for Waste Water Treatment Works and Indirect Discharges (314 CMR 12.00)[2]	o Insures the proper operation and maintenance of waste water treatment facilities including operation and maintenance, sampling, and discharges.	o Guidelines appropriate for a wastewater treatment facility will be followed.
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands.	o The placement of pipes in wetlands, is necessary to connect the central treatment plants, therefore it is consistent with this Executive Order.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial values of floodplains.	o The placement of pipes in floodplains, below grade, poses no additional flood hazard and meets the requirements of the Executive Order.
4) Location-Specific TBCs		
o EPA Groundwater Protection Strategy	o EPA classifies groundwater into three categories depending on current, past or potential use. This serves as a guide for protection of the resource.	o Wells G&H aquifer is a Class IIB aquifer-potentially usable aquifer. Under all MOM alternatives, the aquifer would be useable as a Class II B at the end of the remediation period.

[1]Applicable

[2]Relevant and Appropriate

Therefore, for the central area, this alternative would not meet the objective of rapid aquifer restoration to MCLs. There is also uncertainty regarding the extent of groundwater remediation in fractured bedrock. This alternative would result in protection of human health and the environment, but restoration would only be achieved in an overall time frame of 20-50 years.

4.4.4 Alternative MOM-2A(ii): Pump Source Areas, Pretreatment and Air Stripping at a Central Treatment Plant

4.4.4.1 Description

This alternative is similar to alternative MOM-2A(i) except that all the extracted groundwater from the individual source areas is piped to a central location and treated at one central treatment plant using pretreatment and air stripping (Figure 4-3). A flow of 516 gpm and a groundwater VOC concentration of 30,860 ppb has been used for this alternative. The treatment scheme for this Alternative is the same as that of MOM-2A(i).

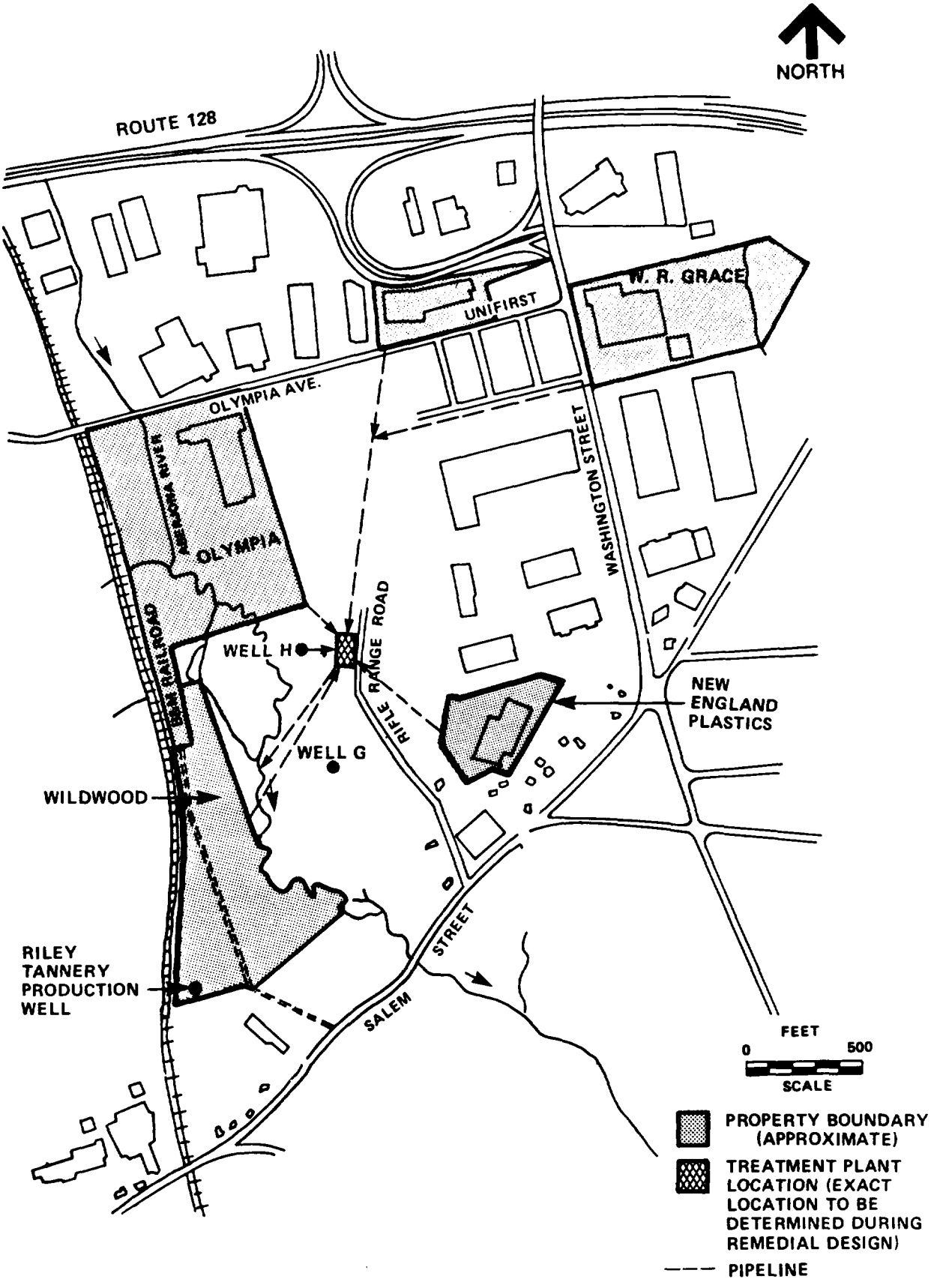
The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood, and Olympia)
- install force mains to connect extraction wells to a central treatment plant
- construct one groundwater treatment plant using pretreatment and air stripping
- pump groundwater from the extraction wells to one central treatment plant
- discharge treated water to the Aberjona River
- regenerate spent vapor phase activated carbon on-site by thermal treatment
- disposal of pretreatment sludge at an off-site facility
- monitor treatment plant effluent and groundwater to review the remediation efficiencies.

4.4.4.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist from direct contact with contaminated groundwater, soils, and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operations. Water spray would be used during the construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only which would reduce exposure of general public. No major

FIGURE 4-3
MOM-2
PUMP SOURCE AREAS AND TREAT AT CENTRAL TREATMENT PLANT



risk to the community during treatment plant operation would be expected. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from the air stripping units.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and the safety training provided to treatment plant operators would familiarize them of potential risks and how to avoid them.

This alternative may also require clearing of some trees for treatment plant construction at the central area. Piping from Olympia, Wildwood areas to the central treatment plant and the discharge line from the central treatment plant would traverse wetlands and cross the river. This wetlands construction would have some negative environmental impacts on the wetlands temporarily. Discharge of treated water to the Aberjona river would increase the river flow primarily during low flow periods. At a 7 day 10 year low flow of 0.46 cfs, the ratio of treatment plant discharge to river flow could go as high as 2.5. However under average flow conditions the impact is expected to be minimal. Groundwater treatment would be conducted for 20-50 years in the source areas with the objective of achieving MCLs (see Appendix C). Under this alternative a combination of pumping at the Riley well and natural attenuation is anticipated to achieve MCLs in the central area aquifer in approximately 22 years assuming no additional contamination. Therefore, this alternative would not achieve the objective of rapid aquifer restoration to MCLs.

Long-Term Effectiveness: Eventually, contamination in the groundwater would be reduced by this alternative to within the target ranges everywhere at the site. Similar to MOM-2A(i), in this alternative source areas would be pumped for 20-50 years with the objective of remediation to MCLs. Pumping at the Riley well and natural attenuation is anticipated to remediate the central area to MCLs over a total period of approximately 22 years (see Appendix C). However, a small portion of the contaminated groundwater in this area may migrate off-site. The effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain. Some residual contamination may remain for this alternative. This alternative would therefore not completely meet the objective of rapid aquifer restoration.

This alternative would meet required process efficiencies. Treatment plant operations and maintenance would require long-term management and monitoring. Routine operation and maintenance of the treatment plants in addition to monitoirng contaminant migration would be required. No uncertainties associated with long-term operation of the treatment plant are expected. With every regeneration of vapor phase activated carbon some loss of carbon would be expected. Replacement or make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: Extraction at source areas and treatment, by pretreatment and air stripping at a central area would significantly reduce the migration of contaminants from source areas. Pretreatment and air stripping processes would directly reduce the toxicity, mobility and volume of contaminated groundwater. Approximately 99.9 percent VOC removal would be expected by the air stripping technology. Regeneration of spent vapor phase activated carbon would ultimately destroy the volatile organic contaminants. Significant quantities of pretreatment sludge would be generated which would be disposed of at an off-site RCRA facility. However, MCLs would not be rapidly achieved in the central area. This alternative would reduce the toxicity, mobility, and volume of the contaminated groundwater throughout the site. Some uncertainty does exist regarding the time frame necessary to achieve MCLs in the bedrock. Contaminated groundwater in the bedrock would be mitigated to a lesser degree due to non-homogeneity in the bedrock and uncertain collection efficiency of the extraction pumping system in the bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been extensively used to treat sanitary, industrial, and hazardous wastewaters. The design and construction of a treatment plant at the central area would not pose any unique problems. Pumping extracted water from five different source locations to the central area would, however, require extensive piping. Piping from Olympia and Wildwood areas would require layout through the wetlands and across the river. This might pose some construction problems. Air stripping can remove the volatile contaminants of concern. The proposed pumping and treatment scheme for this alternative would be expected to attain MCLs in the source areas, once system operations were optimized. Some uncertainty exists regarding the time to achieve MCLs in the bedrock. Overall, it is expected that removal efficiency for total VOCs would be greater than 99.9 percent under optimum conditions. No major technical problems leading to schedule delays would be expected. If the total volume of groundwater to be treated is higher than originally anticipated, the time of operation of the treatment plant can be extended to treat all water in these areas to achieve target risk levels. All treatment units would be covered and vapors would be collected and treated by vapor phase activated carbon. As a result, air quality concerns would be minimized. It may be difficult to monitor the effectiveness of remediation of contamination in the bedrock.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plant. Since the treatment plant would be on-site, it can be installed without obtaining federal, state or local permits although construction and treatment activities must comply with substantive requirements of the permits. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the Aberjona River would likely be considered "on-site" and require no Massachussetts or NPDES permits. Management of the construction and maintenance of one central treatment plant is administratively easier then management of several plants.

- Availability of Services and Materials: The treatment plant would be designed to handle total flow from all source areas (approximately 516 gpm). All of the components of the treatment scheme are readily available from a number of vendors. Competitive bids can be obtained from a number of vendors. Necessary specialists are available for design, construction, and operation of the treatment plants.

Cost: The total present worth of this alternative is estimated at $27.4 million as summarized in Table 4-24, and includes a capital cost of $4.6 million and annual operations and maintenance cost of $1.5 million. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance With ARARs: The compliance of the Alternative MOM-2A(ii) with action- and location-specific ARARs is summarized in Table 4-23.

Overall Protection of Human Health and Environment: This alternative would control the migration of contaminated groundwater from the source areas to the central area and beyond thereby preventing further contamination of the aquifer. Extraction and treatment by this alternative would eventually remove contaminants from groundwater. Volatile organics removed in this alternative would be ultimately destroyed during regeneration of spent vapor phase activated carbon. Iron and manganese removed during pretreatment would be disposed at an off-site facility with pretreatment sludge. The toxicity, mobility, and volume of contaminants in groundwater would be reduced. Similar to MOM-2A(i), this alternative is estimated to require approximately 20-50 years to remediate the source areas to MCLs and a total of approximately 22 years to remediate the central area (based on the assumptions of Appendix C). Also, as with MOM-2A(ii), there is uncertainty regarding the extent of groundwater remediation in fractured bedrock. For the central area this alternative would not meet the objective of rapid aquifer restoration to MCLs.

TABLE 4-24

COST ESTIMATE FOR ALTERNATIVE MOM-2A(ii) PUMP SOURCE AREAS, PRETREATMENT AND AIR STRIPPING AT A CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	18,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	1,285,000
D. Pretreatment Including Equalization	872,000
E. Air Stripping System	83,000
F. Carbon Adsorbers (Vapor Phase)	410,000
G. Discharge System	110,000
H. Buildings	340,000
I. Indirect Construction Costs	100,000
TOTAL DIRECT CONSTRUCTION COSTS	3,374,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	1,214,600
TOTAL CAPITAL COSTS	4,588,600
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	1,485,400
III. PRESENT WORTH OF O&M COSTS	22,833,600
IV. TOTAL PRESENT WORTH*	27,422,200

*Present Worth Analysis based on 30 year period and 5% discount rate.

4.4.5 Alternative MOM-2B(i): Pump Source Areas, Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants

4.4.5.1 Description

This alternative is the same as MOM-2A(i) (Figure 4-2) except that UV/chemical oxidation is used in place of air stripping for the groundwater treatment system. Ultraviolet photolysis and chemical oxidation could be used for the ultimate destruction of the organics. This treatment method is an innovative technology in which ultraviolet light and chemical oxidants are used to create free radicals which oxidize organics such as TCE and PCE to carbon dioxide and water in a relatively short detention time. The pretreatment schemes for MOM-2A(i) and MOM-2B(i) are identical. Treated groundwater would be discharged to the Aberjona River.

The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood, and Olympia)
- construct groundwater treatment plants at five locations using pretreatment and UV/chemical oxidation
- pump groundwater from extraction wells to individual source area treatment plants
- treat groundwater on-site at five source area locations using pretreatment and UV/chemical oxidation
- discharge treated water to the Aberjona River
- regenerate spent vapor phase activated carbon
- dispose of pretreatment sludge at an off-site facility
- monitor treatment plant effluent and groundwater to review the remediation efficiencies.

4.4.5.2 Assessment

Short-Term Effectiveness: The potential public health threats to area residents and workers during construction would be direct contact with contaminated groundwater and soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray would be used during the construction phase to suppress fugitive dust. All treatment plants would be fenced and access would be restricted to authorized personnel only which would reduce exposure to the general public. Vapor

phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from pretreatment processes.

The risk to workers would be minimized by the use of adequate preventative measures and personal protection equipment. Health and safety training would be provided to treatment plant operators to familiarize them with potential risks and how to avoid them.

No major environmental impacts would be expected from this alternative. Some clearing of trees may be necessary for treatment plant construction at the five locations. Construction of discharge lines from Wildwood and Olympia areas to the river would require construction in the wetlands. This construction would have some negative environmental impacts on the wetlands temporarily. Discharge of treated water to the Aberjona river would increase the river flow primarily during low flow periods. At a 7 day 10 year low flow of 0.46 cfs, the ratio of discharge to river flow would be as high as 2.5. However, under average flow conditions the impact is expected to be minimal. Groundwater treatment would be conducted for 20-50 years in the source areas with the objective of achieving MCLs (see Appendix C). However, some contaminated water could remain in fractured bedrock. It is estimated that it could require approximately 22 years to restore the central area to MCLs. The overall duration of the remedial alternative is estimated to take approximately 20-50 years to meet aquifer restoration goals assuming no additional contamination. This alternative would therefore not completely meet the objective of rapid aquifer restoration in a reasonable time frame.

Long-Term Effectiveness: Eventually contamination in the groundwater would be reduced by this alternative to within target ranges throughout the site. Similar to MOM-2A(i), in this alternative source areas would be pumped for 20-50 years with the objective of achieving MCLs. Pumping at the Riley well and natural attentuation would remediate the central area to MCLs over an anticipated total period of approximately 22 years. However, a small portion of the contaminated groundwater in this area may migrate off-site. Again the effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain. Some residual contamination may remain in the bedrock.

UV/chemical oxidation is an innovative technology for destruction of volatile organics. It has been used to treat industrial waste water, however, no data is available on its full scale application at hazardous waste sites. This alternative would be expected to meet required process efficiencies. Proper operation and routine maintenance would be required to achieve treatment goals. Frequent replacement of UV lamps would be expected in this alternative. With every regeneration, some loss of activated carbon would be expected in vapor phase activated carbon system. Replacement or make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: Pumping and treatment would control the migration and mobility of contaminants from highly contaminated source areas to the central area of the site and beyond. Pretreatment would remove suspended solids and metals from water. UV/chemical oxidation would destroy volatile organics to carbon dioxide and water thereby reducing toxicity and volume of contaminants considerably. More than 99.9 percent VOC removal is expected in this alternative. The treatment process would be irreversible. Significant quantities of pretreatment sludge would be generated which would be disposed at an off-site facility. Regeneration of vapor phase activated carbon adsorption systems would utlimately destroy adsorbed volatile organics. Under this alternative clean-up of widespread low level contaminated groundwater in the central areas of the Wells G&H site would result from natural attenuation and pumping at the Riley well over time. However, MCLs would not be rapidly achieved in this area. This alternative would reduce the toxicity, mobility and volume of the contaminated groundwater in the overburden. Contaminated groundwater in bedrock would also be mitigated but there is some uncertainty in the capture efficiency of the extraction system in the bedrock.

Implementability:

- Technical Feasibility: UV/chemical oxidation is an innovative technology which destroys organics to carbon dioxide and water. This technology has been extensively tested on the pilot scale level but only two full scale plants have been designed. No performance data is available on full scale systems or at Superfund sites. The UV/chemical oxidation system can achieve greater than 99.9 percent VOC removal depending on residence time, chemical oxidant dose and UV light intensity. High voltage power lines are required for this alternative due to high power requirements of the UV/chemical oxidation process. If the total volume of groundwater to be treated is higher than originally anticipated, operation of the treatment plants can be extended to treat all water to achieve target levels. Proper operation and control of the treatment plants would be required to meet treatment objectives. Effluent monitoring and sampling of monitoring wells would be required to determine treatment plant performance and to monitor the migration of contaminated groundwater. A treatability study would be required to develop process design information for the remedial design. This may lead to schedule delays. No exposure pathways exist which can not be monitored.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plants. Since the treatment

plants would be on-site, they could be installed without obtaining federal, state, or local permits although treatment activities must comply with substantive requirements of the permit. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the Aberjona river would likely be considered "on-site" and require no Massachusetts or NPDES permits. Some administrative efforts would be required to obtain high voltage power lines required for UV/chemical oxidation process. Construction and maintenance of separate treatment plants could strain administrative resources.

- Availability of Services and Materials: All the components of this treatment scheme except the UV/chemical oxidation system are readily available from a number of vendors and competitive bids would be available from more than one vendor. The UV/chemical oxidation system is apparently available from only two vendors at present time. Due to the lack of full scale data the UV/chemical process is considered innovative. Some uncertainties exist regarding the technology's performance. The UV lamps are expected to require frequent replacement. Vapor phase activated carbon may require occasional replacement or make-up. Specialists are limited for UV/chemical system design, construction and operation. Treatability studies would be required to optimize the design and operating conditions for each of the plants. This may delay the design and the start-up of treatment plants.

Cost: The total present worth of this alternative is estimated at $89.1 million (Table 4-25) and includes a capital cost of $10.3 million and annual operation and maintenance cost of $5.1 million. Detailed supportive data used to derive these estimates are presented Appendix A and B.

Compliance With ARARs: The compliance of the Alternative MOM-2B(i) with action- and location-specific ARARs is summarized in Table 4-26.

Overall Protection of Human Health and the Environment: This alternative would control the migration of contaminated groundwater from the source areas to the central area and beyond, thereby preventing further contamination of the aquifer. Extraction and treatment through implementation this alternative would remove contaminants from groundwater. Volatile organics removed in this alternative would ultimately be destroyed by the UV/chemical oxidation process and carbon regeneration. Iron and manganese removed by pretreatment would be disposed of with pretreatment sludge. Toxicity, mobility,

TABLE 4-25

COST ESTIMATE FOR ALTERNATIVE MOM-2B (i)
PUMP SOURCE AREAS, PRETREATMENT AND UV/CHEMICAL OXIDATION
AT SEPARATE TREATMENT PLANTS

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	73,000
B. Support Facilities	780,000
C. Pumping/Collection and Piping	688,000
D. Pretreatment Including Equalization	1,252,000
E. Chemical Oxidation System (UV/H_2O_2)	967,000
F. Carbon Adsorber (Vapor Phase)	750,000
G. Discharge System	470,000
H. Building	1,009,000
I. Indirect Construction Costs including power lines	1,367,500
J. Treatability Study	250,000
TOTAL DIRECT CONSTRUCTION COSTS	7,606,500
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	2,738,500
TOTAL CAPITAL COSTS	10,345,000
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	5,120,400
III. PRESENT WORTH OF O&M	78,710,800
IV. TOTAL PRESENT WORTH*	89,055,800

* Present Worth Analysis based on 30 year period and 5% discount rate.

TABLE 4-26

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facilities will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Pretreatment, sludge management and off-site disposal will proceed in accordance with RCRA requirements.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of treatment sludges and other materials will adhere to these standards.

TABLE 4-26 (Cont'd)
ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretretment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
		bottom contours. These actions meet the terms of the U.S. Army Corps of Engineers Nationwide Permit No. 12 (33 CFR 330.5(a)(12)). This permit provides authorization under Section 404 for discharge of material for backfill or bedding for "utility lines", provided there is no change in preconstruction bottom contours. A "utility line" is defined as a pipe for the transportation of any liquid for any purpose.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o Eextraction pipes will be laid underground through regulated wetlands, floodplains, and buffer zones. This will not cause loss of flood storage capacity, and will only temporarily disturb wetlands. The performance standards of the regulations will therefore be achieved. All treatment facilities will be constructed above the 100-year floodplain elevation (e.g., 48 feet above sea level.
o Massachusetts Waterways Licenses (310 CMR 9.00)[1]	o Controls dredging, filling, and other work in water of the Commonwealth.	o Alternatives involving source area pumping and central area treatment require placement of pipes under and across the Aberjona River. Pertinent requirements will be followed regarding dredging methods and management of dredged spoil.
o Massachusetts Certification for Dredging and Filling (314 CMR 9.00)[1]	o Establishes water quality-based standards for filling activities (CWA Section 401).	o Alternatives involving source area pumping and central area treatment require placement of pipes under and across the Aberjona River. Proper measures will be taken to avoid contravention of water quality standards (i.e., turbidity) during installation of pipes.

TABLE 4-26 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of treatment sludges and other materials will adhere to these standards.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection at site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on site and procedures will be followed during groundwater monitoring.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o CWA - National Pollutant Discharge Elimination System (NPDES) (40 CFR 122-125)[1]	o Provides permitting process for surface water body point source discharges.	o Water discharges to the Aberjona River will be treated to ensure that violations of the Clean Water Act do not occur.

TABLE 4-26 (Cont'd)
ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Water Discharge Permit Program Requirements (314 CMR 3.00)[1]	o Provides permitting process for surface water body point discharges. This requirement is generally identical to CWA NPDES.	o Water discharges to the Aberjona River will be treated to ensure that violations of the DEQE water discharge permit program do not occur.
o DEQE - Surface Water Quality Standards (314 CMR 4.00)[1]	o This regulation consists of surface water classifications which designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Water discharges to the Aberjona River will be treated to ensure that violations of the DEQE water quality standards for that water body do not occur.
o DEQE - Groundwater Quality Standards (314 CMR 6.00)[1]	o This regulation consists of groundwater classifications which designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Class I groundwater quality criteria will be achieved at end of the remediation process.
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions from pretreatment units to 99.99 percent combustion efficiency in vapor phase carbon adsorption.
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers liquids contaminated with PCBs greater than 50 ppm to be hazardous wastes (M002).
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.

TABLE 4-26 (Cont'd)
ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 3748, February 5, 1987)	o The proposal would set performance standards for RCRA treatment facility air emissions.	o Vapor phase carbon adsorption facilities and other non-incinerators that have air emissions will be designed to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain. A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	o There is adequate space to site treatment plants outside a floodplain. Pipes extending from pumping areas and treatment plants through floodplains do not present any risk of washout due to flooding and will not displace floodplains.
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation activities in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o There is adequate space to site treatment plants outside Section 404 wetlands. Excavation and subsurface placement of extraction wells and piping to and from source areas and treatment plants will be designed to match preconstruction

TABLE 4-26 (Cont'd)
ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-2 Pump and Treat Source Areas
- 2B(i) Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants
- 2B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-3 Pump and Treat Central Area
- 3B Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

MOM-4 Pump and Treat Source Areas and Central Area
- 4B(i) Pretretment and UV/Chemical Oxidation at Separate Treatment Plants
- 4B(ii) Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Inland Wetland Orders (302 CMR 6.00)[2]	o Defines wetland areas, establishes encroachment lines along waterways or floodplain areas, and regulates activities in these areas.	o Some pipes connecting central treatment plants will be laid across the river. In these cases, consultation with DEQE regarding proper construction will occur.
o Operation and Maintenance and Pretreatment Standards for Waste Water Treatment Works and Indirect Discharges (314 CMR 12.0)[2]	o Insures the proper operation and maintenance of waste water treatment facilities including operation and maintenance, sampling, and discharges.	o Guidelines appropriate for a wastewater treatment facility will be followed.
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If no practicable alternative exists impacts must be mititated	o The placement of pipes in wetlands, is necessary to connect the central treatment plants. Therefore, it is consistent with the requirements of the Executive Order.
o Floodplains Executive Order (EO 11888)[1]	o Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o The placement of pipes in wetlands, below grade, poses no additional flood hazard and meets the requirements of the Executive Order.
4) Location-Specific TBCs		
o EPA Groundwater Protection Strategy	o EPA classifies groundwater into three categories depending on current, past or potential use. This serves as a guide for protection of the resource.	o Wells G&H aquifer is a Class II B aquifer-potentially usable aquifer. At the end of remediation, all MOM alternatives will attain standards for Class IIB aquifers.

[1]Applicable
[2]Relevant and Appropriate
9428b

and volume of contaminants in groundwater would be greatly reduced. Some uncertainties regarding performance of the UV/chemical oxidation system exists due to lack of full scale performance data. Similar to MOM-2A(i), this alternative is assumed to require approximately 20-50 years to remediate the source areas to MCLs and a total of approximately 22 years to remediate the central area. Therefore, this alternative would not meet the objective of rapid aquifer restoration to MCLs. There is also uncertainty regarding the extent of remediation of contaminated groundwater in fractured bedrock in the respective source areas. This alternative would result in protection of human health and the environment but in an overall time frame of approximately 20-50 years.

4.4.6 Alternative MOM-2B(ii): Pump Source Areas, Pretreatment and UV/Chemical Oxidation at Central Treatment Plant

4.4.6.1 Description

This alternative is similar to alternative MOM-2A(ii) (Figure 4-3) except that air stripping is replaced by a UV/chemical oxidation process. A flow of 516 gpm and groundwater contaminant concentration of 30,860 ppb VOC has been used for preliminary sizing and cost estimating.

The major work items associated with this alternative are:

- install extraction wells at each of the five properties (W.R. Grace, Unifirst, New England Plastics, Wildwood, and Olympia)
- install force mains to connect extraction pumps from wells to the central treatment plant
- construct one groundwater teatment plant using pretreatment and UV/chemical oxidation
- pump groundwater from extraction wells to one central treatment plant
- discharge treated water to the Aberjona River
- regenerate spent activated carbon on-site by thermal treatment
- disposal of pretreatment sludge at an off-site facility
- monitor treatment plant effluent and groundwater to review the remediation efficiencies.

4.4.6.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist from direct contact with contaminated groundwater and soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and

organic vapors during the construction and treatment plant operation. Water spray would be used during the construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only thus reducing the exposure of the general public. Possible volatile emissions from the treatment would be low since air stripping is not involved. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from the pretreatment system.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would familiarize them with potential risks and how to avoid them.

No major environmental impacts are expected from construction of the treatment plant. Some clearing of trees may be necessary for treatment plant construction at one location. The ratio of discharge of treatment water to the Aberjona river will increase the river flow primarily during low flow periods. The ratio of discharge to river flow ratio at a 10 year, 7 day low flow of 0.46 cfs is as high as 2.5. Under average flow conditions the impact on the river is expected to be minimal. Groundwater treatment would be conducted for 20-50 years in the source areas with the objective of achieving MCLs. This alternative would need extensive piping to bring extracted ground-water from source areas to the central treatment plant. Piping from Wildwood and Olympia areas to the central treatment plant and the discharge line from the central treatment plant would traverse wetlands and cross the river. This wetlands construction would have some negative environmental impacts on the wetlands temporarily. Some contaminated water could remain in fractured bedrock. The time required to restore the central areas to MCLs has been estimated to be approximately 22 years assuming no additional contamination. The duration of this remedial alternative is estimated to be 20-50 years to meet aquifer restoration goals. This remedial alternative would therefore not meet the objective of rapid aquifer restoration.

Long-Term Effectiveness: Eventually contamination in the groundwater would be reduced by this alternative to within the target risk range throughout the site. Under this alternative source areas would be pumped for 20-50 years with the objective of achieving MCLs. Pumping at the Riley well and natural attenuation is anticipated to remediate the central area to MCLs over a total period of approximately 22 years (see Appendix C).

However, a small portion of the contaminated groundwater in this area may migrate off-site. The effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain and some residual contamination would remain for this alternative.

Although this alternative is expected to meet required process efficiencies some uncertainties exist due to lack of information. Proper operation and routine maintenance of the treatment plant would be required. The UV lamps are expected to need frequent replacement. With every regeneration of vapor phase activated carbon adsorption system some loss of carbon would be expected. Replacement of carbon would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: Pumping and extraction would control the migration and mobility of contaminants from highly contaminated source areas to the central area and beyond. Pretreatment would remove suspended solids and metals from the water. The UV/chemical oxidation process would destroy organics to form carbon dioxide and water thus reducing toxicity and volume of contaminants considerably. More than 99.9 percent VOC removal would be expected using this alternative. Significant quantities of sludge would be generated by pretreatment and would be disposed of at an off-site facility. Under this alternative clean-up of widespread low level contaminated groundwater in the central area of the Wells G&H site from pumping at the sources and the Riley well and natural attenuation over time. This alternative would reduce the toxicity, mobility, and volume of the contaminated groundwater in overburden. Contaminated groundwater in the bedrock would also be remediated but to a lesser degree than in the overburden due to non-homogeneity and uncertainty in capture efficiency of the extraction system in the bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative except UV/chemical oxidation have been used extensively in treatment of sanitary, industrial, and hazardous wastewaters. The UV/chemical oxidation process is an innovative technology which destroys organics forming carbon dioxide and water. This technology has been extensively tested on a pilot scale, but only two full scale plants have been designed. No performance data are available. The UV/chemical oxidation system can achieve greater than 99.9 percent VOC removal depending on residence time, chemical oxidant dose, and UV light intensity. Piping extracted water from the Olympia and Wildwood areas might pose some constuction problems because it would require laying pipe lines through wetlands and across the river. Proper operation and control of the treatment plant would be required to meet treatment objectives. Effluent monitoring and sampling of monitoring wells would be required to determine the effectiveness of the treatment plant and to monitor the migration of contaminated groundwater.

Extraction would control the migration of contaminated groundwater from source areas. Pretreatment would be effective in removing suspended solids and metals such as iron and manganese. The UV/chemical oxidation process would be effective in destroying volatile organics. A treatability study for the UV/chemical process would be required to develop process design information for the remedial design. This may lead to some schedule delays. If the total volume of groundwater to be treated is higher than originally anticipated, operation of the treatment plant can be extended to treat all water and to achieve treatment goals. No exposure pathways exist which can not be monitored. However, it would be difficult to monitor migration of residual contaminated groundwater in the fractured bedrock.

- Administrative Feasibility: Implementation of this alternative would require the establishment of administrative and institutional responsibilities for the operations and maintenance of the treatment plant. Since the treatment plant would be on-site, its operation could be implemented without obtaining federal, state, or local permits although actions must comply with substantive requirements of the permit. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits. Some administrative effort would be required to obtain a high voltage power line that is required for the UV/chemical oxidation system. Management of the construction and maintenance of one central treatment plant is administratively easier than management of several plants.

- Availability of Services and Materials: All the components of this treatment scheme except the UV/chemical oxidation system are readily available from more than one vendor and competitive bids will be available from more than one vendor. The UV/chemical oxidation system is apparently available from only two vendors at the present time. Due to its innovative nature and lack of data on full scale performance of the UV/chemical oxidation system, the performance of this system is uncertain. The UV lamps are expected to need frequent replacement. Occasional replacement or make up of activated carbon in the vapor phase adsorption system is expected. Specialists to design, construct, and operate the UV/chemical oxidation system may not be readily available. Treatability studies would be required which might lead to schedule delays.

Cost: The total present worth of this alternative is estimated at $44.2 million (Table 4-27) and includes a capital cost of $5.4 million and an annual operations and maintenance cost of $2.5 million. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance With ARARs: The compliance of the Alternative MOM-2B(ii) with action- and location-specific ARARs is summarized in Table 4-26.

Overall Protection of Human Health and the Environment: This alternative would control the migration of contaminated groundwater from the source areas, thereby preventing further contamination of the aquifer. Extraction and treatment by this alternative would eventually remove contaminants from groundwater. Toxicity, mobility, and volume of contaminants in groundwater would be reduced. Similar to MOM-2A(i), this alternative is estimated to require approximately 20-50 years to remediate the source areas to MCLs and a total of approximately 22 years to remediate the central area. Volatile organics removed in this alternative would be destroyed by the UV/chemical oxidation system or during vapor phase activated carbon regeneration. Iron and manganese removed during pretreatment would be disposed of with the pretreatment sludge. There is uncertainty in the amount of contaminated groundwater remediated in fractured bedrock in the source areas. This alterative would not achieve the remedial objective of rapid aquifer restoration to MCLs.

4.4.7 Alternative MOM-3: PUMP AND TREAT CENTRAL AREA

This alternative includes one pump and treat system constructed near the previously abandoned Wells G and H location to treat the contaminated groundwater prior to discharge to the Aberjona River. This pumping scenario would treat contaminated groundwater in the central area as well as intercept contaminated groundwater from the source areas. A total pumping rate of 540 gpm was used for this alternative. The abandoned wells G and H would have to be rehabilitated since the pumps, buildings, and electrical service was dismantled and removed.

The groundwater contaminant concentrations in this central area are lower than those at the source areas, therefore, the preliminary sizing and cost estimates for the treatment system have been based on 155 ppb VOC.

TABLE 4-27

COST ESTIMATE FOR ALTERNATIVE MOM-2B(ii) PUMP SOURCE AREAS, PRETREATMENT AND UV/CHEMICAL OXIDATION AT CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	18,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	1,285,000
D. Pretreatment Including Equalization	872,000
E. Chemical Oxidation System (UV/H_2O_2)	550,000
F. Carbon Adsorber (Vapor Phase)	150,000
G. Discharge System	110,000
H. Building	340,000
I. Indirect Construction Costs Including Power Lines	420,000
J. Treatability Study	50,000
TOTAL DIRECT CONSTRUCTION COSTS	3,951,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	1,422,400
TOTAL CAPITAL COSTS	5,373,400
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	2,528,400
III. PRESENT WORTH OF O&M COST	38,866,600
IV. TOTAL PRESENT WORTH*	44,240,000

* Present Worth Analysis based on 30 year period and 5% discount rate.

4.4.8 Alternative MOM-3A: Pump and Treat Central Area, Pretreatment and Air Stripping at Central Treatment Plant

4.4.8.1 Description

This alternative includes pumping groundwater at Wells G and H followed by pretreatment and air stripping at one central treatment plant (Figure 4-4). Vapor phase carbon adsorption is included to remove the organics in the vapor emissions from the air stripper and pretreatment system.

The major work items associated with this alternative are:

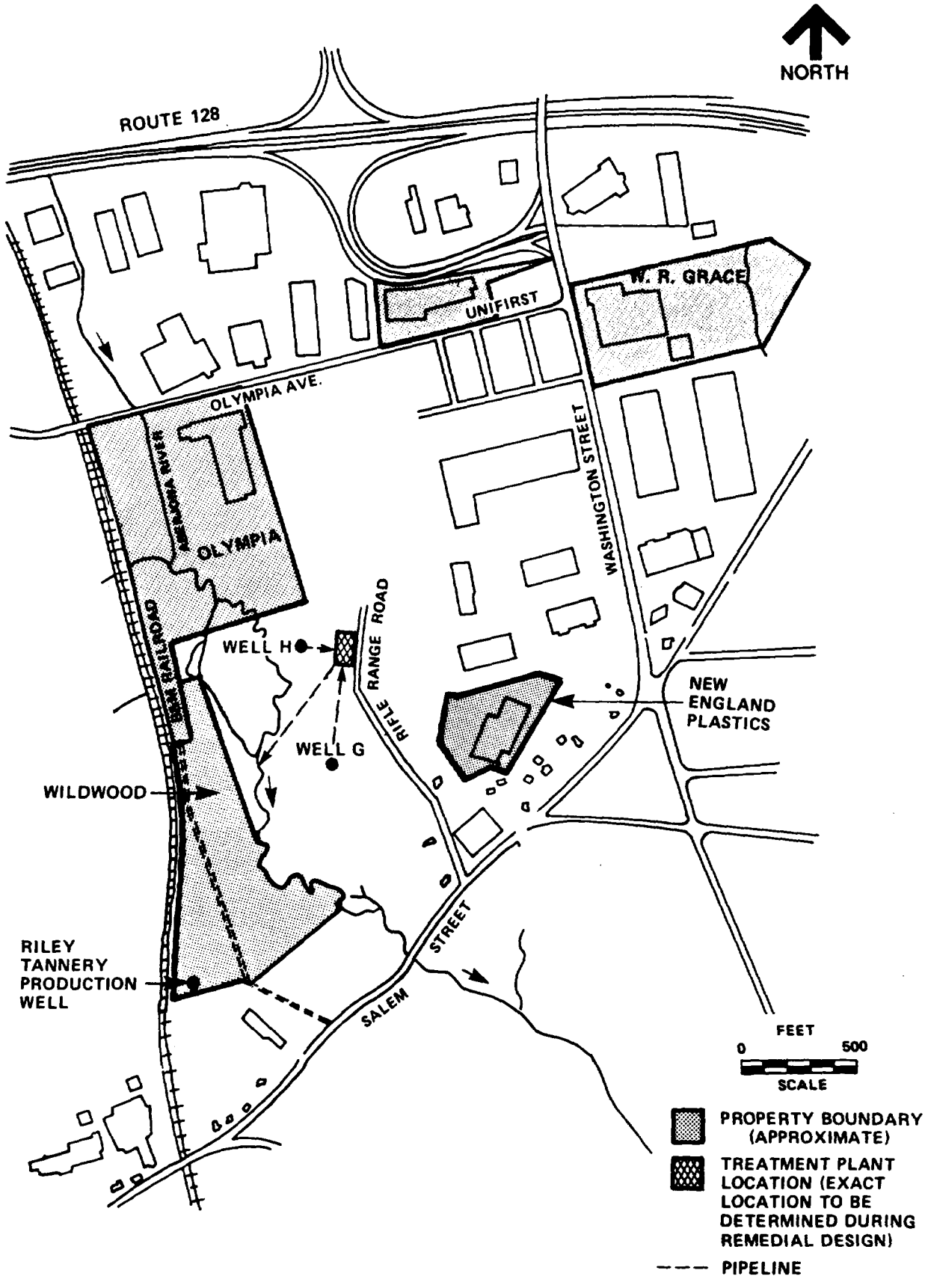
- rehabilitate and restore operation of Wells G and H or install new extraction wells
- pump groundwater at Wells G and H to a treatment plant at 540 gpm
- treat groundwater on-site at a central area using pretreatment and air stripping
- discharge treated water to the Aberjona River
- disposal of pretreatment sludge to an off-site facility
- regenerate spent vapor phase activated carbon
- monitor treatment system performance and groundwater to review the effectiveness of this alternative.

4.4.8.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist from direct contact with contaminated groundwater, soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray would be used during the construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only thereby reducing exposure to the general public. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from the air strippers.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training would be provided for treatment plant operators and would familiarize them with potential risks and how to avoid them.

FIGURE 4-4
MOM-3
PUMP CENTRAL AREA AND TREAT AT CENTRAL TREATMENT PLANT



No major environmental impacts would be expected from this alternative. Some clearing of trees may be necessary for treatment plant construction at the treatment plant location. Construction of a discharge line from the central treatment plant would require construction in the wetlands. This construction would have some negative environmental impact on the wetlands temporarily. Discharge of treated water to the Aberjona river would increase the river flow considerably during low flow periods. The ratio of discharge to river flow at a 10 year, 7 day low flow of 0.46 cfs would be as high as 2.6. However, under average flow conditions the impact on the river is expected to be minimal. Under this alternative Wells G and H would be pumped for in excess of 60 years. Remediation is anticipated to require approximately 20-50 plume volumes to migrate through the source areas (see Appendix C). Since this alternative does not pump the bedrock contaminants directly, the bedrock contamination could continue to recontaminate the overburden. Due to these factors this alternative is anticipated to require in excess of 60 years to remediate the entire site to MCLs based on the assumptions of Appendix C. In addition, the downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area. Therefore this alternative would not meet the remedial objective of rapid aquifer restoration to MCLs.

Long-Term Effectiveness: The extraction and treatment of groundwater by this alternative would significantly reduce migration of contaminants off-site to the south due to the large capture zone for Wells G and H (USGS, 1987). However, a small portion of contaminated groundwater in certain source areas could migrate off-site (see Appendix C). Also, the effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain since no direct bedrock pumping at the sources would occur. Therefore, some residual contamination may remain in the bedrock for this alternative. This residual bedrock contamination might result in future recontamination of the overburden. Therefore, the achievement of MCLs throughout the site is anticipated to require in excess of 60 years.

This alternative would meet required process efficiencies. Proper operation and routine maintenance of the treatment plant would be required to achieve treatment goals. No replacement of technical components are expected. With every regeneration, some loss of activated carbon would be expected in the vapor phase activated carbon system. Replacement or make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility or Volume: Pumping would control the migration of contaminated groundwater off-site, thus preventing contamination of groundwater downgradient of the

site. Air stripping would directly reduce toxicity, mobility, and volume of volatile organics in the groundwater. Approximately 99.9 percent VOC removal is expected by using the air stripping technology. Regeneration of spent activated carbon will ultimately destroy the volatile contaminants. Iron and manganese would be removed by pretreatment. Significant quantities of pretreatment sludge would be generated which would be disposed of at an off-site facility. Some contaminated water in fractured bedrock may remain untreated after remediation since the extraction system may not capture all the contaminated groundwater in the bedrock and would not directly address the bedrock contamination at the sources.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been used extensively to treat sanitary, industrial and hazardous wastewaters. The design and construction of a treatment plant at the central area would not pose any unique problems. Air stripping can remove the volatile contaminants of concern. The proposed treatment scheme for this alternative would be expected to attain discharge requirements, once system operations were optimized. It is expected that removal efficiency for total VOCs would be greater than 99.9 percent under optimum conditions. No major technical problems leading to schedule delays are expected. If the total volume of groundwater to be treated is higher than originally anticipated, the time of operation of treatment plants can be extended. This alternative would not be effective in treating all contaminated water in fractured bedrock in the source areas. All units will be covered and vapors would be collected and treated by vapor phase activated carbon. As a result air quality concerns would be significantly reduced. Migration of residual contaminated groundwater in deep fractured bedrock would be difficult to monitor.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibility for the operation and maintenance of the treatment plant. Since the treatment plant would be located on-site, its operation could be implemented without obtaining federal, state, or local permits, but it would have to meet substantive requirements for the permits. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and not require Massachussetts or NPDES permits.

- Availability of Services and Materials: The treatment plant would be designed to handle an anticipated flow of 540 gpm. All of the components of this treatment scheme are readily available from more than one vendor.

Competitive bids can be obtained from a number of vendors. Necessary specialists are available for the design, construction, and operation of the treatment plant.

Cost: The total present worth of this alternative is estimated to be $24.2 million (Table 4-28) which includes a capital cost of $3.1 million and an annual operations and maintenance cost of $1.4 million. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARs: The compliance of the Alternative MOM-3A with action- and location-specific ARARs is summarized in Table 4-23.

Overall Protection of Human Health and the Environment: This alternative would control the migration of contaminated groundwater downgradient of the site. However, a small portion of contaminated groundwater in the vicinity of the New England Plastics property may migrate off site. Volatile organics removed in this alternative would be destroyed during carbon regeneration. Iron and manganese removed by pretreatment would be disposed of in the sludge. Toxicity, mobility, and volume of contaminants in groundwater would be reduced. However, this alternative would probably not be effective in removing contaminated water from fractured bedrock. In the absence of bedrock pumping, the overburden may be recontaminated through the migration of bedrock contaminants.
The downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area. Therefore, this alternative is anticipated to require in excess of 60 years to achieve MCLs throughout the site and would not meet the objective of rapid aquifer restoration. In short this alternative would result in protection of human health and the environment only after a lengthy remediation period.

4.4.9 Alternative MOM-3B: Pump and Treat at the Central Area, Pretreatment and UV/Chemical Oxidation at a Central Treatment Plant

4.4.9.1 Description

This alternative is similar to alternative MOM-3A (Figure 4-4) except that the treatment scheme includes UV/chemical oxidation instead of air stripping. A flow of 540 gpm and groundwater contaminant concentration of 155 ppb of VOCs has been used for costing this alternative. The treatment scheme for this alternative is same as that of MOM-2B(i). The pretreatment scheme for this alternative and that for MOM-3A are identical.

The major work items associated with this alternative are:

- rehabilitate and restore operation of Wells G and H
- pump groundwater at Wells G and H to the treatment plant at a rate of 540 gpm.

TABLE 4-28

COST ESTIMATE FOR ALTERNATIVE MOM-3A PUMP AND TREAT CENTRAL AREA, PRETREATMENT AND AIR STRIPPING AT A CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	18,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	123,000
D. Pretreatment Including Equalization	918,000
E. Air Stripper	87,000
F. Carbon Adsorber (Vapor Phase)	410,000
G. Discharge System	110,000
H. Building	342,000
I. Indirect Construction Costs	100,000
TOTAL DIRECT CONSTRUCTION COSTS	2,445,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	880,300
TOTAL CAPITAL COSTS	3,079,000
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	1,373,600
III. PRESENT WORTH OF O&M COSTS	21,115,000
IV. TOTAL PRESENT WORTH *	24,194,000

* Present Worth Analysis based on 30 year period and 5% discount rate.

- o treat groundwater on-site at the central area using pretreatment and UV/chemical oxidation
- o discharge treated water to the Aberjona River
- o dispose of pretreatment sludge at an off-site facility
- o regenerate spent vapor phase activated carbon
- o monitor treatment plant effluent and groundwater to review the remediation efficiencies

4.4.9.2 Assessment

Short-Term Effectiveness: The potential public health threat to area residents and workers during construction would be direct contact with contaminated groundwater and soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction phase and treatment plant operation. Water spray would be used during the construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from the pretreatment process.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would familiarize them with the potential risks and how to avoid them.

No major environmental impacts would be expected from this alternative. Some clearing of trees may be necessary for the treatment plant construction at the central location. Construction of discharge lines from the central treatment plant would require construction in the wetlands. This construction would have some negative environmental impact on the wetlands temporarily. Discharge of treated water to the Aberjona river would increase the river flow considerably during low flow periods. The ratio of discharge to river flow at a 10 year, 7 day low flow of 0.46 cfs is as high as 2.6. However, under average flow conditions the impact on the river is expected to be minimal. Under this alternative Wells G and H would be pumped for in excess of 60 years (see Appendix C). Remediation is anticipated to require approximately 20-50 plume volumes to migrate through the source areas. However, since this alternative does not pump the bedrock contamination directly, only slow remediation of the bedrock would occur. Due to these factors, this alternative is anticipated to require in excess of 60 years to achieve MCLs. In addition, the downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area. Some contaminated water could remain in the bedrock in the source areas. Therefore, this alternative would not meet the objective of rapid restoration of the aquifer to MCLs.

Long-Term Effectiveness: The extraction and treatment by this alternative would significantly reduce off site migration of contaminants due to the large capture zone of Wells G and H. However, a small portion of contaminated groundwater in certain source areas may migrate off-site (see Appendix C). Also, the effectiveness of extraction of contaminated groundwater from the fractured bedrock is somewhat uncertain. Some residual contamination may remain for this alternative. This alternative is anticipated to require in excess of 60 years to achieve MCLs and not meet the objective of rapid aquifer restoration to MCLs.

The UV/chemical oxidation alternative is expected to meet required process efficiencies. There are some uncertainties concerning efficiencies due to lack of data. Proper operation and routine maintenance would be required to achieve the treatment goals. Occasional replacement of the UV lamps would be expected in this alternative. With every regeneration, some loss of activated carbon is expected in vapor phase activated carbon system. Replacement or make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: Pumping would control the migration of contaminated water off-site, thus preventing contamination of groundwater downgradient from the site. Volatile organics will be completely destroyed and converted to carbon dioxide and water resulting in permanent reduction in volume, toxicity, and mobility of contaminants. More than 99.9 percent VOC removal would be expected by UV/chemical oxidation. Iron and manganese would be removed by pretreatment. Significant quantities of pretreatment sludge would be generated which will be disposed of at an off-site facility. Some contaminated groundwater in deep fractured bedrock may remain untreated since extraction at central area may not be able to capture all of the groundwater in the bedrock.

Implementability

- Technical Feasibility: The reported efficiency of the UV/chemical oxidation system can be greater than 99.9 percent depending on the residence time, chemical oxidant dose, and UV light intensity. High voltage power lines will be required for this alternative due to high power requirements of the UV/chemical oxidation process. If the total volume of groundwater to be treated is higher than originally anticipated, operation of the treatment plant can be extended to treat all water. Proper operation and control of the treatment plant would be required to meet the treatment objectives. Effluent monitoring and sampling of monitoring wells would be required to determine the effectiveness of the treatment plant and to monitor the migration of contaminated groundwater. A treatability study would be required to develop process design information for the remedial design. This may lead to

schedule delays. No exposure pathways exist which can not be monitored. Migration of residual contaminated groundwater in deep fractured bedrock would be however, difficult, to monitor.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plant. Since the treatment plant would be on-site, it could be implemented without obtaining federal, state, or local permits although these actions must comply with substantive requirements of the permits. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits. Some administrative efforts would be required to obtain the high voltage power lines required for the UV/chemical oxidation process.

- Availability of Services and Materials: All the components of this treatment scheme except the UV/chemical oxidation system are readily available from a number of vendors and competitive bids would be available from more than one vendor. The UV/chemical oxidation system is apparently available from only two vendors at the present time. Due to lack of data for the full scale UV/chemical process, it is considered innovative. Some uncertainties exist regarding its performance. Specialists are limited for this alternative for UV/chemical system design, construction, and operation.

Cost: The total present worth of this alternative is estimated at $28.2 million (Table 4-29) and includes a capital cost of $3.3 million and an annual operations and maintenance cost of $1.6 million. Detailed supportive data used to derive these estimates are presented Appendices A and B.

Compliance With ARARs: The compliance of the Alternative MOM-3 with action- and location-specific ARARs is summarized in Table 4-26.

Overall Protection of Human Health and the Environment: This alternative would control the off-site migration of contaminated groundwater downgradient of the site. However, a small portion of contaminated groundwater in the vicinity of the New England Plastics property may migrate off-site. Extraction and treatment by UV/chemical oxidation would eventually remove organic contaminants from overburden and bedrock. Volatile organics removed by this alternative would be ultimately destroyed by UV/chemical oxidation and spent carbon regeneration. Iron and manganese removed by pretreatment would be disposed of as sludge. The toxicity, mobility, and volume of contaminants in the groundwater would be greatly reduced.

TABLE 4-29

COST ESTIMATE FOR ALTERNATIVE MOM-3B PUMP AND TREAT CENTRAL AREA, PRETREATMENT AND UV/CHEMICAL OXIDATION AT CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	18,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	123,000
D. Pretreatment Including Equalization	918,000
E. Chemical Oxidation System (UV/H_2O_2)	268,000
F. Carbon Adsorber (Vapor Phase)	150,000
G. Discharge System	110,000
H. Building	342,000
I. Indirect Construction Costs including power line	300,000
J. Treatability Study	50,000
TOTAL DIRECT CONSTRUCTION COSTS	2,435,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COSTS	876,700
TOTAL CAPITAL COSTS	3,311,700
II. ANNUAL OPERATING & MAINTENANCE COSTS	
1 - 30 years	1,619,800
III. PRESENT WORTH OF O&M COST	24,899,600
IV. TOTAL PRESENT WORTH*	28,211,300

* Present Worth analysis is based on 30 year period and 5% discount rate.

However, this alternative would not be effective in removing all contaminated water from fractured bedrock in the source areas. In absence of bedrock pumping the overburden could be recontaminated through long-term migration of contaminants from the bedrock. In addition, the downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area to MCLs.

This alternative is anticipated to require in excess of 60 years to achieve MCLs throughout the site and would not meet the objective of rapid aquifer restoration to MCLs. In short this alternative eventually would result in protection of human health and the environment only after a lengthy remediation period.

4.4.10 Alternative MOM-3C: Pump and Treat Central Area Pretreatment and Carbon Adsorption at a Central Treatment Plant

4.4.10.1 Description

This alternative is similar to alternative MOM-3A (Figure 4-4) except that the treatment scheme includes carbon adsorption instead of air stripping to adsorb the organics from the groundwater. A flow of 540 gpm and groundwater contaminant concentration of 155 ppb has been used for preliminary sizing and cost estimating for this alternative. The pretreatment scheme is identical to the other alternatives.

The major work items associated with this alternative are:

- rehabilitate and restore operation of Wells G and H
- pump groundwater at Wells G and H to the central treatment plant at 540 gpm
- treat groundwater at one central treatment plant using pretreatment and carbon adsorption
- discharge treated water to the Aberjona River
- regenerate spent liquid phase activated carbon at an off-site facility
- regenerate of spent vapor phase activated carbon.
- dispose of pretreatment sludge at an off-site facility
- monitor treatment plant effluent and groundwater to review the remediation effectiveness.

4.4.10.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist from direct contact with contaminated groundwater and soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray would be used during the construction

phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only. There is potential for exposure of operators to volatile organics during spent liquid phase carbon replacement. All treatment units would be covered and vapors would be collected and treated by activated carbon adsorption. As a result, air quality concerns would be significantly reduced.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would familiarize them with potential risks and how to avoid them.

No major environmental impacts are expected from this alternative. Some clearing of trees may be necessary for treatment plant construction. Construction of discharge line from the central treatment plant would require construction in the wetlands. This construction would have some negative environmental impact on the wetlands temporarily. Discharge of treated water to the Aberjona River would increase the river flow considerably during low flow periods. The ratio of discharge to river flow at a 10 year, 7 day low flow of 0.46 cfs is as high as 2.6. However, under average flow conditions the impact is expected to be minimal. Under this alternative Wells G and H would be pumped for in excess of 60 years. Remediation is anticipated to require approximately 20-50 plume volumes to migrate through the source areas (see Appendix C). Since this alternative does not include bedrock pumping it would continue to recontaminate the overburden. Due to these factors this alternative is anticipated to require in excess of 60 years to achieve MCLs throughout the site. In addition, downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area. This alternative would therefore not meet the objective of rapid aquifer restoration to MCLs.

Long-Term Effectiveness: The extraction and treatment by this alternative would significantly reduce migration of contaminants off-site. However, a small portion of contaminated groundwater from the source areas could migrate off site (see Appendix C). The effectiveness of extraction of contaminated groundwater from the fractured bedrock is uncertain. Some residual contamination would remain in the bedrock for this alternative. This residual contamination might recontaminate the overburden. Therefore, the achievement of MCLs throughout the site is anticipated to require in excess of 60 years.

This alternative would meet required process efficiencies. Proper operation and routine maintenance of the treatment plant would be required to achieve treatment goals. Frequent replacement of spent activated carbon would be expected.

Reduction of Toxicity, Mobility, or Volume: The extraction at the central area would significantly reduce the migration of contaminants downgradient of the site. Pretreatment and carbon

adsorption would reduce the toxicity, mobility, and volume of contaminants in the overburden aquifer. Approximately 99.9 percent organic removal would be expected by carbon adsorption. Regeneration of spent activated carbon would ultimately destroy the adsorbed organics. Significant quantities of pretreatment sludge will be generated which would be disposed of at an off-site facility. Some contaminants would remain in deep bedrock since extraction pumping in the central area would not capture all the contaminants in the deep bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been extensively used to treat sanitary, industrial, and hazardous wastewaters. The design and construction of a treatment plant in the central area would not pose any unique problems. Carbon adsorption would remove the organic contaminants of concern. The proposed treatment scheme for this alternative would be expected to attain MCLs for treated water once system operations were optimized. Overall, it is expected that removal efficiency for total organics would be greater than 99.9 percent under optimum conditions. No major technical problems leading to schedule delays would be expected. Occasional replacement of spent liquid phase carbon would be required. If the total volume of groundwater to be treated would be higher than originally anticipated, the time of operation of the treatment plant would be extended. However, this alternative would not be efficient in treating contaminated water in bedrock at the source areas. Migration of residual contaminated groundwater in deep fractured bedrock would be difficult to monitor.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plant. Since the treatment plant would be on-site, it could be constructed and operated without obtaining federal, state, or local permits, although actions must comply with substantive requirements of the permits. Transportation of pretreatment sludge and spent activated carbon to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits.

- Availability of Services and Materials: The treatment plant in the central area would be designed to treat all extracted water (540 gpm). All the components of the treatment scheme are readily available and competitive bids can be obtained from a number of vendors. Specialists are available for design, construction, and operation of the treatment plant.

Cost: The total present worth of this alternative is estimated at $26.9 million (Table 4-30) and includes capital costs of $2.8 million and an annual operation and maintenance cost of $1.6 million. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance With ARARs: The compliance of the Alternative MOM-3C with action- and location-specific ARARs is summarized in Table 4-31.

Overall Protection of Human Health and Environment: This alternative would control the migration of contaminated groundwater downgradient of the site, thereby preventing further contamination of the aquifer. However, a small portion of contaminated groundwater in the vicinity of the New England Plastics property may migrate off site. Extraction and treatment by this alternative would remove contaminants from groundwater. Volatile organics removed in this alternative would be ultimately destroyed during off-site liquid phase carbon regeneration or in situ vapor phase carbon regeneration. Iron and manganese removed by pretreatment would be disposed of with pretreatment sludge. Toxicity, mobility and volume of contaminants in groundwater would be reduced. However, this alternative would not be effective in remediating contaminated groundwater in bedrock. Therefore, this alternative would not meet the objective of rapid aquifer restoration to MCLs. In addition, downgradient migration of contaminants from the source areas would result in relatively slow remediation of the central area to MCLS. Air emissions concern would be minimized in this alternative because volatile organics would not be stripped as in alternative MOM-3A. In the absence of bedrock pumping, the overburden could be recontaminated by bedrock contaminants. In short, this alternative eventually would result in protection of human health and the environment only after a lengthy remediation.

4.4.11 Alternative MOM-4: PUMP AND TREAT SOURCE AREAS AND CENTRAL AREA

This overall remedial alternative includes pumping all the source areas and the central area for treatment. The treatment schemes used and the location of the treatment plant are discussed and evaluated as subalternatives.

4.4.12 Alternative MOM-4A(i): Pump and Treat Source Areas and Central Area, Pretreatment and Air-Stripping at Separate Treatment Plants

4.4.12.1 Description

This alternative combines alternatives MOM-2A(i) and MOM-3A to provide groundwater pumping and treatment in all areas of the site. Pump and treat systems would be provided at the 5 source areas as in MOM-2A and also at the Central area as in MOM-3A (Figure 4-5). Anticipated groundwater flows to be treated are

TABLE 4-30

COST ESTIMATE FOR ALTERNATIVE MOM-3C PUMP AND TREAT
CENTRAL AREA, PRETREATMENT AND
CARBON ADSORPTION AT CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	18,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	123,000
D. Pretreatment Including Equalization	918,000
E. Carbon Adsorber (Liquid Phase)	168,000
F. Carbon Adsorber (Vapor Phase)	150,000
G. Discharge System	110,000
H. Building	342,000
I. Construction Indirects	100,000
TOTAL DIRECT CONSTRUCTION COST	2,085,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	750,700
TOTAL CAPITAL COST	2,835,700
II. ANNUAL OPERATING & MAINTENANCE COST	
1 - 30 years	1,566,400
III. PRESENT WORTH OF O&M COST	24,078,700
IV. TOTAL PRESENT WORTH *	26,914,400

* Present Worth Analysis based on 30 year period and 5% discount rate.

TABLE 4-31

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-3 Pump and Treat Central Area
- 3C Pretreatment and Carbon Adsorption at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
1) Action-Specific ARARs		
o RCRA - General Facility Requirements (40 CFR 264.10-264.18)[2]	o General facility requirements outline general waste security measures, inspections, and training requirements.	o Facility will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained.
o RCRA - Generator and Transporter Responsibilities (40 CFR 262 and 263)[2]	o Provides standards for packing and accumulating hazardous waste prior to off-site disposal.	o Pretreatment sludge and spent carbon adsorption waste management and off-site treatment will proceed in accordance with RCRA requirements.
o RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)[2]	o This regulation outlines requirements for safety equipment and spill control.	o On-site facilities and activities will be designed and operated in accordance with RCRA requirements.
o RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)[2]	o This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	o Emergency procedures will be developed and implemented in accordance with RCRA requirements.
o RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)[2]	o This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	o Records will be maintained during site remediation in compliance with this requirement.
o RCRA - Container Requirements (40 CFR 264 Subpart I)[2]	o This regulation sets forth RCRA requirements for use and management of containers at RCRA facilities.	o Packing and accumulation of treatment sludges and other materials will adhere to these standards.
o DOT - Transportation of Hazardous Waste Requirements (49 CFR 171-179)[2]	o Those regulations set forth DOT requirements for transportation of hazardous waste. These are generally identical to RCRA requirements at 40 CFR 263.	o All on- and off-site transport of treatment sludges and other materials is to follow these standards.
o CAA - National Air Quality Standards for Total Suspended Particulates (40 CFR 129.105, 750)[1]	o This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	o Fugitive dust emissions from site activities will be maintained below 150 ug/m^3 (secondary standard) by water sprays and other dust suppressants.
o DEQE - Air Quality Air Pollution (310 CMR 6.00-8.00)[1]	o This regulation specifies dust, odor, and noise emissions from construction activities.	o Fugitive dust will be controlled by water sprays or suppressants. All equipment will be maintained so as not to produce excessive noise.

TABLE 4-31 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-3 Pump and Treat Central Area
-3C Pretreatment and Carbon Adsorption at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o OSHA - General Industry Standards (29 CFR 1910)[1]	o This regulation specifies the 8-hour, time-weighted average concentration for various organic compounds and 2 PCB compounds; site control procedures; training; and protective clothing requirements for worker protection of site remediations.	o Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
o OSHA - Safety and Health Standards (29 CFR 1926)[1]	o This regulation specifies the type of safety equipment and procedures to be followed during construction and excavation activities.	o All appropriate safety equipment will be on-site and procedures will be followed during groundwater monitoring.
o OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)[1]	o The regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	o These regulations are applicable to the company contracted to execute site remediation.
o CWA - National Pollutant Discharge Elimination System (NPDES) (40 CFR 122-125)[1]	o Provides permitting process for surface water body point source discharges.	o Water discharges to the Aberjona River will be treated to ensure that violations of the Clean Water Act do not occur.
o DEQE - Water Discharge Permit Program Requirements (314 CMR 3.00)	o Provides permitting process for surface water body point discharges. This requirement is generally identical to the CWA-NPDES regulations.	o Water discharges to the Aberjona River will be treated to ensure that violations of the DEQE water discharge permit program.
o DEQE - Surface Water Quality Standards (314 CMR 4.00)[1]	o This regulation consists of surface water classifications which designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Water discharges to the Aberjona River will be treated to ensure that violations of the DEQE water quality standards for that water body do not occur.
o DEQE - Groundwater Quality Standards (314 CMR 6.00)[1]	o This regulation consists of groundwater classifications which designate and assign uses, and water quality criteria necessary to sustain the designated uses.	o Class I groundwater quality criteria will be achieved at end of the remediation process.
o DEQE - Air Emission Limitations for Unspecified Sources of Volatile Organic Compounds (310 CMR 7.18(17))[2]	o Unspecified source with the potential to emit 100 tons/year of VOCs must install "Reasonably Available Control Technology" (RACT).	o Treatment of VOC air emissions to 99.99 percent combustion efficiency by carbon adsorption.

TABLE 4-31 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-3 Pump and Treat Central Area
-3C Pretreatment and Carbon Adsorption at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o DEQE - Hazardous Waste Management Requirements (310 CMR 30.00)[2]	o These regulations provide comprehensive monitoring, storing, recordkeeping, etc. programs at hazardous waste sites.	o During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be utilized. Note that Massachusetts considers liquids contaminated with PCBs greater than 50 ppm to be hazardous wastes (M002).
o DEQE - Air Pollution Control New Source Approvals (310 CMR 7.00)[1]	o Regulates new sources of air pollution to prevent air quality degradation. Requires the use of "Best Available Control Technology" (BACT) on all new sources.	o BACT will be used on all new sources.
o Employee and Community Right-to-Know Requirements (310 CMR 33)[1]	o Establishes rules for the dissemination of information related to toxic and hazardous substances to the public.	o Information dissemination procedures in these regulations will be used.
2) Action-Specific TBCs		
o RCRA - Proposed Air Emission Standards for Treatment Facilities (52 FR 374B, February 5, 1987)	o Set Performance Standards for RCRA treatment facility air emissions.	o Design of carbon adsorption facilities and other non-incinerators which have air emissions (e.g., air strippers) to meet the proposed federal regulations.
3) Location-Specific ARARs		
o RCRA - Location Standards (40 CFR 264.18)[2]	o This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain.	There is adequate space to site the treatment plant outside a floodplain. Pipes extending from these facilities through the floodplain, do not present any risk of washout due to flooding.
	o A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility, or no adverse effects on human health and the environment would result if washout occurred.	

TABLE 4-31 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-3 Pump and Treat Central Area
-3C Pretreatment and Carbon Adsorption at a Central Treatment Plant

WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o CWA - Section 404 Dredge and Fill Requirements (Guidelines at 40 CFR 230)[1]	o The placement for fill pursuant to remediation activities in Aberjona River wetlands triggers Section 404 jurisdiction. The governing regulations favor practicable alternatives that have less impact on wetlands. If no practicable alternative exists, impacts must be mitigated.	o There is adequate space to site the treatment plant outside Section 404 wetlands. Excavation and subsurface placement of extraction wells and pipes will be designed to match preconstruction bottom contours. These actions meet terms of the U.S. Army Corps of engineers Nationwide Permit No. 12 (33 CFR 330.5(a)(12). This permit provides authorization under Section 404 for discharge of material for backfill or bedding for "utility lines", provided there is no change in preconstruction bottom contours. A "utility line" is defined as a pipe for the transportation of any liquid for any purpose.
o Massachusetts Wetlands Protection Requirements (310 CMR 10.00)[1]	o These requirements control regulated activities in freshwater wetlands, 100-year floodplains, and 100-foot buffer zones beyond these areas. Regulated activities include virtually any construction or excavation activity. Performance standards are provided for evaluation of the acceptability of various activities.	o Extraction pipes will be laid underground through regulated wetlands, floodplains, and buffer zones. This will not cause loss of flood storage capacity, and will only temporarily disturb wetlands. The performance standards of the regulations can be achieved. All treatment facilities will be constructed above the 100-year floodplain elevation (e.g., 48 feet above sea level).
o Inland Wetland Orders (302 CMR 6.00)[2]	o Defines wetland areas, establishes encroachment lines along waterways or floodplain areas, and regulates activities in these areas.	o Some pipes connecting central treatment plants will be laid across the river. In these cases, consultation with DEQE regarding proper construction will occur.
o Operation and Maintenance and Pretreatment Standards for Waste Water Treatment Works and Indirect Discharges (314 CMR 12.00)[2]	o Insures the proper operation and maintenance of waste water treatment facilities including operation and maintenance, sampling, and discharges.	o Guidelines appropriate for a wastewater treatment facility will be followed.

TABLE 4-31 (Cont'd)

ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARS AND TBCS FOR MOM ALTERNATIVES:

MOM-3 Pump and Treat Central Area
- 3C Pretreatment and Carbon Adsorption at a Central Treatment Plant

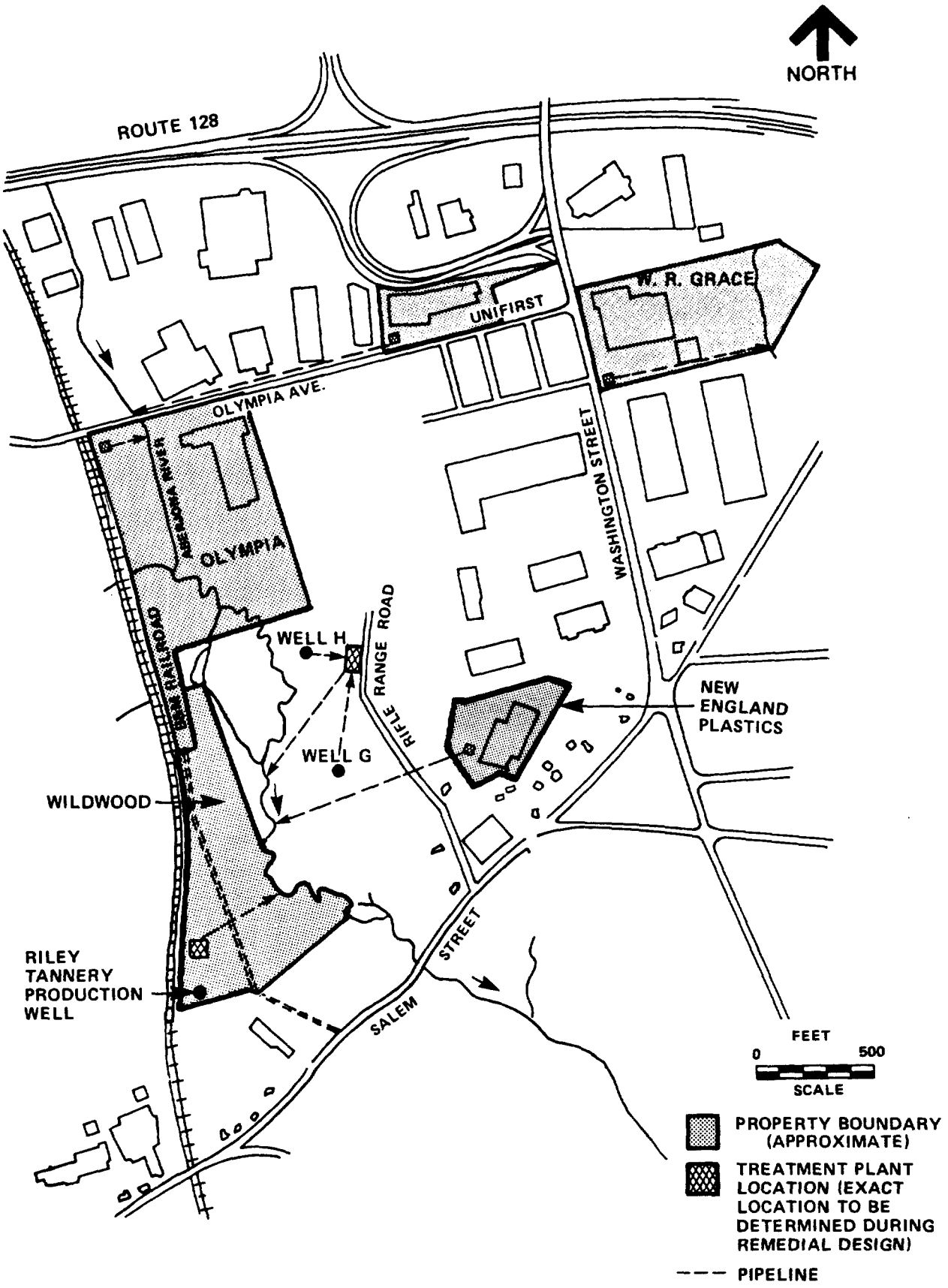
WELLS G&H SITE, WOBURN, MASSACHUSETTS

REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
o Wetlands Executive Order (EO 11990)[1]	o Under this Executive Order, federal agencies are required to minimize the destruction, loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If no practicable alternative exists, impacts must be mitigated.	o The placement of pipes in wetlands, is necessary to connect the central treatment plant. Therefore, the action does not conflict with the requirements of this Executive Order.
o Floodplain Executive Order (EO 11888)	o Federal Agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	o Placement of the pipes in floodplains, below grade, poses no additional flood hazard and meets the requirements of the Executive Order. In addition, there is no alternative for pipe placement. Treatment plant will be located outside of Floodplain.
4) Location-Specific TBCs		
o EPA Groundwater Protection Strategy	o EPA classifies groundwater into three categories depending on current, past or potential use. This serves as a guide for protection of the resource.	o Wells G&H aquifer is a Class II B aquifer-potentially usable aquifer. At the end of remediation, this MOM alternative will attain standards for Class IIB aquifers.

[1]Applicable

[2]Relevant and Appropriate

FIGURE 4-5
MOM-4
PUMP SOURCE AREAS AND CENTRAL AREA AND TREAT AT SEPARATE TREATMENT PLANTS



65 gpm, 50 gpm, 300 gpm, 21 gpm, 80 gpm and 540 gpm at W.R. Grace, Olympia, Wildwood, New England Plastics, Unifirst and the Central Area respectively. Estimated influent VOC concentrations are 2445 ug/l, 1080 ug/l, 52,255 ug/l, 195 ug/l, 3925 ug/l and 155 ug/l at W.R. Grace, Olympia, Wildwood, New England Plastics, Unifirst and the Central Area respectively. The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood and Olympia)
- rehabilitate and restore the two wells G and H or install other wells in the central area
- construct six groundwater treatment plants at six locations using pretreatment and air stripping
- discharge treated water to the Aberjona River
- regenerate spent vapor phase activated carbon on-site using thermal treatment
- dispose pretreatment sludge at an off-site facility
- monitor treatment plant performance and groundwater contaminant migration

4.4.12.2 Assessment

Short-Term Effectiveness: Potential public health threats to the community and workers during construction would exist from direct contact with contaminated groundwater, soil and inhalation of fugitive dust and organic vapors resulting from construction and operation of treatment plants. Air monitoring for particulates and organic vapors would be conducted to monitor exposure of the community and workers to dust and organic vapors. All the treatment plants would be fenced and access would be restricted to authorized personnel only. Water spray would be used during construction to suppress fugitive dust. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat volatile emissions from air strippers.

The risk to workers from exposure to contaminated soil and water would be minimized by use of adequate preventive measures and personal protection equipment. Health and safety training would be provided to workers to educate them with respect to potential risks and preventive measures. No major environmental impact would be expected from extraction and treatment. This alternative may require clearance of some trees for treatment plant construction at six locations. Construction of discharge lines from Wildwood, New England Plastics and Olympia treatment plants and the central treatment plants would require

construction in the wetlands. This construction would have some negative environmental impact on the wetlands temporarily. Discharge of treated water to the Aberjona River would increase the river flow considerably during low flow periods. At a 7 day 10 year low flow of 0.46 cfs, the treatment plant discharge to river flow ratio would be as high as 5.1. However, under average flow conditions the impact on the river is expected to be minimal. Under this alternative groundwater in the central area of the site would be pumped and treated for approximately 10 years and groundwater in the source areas for 20-50 years with the objective of meeting MCLs (based on the assumptions of Appendix C). There is some uncertainty as to whether bedrock contamination would be remediated completely and there is therefore a possibility that long-term bedrock pumping might be required after 20-50 years to control leaching of residual contaminants from the bedrock to the overburden.

Long-Term Effectiveness: Contamination of groundwater would be reduced under this alternative by restoring groundwater to MCL goals throughout the site except in some of the fractured bedrock. The effectiveness of extraction of contaminated groundwater from deep fractured bedrock is uncertain. In the central area, this alternative would meet the remedial objective of rapid aquifer restoration since it is anticipated to achieve MCLs in approximately 10 years assuming no further contamination.

This alternative would meet required process efficiencies. Treatment plant operation and maintenance would require long term management and monitoring. Routine operation and maintenance of the treatment plants in addition to monitoring contaminant migration would be required. No uncertainties associated with long-term operation of the treatment would be expected. With every regeneration of vapor phase activated carbon, some loss of carbon would be expected. Replacement or make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: The extraction of contaminated groundwater at the source areas and central area followed by pretreatment and air stripping at separate treatment plants would significantly reduce the migration of contaminants from source areas as well as the central area. Air stripping processes would directly reduce the toxicity, mobility and volume of volatile organics in the groundwater. Regeneration of spent vapor phase activated carbon would ultimately destroy the volatile contaminants. Significant quantities of pretreatment sludge would be generated which would be disposed of at an off-site facility. This alternative would use treatment to reduce the toxicity, mobility, and volume of the contaminated groundwater in overburden throughout the site. Contaminated groundwater in the bedrock would also be mitigated but to a lesser degree than the overburden due to non-homogeneity of bedrock and uncertainty in the capture efficiency of the extraction system in the bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been used extensively to treat sanitary, industrial and hazardous wastewaters. The design and construction of treatment plants at source areas and the central area would not pose any unique problems. Air stripping can remove the volatile contaminants of concern. The proposed treatment scheme for this alternative would be expected to attain MCLs for treated water once system operations were optimized. Overall, it is expected that removal efficiency for total VOCs would be greater than 99.9 percent. No major technical problems leading to schedule delays would be expected. If the total volume of groundwater to be treated is higher than originally anticipated, the time of operation of treatment plants could be extended to achieve MCL goals in groundwater. All treatment units would be covered and vapors would be collected and treated by vapor phase activated carbon system. As a result air quality concerns would be significantly reduced. It may not be possible to extract all contaminated groundwater from deep fractured bedrock.

- Administrative Feasibility: Implementation of this alternative would require establishing administrative and institutional responsibilities for the operation and maintenance of the treatment plants. Since the treatment plants would be on-site, they could be implemented without obtaining federal, state or local permits although actions must comply with substantive requirements of the permits. Administratively, however, it is more difficult to oversee six separate treatment plants than one central treatment plant. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the Aberjona River would likely be considered "on-site" and would not require Massachusetts or NPDES permits.

- Availability of Services and Materials: All the components of the treatment scheme are readily available and competitive bids can be obtained from a number of vendors. Necessary specialists are available for design, construction and operation of the treatment plants.

Cost: The total present worth of this alternative is estimated at $79.1 million (Table 4-32) including a capital cost of $11.4 million and an annual operation and maintenance cost of $5.1 million for first 10 years and $3.7 million for next 20 years. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

TABLE 4-32

COST ESTIMATE FOR ALTERNATIVE MOM-4A(i) PUMP AND TREAT AT SOURCE AND CENTRAL AREAS, PRETREATMENT AND AIR STRIPPING AT SEPARATE TREATMENT PLANTS

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	91,000
B. Support Facilities	936,000
C. Pumping/Collection and Piping	811,000
D. Pretreatment Including Equalization	2,170,000
E. Air Stripper System	530,000
F. Carbon Adsorber (Vapor Phase)	1,420,000
G. Discharge System	580,000
H. Building	1,351,000
I. Construction Indirects	530,000
TOTAL DIRECT CONSTRUCTION COST	8,419,000
CONTINGENCY/ENGINEERING/LEGAL & ADMINISTRATIVE COST	3,030,800
TOTAL CAPITAL COST	11,449,800
II. ANNUAL OPERATING & MAINTENANCE COST	
1 - 10 years	5,087,100
11 - 30 years	3,713,500
III. PRESENT WORTH* OF O&M COST	
1 - 10 years	39,282,600
11 - 30 years	28,408,300
TOTAL PRESENT WORTH OF O&M COST	67,690,900
IV. TOTAL PRESENT WORTH	79,140,700

* Present Worth Analysis based on total operation of 30 year period and 5% discount rate.

Compliance with ARARS: The compliance of Alternative MOM-4A(i) with action- and location-specific ARARs is summarized in Table 4-23.

Overall Protection of Human Health and Environment: This alternative would control the migration of contaminated groundwater within and downgradient of the site. Extraction and treatment by this alternative would remove contaminants from the overburden throughout the site and most of the bedrock to MCLs. Toxicity, mobility and volume of contaminants in groundwater would be greatly reduced. Volatile organics removed would ultimately be destroyed during carbon regeneration. Iron and manganese removed during pretreatment would be disposed at an off-site facility. Treated groundwater would meet discharge requirements and result in protection of Aberjona River. This alternative would result in overall protection of human health and the environment and in the central area of the site would meet the objective of rapid aquifer restoration.

4.4.13 Alternative MOM-4A(ii): Pump and Treat Source Areas and Central Area, Pretreatment and Air Stripping at Central Treatment Plant

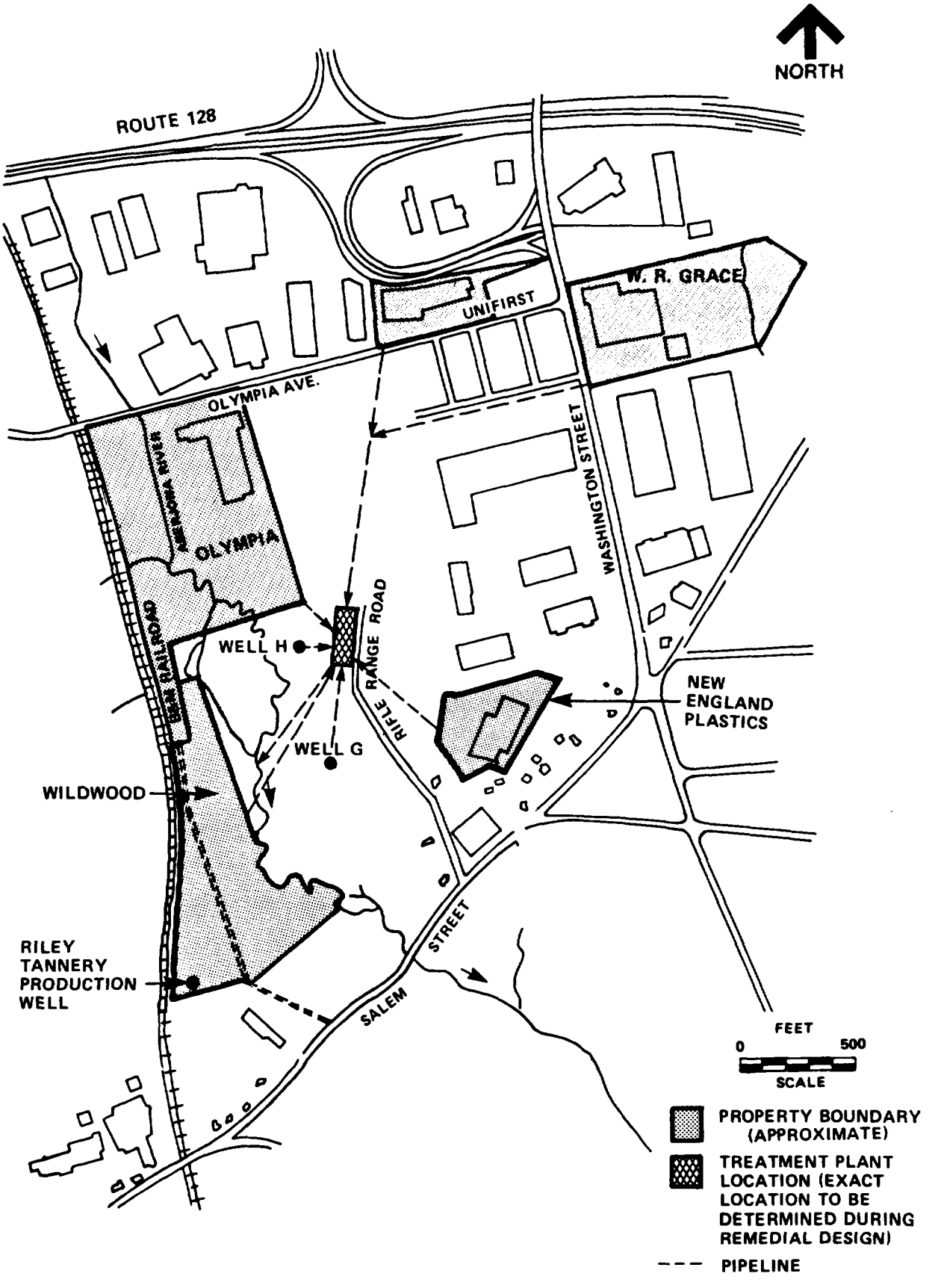
4.4.13.1 Description

This alternative is similar to alternative MOM-4A(i) (Figure 4-6) except that all the groundwater extracted from each source area and the central area would be piped to one central treatment plant. A flow of 1056 gpm and groundwater contaminant concentration of 15,160 ppb VOC has been used for this alternative. The pretreatment scheme for this alternative is also identical to other alternatives.

The major work items associated with this alternative are:

- install extraction wells at each of the five source areas. (W.R. Grace, Unifirst, New England Plastics, Wildwood and Olympia).
- rehabilitate and restore the two wells G and H or install new extraction wells in the central area.
- install force mains to connect pumps from excavation wells to a central treatment plant.
- pump groundwater from all wells to a central treatment plant.
- construct one central treatment plant using pretreatment and air stripping.
- discharge treated water to the Aberjona River
- regenerate spent vapor phase activated carbon on-site using thermal treatment
- dispose of pretreatment sludge at an off-site facility
- monitor treatment plant performance and groundwater to review the remediation efficiencies

FIGURE 4-6
MOM-4
PUMP SOURCE AREAS AND CENTRAL AREA AND TREAT AT CENTRAL TREATMENT PLANT



4.4.13.2 Assessment

Short-Term Effectiveness: Potential public health threats to the community and workers would exist from direct contact with contaminated groundwater, soils and inhalation of fugitive dust and organic vapors resulting from construction and operation of the treatment plant. Air monitoring for particulates and organic vapors would be conducted to monitor exposure of the community to dust and organic vapors. The treatment plant would be fenced and access would be restricted to authorized personnel only. Water spray would be used during construction to suppress fugitive dust. Vapor phase carbon adsorption would be included to control and treat volatile emissions from air strippers. All treatment units would be covered and vapors would be collected and treated by vapor phase activated carbon.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training would be provided to workers to educate them to potential risks and preventive measures. No significant environmental impacts are expected from treatment plant construction and operation. This alternative may require clearing of some trees at the treatment plant location. Construction of force mains from Wildwood and Olympia areas to the central treatment plant and the discharge line from the central treatment plant would require construction in the wetlands and across the river. This construction would have some negative environmental impact on the wetlands and the Aberjona River temporarily. At a 7 day 10 year low flow of 0.46 cfs, the treatment plant discharge to river flow ratio could be as high as 5.1. However, under average flow conditions the impacts on the river are expected to be minimal. Under this alternative groundwater in the central area of the site would be pumped and treated for 10 years and groundwater in the source areas for 20-50 years with the objective of remediation to MCLs. There is uncertainty that the bedrock contamination would be remediated completely and there is therefore a possibility that long-term bedrock pumping could be required after 20-50 years to control leaching of residual contaminants from the bedrock to the overburden.

Long-Term Effectiveness: Eventually contamination in the groundwater would be reduced by this alternative by restoring groundwater to MCL goals everywhere at the site except possibly in some of the fractured bedrock. The effectiveness of recovery of contaminated groundwater from fractured bedrock would be uncertain. In the central area this alterative would meet the remedial objective of rapid aquifer restoration to MCLs.

This alternative would meet required process efficiencies. Routine operation and maintenance of the treatment plant in addition to monitoring contaminant migration would be required. No uncertainties associated with long term operation of the treatment plant would be expected. With every regeneration of the vapor phase activated carbon system some loss of carbon would be expected. Replacement of make-up carbon would be required occasionally.

Reduction of Toxicity, Mobility or Volume: This alternative provides the maximum recovery of groundwater in contaminated areas by pumping at the source areas plus the central area of the site. Pumping would control the migration of highly contaminated groundwater from the source areas to the central area as well as migration off-site. Pretreatment and air stripping would directly reduce toxicity, mobility and volume of contaminants. Regeneration of vapor phase activated carbon would ultimately destroy organic contaminants. Significant quantities of pretreatment sludge would be generated for disposal at an off-site facility. Toxicity of the groundwater would be reduced to target levels and be suitable for discharge to the river.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative have been used extensively to treat sanitary, industrial and hazardous wastewaters. The design and construction of the treatment plant at the central area would not pose any unique problems. This alternative would require extensive piping to transfer extracted groundwater from all wells to the central treatment plant. Piping from Wildwood and Olympia properties would require construction through the wetlands and across the river. This may create some construction problems. Air stripping would remove the volatile contaminants of concern. The proposed treatment scheme for this alternative would be expected to attain discharge requirements for treated water once system operations were optimized. Overall, it is expected that removal efficiencies for total VOCs would be greater than 99.9 percent under optimum conditions. If the total volume of groundwater to be treated were higher than originally anticipated, the time of operation of the treatment plants could be extended. There is uncertainty about capturing all contaminated water in deep fractured bedrock in some source areas. Migration of residual contaminated groundwater in deep fractured bedrock would be difficult to monitor. All treatment units would be covered and vapors would be collected and treated by a vapor phase activated carbon system. As a result, air quality concerns would be significantly reduced.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for operation and maintenance of the treatment plant. Since the treatment plant would be located on-site, it could be constructed and operated without obtaining federal, state or local permits but it would have to meet substantive requirements for the permit. Transportation of pretreatment sludge to an off-site facilities would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits. Administratively, one central treatment is easier to monitor than separate plants.

- Availability of Services and Materials: All the components of this treatment scheme are readily available and competitive bids can be obtained from a number of vendors. Specialists are available for design, construction and operation of the treatment plant in this alternative.

Cost: The total present worth of this alternative is estimated at $37.1 million as summarized in Table 4-33 including a capital cost of $7.0 million and an annual operation and maintenance cost of $2.3 million for first 10 years and $1.6 million for next 20 years. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARS: The compliance of Alternative MOM-4A(ii) with action- and location-specific ARARs is summarized in Table 4-23.

Overall Protection of Human Health and Environment: This alternative would control the migration of contaminants from the source areas to the central area as well as control the downgradient migration. Extraction and treatment would remove contaminants of concern to MCL goals and restore the overburden aquifer everywhere at the site and most of the bedrock aquifer. In addition, in the central area this alternative whould meet the remedial objective of rapid aquifer restoration to MCLs. Toxicity, mobility and volume of contaminants in groundwater would be greatly reduced. All the volatile organics removed from groundwater would be ultimately destroyed during spent carbon regeneration. Iron and manganese removed during pretreatment would be disposed at an off-site facility. This alternative would result in overall protection of human health and the environment upon completion of remediation.

TABLE 4-33

COST ESTIMATE FOR ALTERNATIVE MOM-4A(ii) PUMP AND TREAT AT SOURCE AREAS AND CENTRAL AREA, PRETREATMENT AND AIR STRIPPING AT CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	26,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	1,410,000
D. Pretreatment Including Equalization	1,677,000
E. Air Stripper System	168,000
F. Carbon Adsorber (Vapor Phase)	820,000
G. Discharge System	110,000
H. Building	680,000
I. Construction Indirects	100,000
TOTAL DIRECT CONSTRUCTION COST	5,147,000
CONTINGENCY/ENGINEERING/ LEGAL & ADMINISTRATIVE COST	1,853,000
TOTAL CAPITAL COST	7,000,000
II. ANNUAL OPERATING & MAINTENANCE COST	
1 - 10 years	2,271,700
11 - 30 years	1,647,000
III. PRESENT WORTH* OF O&M COST	
1 - 10 years	17,542,100
11 - 30 years	12,599,600
TOTAL PRESENT WORTH OF O&M COST	30,141,700
IV. TOTAL PRESENT WORTH	37,141,700

* Present Worth Analysis based on total operation of 30 year period and 5% discount rate.

4.4.14 Alternative MOM-4B(i): Pump and Treat Source Areas and Central Area, Pretreatment and UV/Chemical Oxidation at Separate Treatment Plants

4.4.14.1 Description

This alternative is identical to MOM-4A(i) (Figure 4-5) except for the use of treatment scheme in which the Air Stripping is replaced by UV/Chemical Oxidation.

The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood and Olympia)
- rehabilitate and restore the two wells G and H or install new extraction wells in the central area.
- construct six groundwater treatment plants on-site at six locations using pretreatment and UV/Chemical oxidation.
- discharge treated water to the Aberjona River
- regenerate spent vapor phase activated carbon on-site using thermal treatment
- dispose of pretreatment sludge at an off-site facility
- monitor treatment plant performance and groundwater contaminant migration

4.4.14.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during construction would exist from direct contact with contaminated groundwater, soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray would be used during the construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only. There would be very little volatile emissions from this treatment since air stripping is not used. Vapor phase adsorption of air emissions using carbon adsorption has been included to control and treat any volatile emissions from the pretreatment system.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would educate them of potential risks and how to avoid them.

No major environmental impacts would be expected from this alternative. Some clearing of trees may be necessary for treatment plant construction at six locations. Discharge of treatment water to the Aberjona river would increase the river flow considerably during low flow periods. The treatment plant discharge to river flow ratio at 10 year, 7 day low flow would be as high as 5.1. However under average flow conditions the impact on the river is expected to be minimal. Under this alternative groundwater in the central area of the site would be pumped and treated for 10 years and groundwater in the source areas for 20-50 years with the objective of achieving MCLs. There is uncertainty that the bedrock contamination would be remediated completely and there is therefore a possibility that long-term bedrock pumping would be required after 20-50 years to control leaching of residual contaminants from the bedrock to the overburden.

Long-Term Effectiveness: Eventually contamination in the groundwater would be reduced under this alternative by restoring groundwater to MCL goals everywhere at the site except possibly in some of the fractured bedrock. The effectiveness of recovery of contaminated groundwater from deep fractured bedrock is uncertain. In the central area this alternative would meet the remedial objective of rapid aquifer restoration to MCLs.

Proper operation and routine maintenance of the treatment plants would be required. UV lamps are expected to need frequent replacement. With every regeneration of the vapor phase activated carbon adsorption system, some loss of carbon is expected. Replacement or make-up would be required occasionally.

Reduction of Toxicity, Mobility, or Volume: Pumping and extraction would control the migration and mobility of contaminants from highly contaminated source areas to the central area and downgradient of the site. UV/chemical oxidation would destroy organics to form carbon dioxide and water, thereby reducing the toxicity and volume of contaminants. Significant quantities of pretreatment sludge would be generated by pretreatment for disposal of at an off-site facility. This alternative would reduce the toxicity, mobility and volume of the contaminated groundwater in the overburden throughout the site as well as most of the bedrock aquifer. However, there is some uncertainty with respect to recovery of contaminated groundwater in deep fractured bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative except UV/chemical oxidation have been used extensively in treatment of sanitary, industrial

and hazardous wastewaters. UV/chemical oxidation is an innovative technology which destroys organics to carbon dioxide and water. This technology has been extensively tested on pilot scale but only two full scale plants have been designed and constructed. No performance data is available. The reported efficiency of UV/chemical oxidation system is greater than 99.9 percent depending on the residence time, chemical oxidant dose and UV light intensity. The UV/chemical oxidation system would require a high voltage power line. Proper operation and control of the treatment plants would be required to meet treatment objectives. Effluent monitoring and sampling of monitoring wells would be required to determine the effectiveness of the treatment system and to check the migration of contaminated groundwater. Monitoring of groundwater migration in fractured bedrock would be difficult.

Extraction would control the migration of contaminated groundwater. A treatability study for the UV/chemical oxidation process would be required. This may lead to some schedule delays. If the total volume of groundwater to be treated were higher than originally anticipated, operation of treatment plants could be extended to treat all water to achieve treatment goals. No exposure pathways exist which cannot be monitored.

- Administrative Feasibility: Implementation of this alternative would require establishment of administrative and institutional responsibilities for the operation and maintenance of the treatment plants. Since the treatment plants would be on-site, they could be constructed and operated without obtaining federal, state or local permits although actions must comply with substantive requirements of the permits. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits. Some administrative effort would be required to obtain the high voltage power lines to the treatment plants.

- Availability of Services and Materials: All the components of this treatment scheme except UV/chemical oxidation system are readily available from more than one vendor and competitive bids would be available from more than one vendor. The UV/chemical oxidation system is apparently available from only two vendors at the present time. Due to its innovative nature and lack of full scale data, performance of the UV/chemical oxidation system is uncertain and would require a treatability study. UV lamps would be expected to need frequent replacement.

Occasional replacement or make-up of activated carbon in vapor phase adsorption is expected. Necessary specialists to design, construct and operate UV/chemical oxidation systems may be limited.

Cost: The total present worth of this alternative is estimated at $104.8 million (Table 4-34) including a capital cost of $13.7 million and an annual operation and maintenance cost of $6.7 million for the first 10 years and $5.1 million for the next 20 years. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

Compliance with ARARS: The compliance of Alternative MOM-4B(i) with action- and location-specific ARARs is summarized in Table 4-26.

Overall Protection of Human Health and Environment: This alternative would mitigate the migration of contaminants and restore the overburden and most of the bedrock groundwater to MCLs everywhere at the site. In the central area, this alternative would meet the remedial objective of rapid aquifer restoration to MCLs. Volatile organics removed from the groundwater would be ultimately destroyed by UV/chemical oxidation and carbon regeneration. Iron and manganese removed by pretreatment would be disposed at an off-site facility. Toxicity, mobility and volume of contaminants in groundwater would be reduced. Some uncertainties exist regarding performance of the UV/chemical oxidation system due to lack of full scale information. This alternative would result in overall protection of human health and the environment.

4.4.15 Alternative MOM 4B(ii): Pump and Treat Source Areas and Central Area, Pretreatment and UV/Chemical Oxidation at Central Treatment Plant

4.4.15.1 Description

This alternative is similar to Alternative 4A(ii) (Figure 4-6) except that air stripping is replaced by the UV/chemical oxidation process. A flow of 1056 gpm and groundwater contaminant concentration of 15,160 ppb VOC has been used for this alternative.

The major work items associated with this alternative are:

- install extraction wells at each of the five source areas (W.R. Grace, Unifirst, New England Plastics, Wildwood and Olympia)
- rehabilitate and restore the two wells G and H or install new extraction wells in the central area
- install force mains to connect pumps from extraction wells to the central treatment plant

TABLE 4-34

COST ESTIMATE FOR ALTERNATIVE MOM-4B(i) PUMP AND TREAT AT SOURCE AREAS AND CENTRAL AREA, PRETREATMENT AND UV/CHEMICAL OXIDATION AT SEPARATE TREATMENT PLANTS

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	91,000
B. Support Facilities	936,000
C. Pumping/Collection and Piping	811,000
D. Pretreatment Including Equalization	2,170,000
E. Chemical Oxidation System (UV/H_2O_2)	1,235,000
F. Carbon Adsorber (Vapor Phase)	900,000
G. Discharge System	580,000
H. Building	1,351,000
I. Construction Indirects Including Power Line	1,667,500
J. Treatability Study	300,000
TOTAL DIRECT CONSTRUCTION COST	10,041,500
CONTINGENCY/ENGINEERING/LEGAL & ADMINISTRATIVE COST	3,615,200
TOTAL CAPITAL COST	13,656,700
II. ANNUAL OPERATING & MAINTENANCE COST	
1 - 10 years	6,740,200
11 - 30 years	5,120,400
III. PRESENT WORTH* OF O&M COST	
1 - 10 years	52,047,800
11 - 30 years	39,171,100
TOTAL PRESENT WORTH OF O&M COST	91,218,900
IV. TOTAL PRESENT WORTH	104,875,600

* Present Worth Analysis based on total operation of 30 year period and 5% discount rate.

- construct a central treatment plant using pretreatment and UV/chemical oxidation
- pump groundwater from all wells to central treatment plant
- discharge treated water to the Aberjona River
- regenerate of spent vapor phase activated carbon on-site using thermal treatment
- dispose of pretreatment sludge to off-site facility
- monitor treatment plant performance and groundwater to review the remediation efficiencies

4.4.15.2 Assessment

Short-Term Effectiveness: Potential public health threats to area residents and workers during remediation would exist from direct contact with contaminated groundwater, soils and inhalation of fugitive dust and organic vapors. Air monitoring for particulates and organic vapors would have to be conducted to monitor the exposure of workers and the community to dust and organic vapors during the construction and treatment plant operation. Water spray would be used during construction phase to suppress fugitive dust. The treatment plant would be fenced and access would be restricted to authorized personnel only. There would be potentially less volatile emissions from the treatment system since air stripping would not be used. Vapor phase adsorption of the air emissions using carbon adsorption has been included to control and treat emissions from the pretreatment system.

The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment. Health and safety training provided to treatment plant operators would educate them to potential risks and how to avoid them.

No major environmental impacts would be expected from construction of the treatment plant. Some clearing of trees may be necessary for treatment plant construction. This alternative would require extensive piping to bring extracted groundwater from source areas to the central treatment plant. Piping would be required from the Wildwood and Olympia areas to the central treatment plant and a discharge line from the central treatment plant through the wetlands and across the river. This construction would have some negative environmental impacts on the wetlands and the Aberjona River temporarily. Discharge of treated water to the Aberjona River would increase the river flow considerably during low flow periods. The treatment plant discharge to river flow ratio at 10 year, 7 day low flow of 0.46 cfs would be as high as 5.1. However, during average flow conditions the impact on the river is expected to be minimal. Under this alternative groundwater in the central area of the site would be pumped and treated for 10 years and groundwater in the source areas for 20-50 years with the objective of achieving MCLs. There is some uncertainty as to whether bedrock contamination would be remediated completely and there is

therefore a possibility that long term bedrock pumping might be required after 20-50 years to control leaching of the residual contaminants from the bedrock to the overburden.

Long-Term Effectiveness: Eventually contamination in the groundwater would be reduced by attainment of MCLs throughout the site except in some of the fractured bedrock. The effectiveness of recovery of contaminated groundwater from the fractured bedrock is uncertain. In the central area this alternative would meet the remedial objective of rapid aquifer restoration to MCLs.

Although this alternative would be expected to meet required process efficiencies some uncertainties exist due to lack of information. Proper operation and routine maintenance of the treatment plant would be required. UV lamps are expected to need frequent replacement. With every regeneration of spent vapor phase activated carbon some loss of carbon would be expected. Replacement or make-up carbon would be required occasionaly.

Reduction of Toxicity, Mobility, or Volume: Pumping and extraction by this alternative would control the migration and mobility of contaminants throughout the site. UV/chemical oxidation would destroy organics to form carbon dioxide and water reducing toxicity and volume of contaminants considerably. Significant quantities of pretreatment sludge would be generated for disposal at an off-site facility. This alternative would reduce the toxicity, mobility and volume of the contaminated groundwater in the overburden throughout the site, however some contaminated ground water may remain in deep bedrock due to uncertainty in the capture of contaminated groundwater in deep fractured bedrock.

Implementability:

- Technical Feasibility: All the unit processes associated with this alternative except UV/chemical oxidation have been used extensively in treatment of sanitary, industrial and hazardous wastewaters. UV/chemical oxidation is an innovative technology which destroys organics to carbon dioxide and water. This technology has been extensively tested on pilot scale but only two full scale plants have been designed. No full-scale performance data is available. The reported efficiency of the UV/chemical oxidation system is greater than 99.9 percent depending on residence time, chemical oxidant dose and UV light intensity. Piping extracted water from Olympia and Wildwood areas to the central treatment plant might pose some constuction problems as this would require laying pipe lines through wetlands and across the river. This alternative

would require high voltage power lines due to the power requirements of the UV/chemical oxidation system. Proper operation and control of the treatment plant would be required to meet treatment objectives. Effluent monitoring and sampling of monitoring wells would be required to determine the effectiveness of the treatment plant and to monitor the migration of contaminated groundwater.

Extraction would control the migration of contaminated groundwater from source areas to the central area and beyond. UV/chemical oxidation would be effective in destroying volatile organics. A treatability study for the UV/chemical oxidation process would be required. This may lead to some schedule delays. If the total volume of groundwater to be treated were higher than originally anticipated, operation of the treatment plant could be extended to treat all water to achieve MCLs in groundwater. However, it would be difficult to monitor migration of residual contaminated groundwater in fractured bedrock.

- Administrative Feasibility: Implementation of this alternative would require establishing administrative and institutional responsibilities for the operation and maintenance of the treatment plant. Since the treatment plant would be on-site, it could be constructed and operated without obtaining federal, state or local permits although actions must comply with substantive requirements of the permit. Transportation of pretreatment sludge to an off-site facility would require DOT permits. Disposal of treated water to the river would likely be considered "on-site" and would not require Massachusetts or NPDES permits. Some administrative effort would be required to obtain high voltage power lines to the treatment plant.

- Availability of Services and Materials: All the components of this treatment scheme except the UV/chemical oxidation system are readily available and competitive bids would be available from a number of vendors. The UV/chemical oxidation system is apparently available from two vendors at present time. Due to its innovative nature and lack of full scale data, performance of the UV/chemical oxidation system is uncertain. UV lamps are expected to need frequent replacement. Occasional replacement or make up of activated carbon in the vapor phase adsorption system would be expected. Specialists to design, construct and operate the UV/chemical oxidation system may be limited.

Cost: The total present worth of this alternative is estimated at $60.2 million (Table 4-35) including a capital cost of $8.5 million and an annual operation and maintenance cost of $3.8 million for first 10 years and $2.9 million for next 20 years. Detailed supportive data used to derive these estimates are presented in Appendices A and B.

TABLE 4-35

COST ESTIMATE FOR ALTERNATIVE MOM-4B(ii) PUMP AND TREAT SOURCE AREAS AND CENTRAL AREA, PRETREATMENT AND UV/CHEMICAL OXIDATION AT CENTRAL TREATMENT PLANT

Item	Cost (1988 Dollars)
I. CAPITAL COSTS	
A. Site Preparation	26,000
B. Support Facilities	156,000
C. Pumping/Collection and Piping	1,410,000
D. Pretreatment Including Equalization	1,677,000
E. Chemical Oxidation System (UV/H_2O_2)	1,100,000
F. Carbon Adsorber (Vapor Phase)	300,000
G. Discharge System	110,000
H. Building	680,000
I. Construction Indirects Including Power Line	740,000
J. Treatability Study	50,000
TOTAL DIRECT CONSTRUCTION COST	6,249,000
CONTINGENCY/ENGINEERING/LEGAL & ADMINISTRATIVE COST	2,249,700
TOTAL CAPITAL COST	8,498,700
II. ANNUAL OPERATING & MAINTENANCE COST	
1 - 10 years	3,847,500
11 - 30 years	2,877,100
III. PRESENT WORTH* OF O&M COST	
1 - 10 years	29,710,400
11 - 30 years	22,009,800
TOTAL PRESENT WORTH OF O&M COST	51,720,200
IV. TOTAL PRESENT WORTH	60,218,900

* Present Worth Analysis based on total operation of 30 year period and 5% discount rate.

Compliance with ARARS: The compliance of Alternative MOM-4B(ii) with ARARs is summarized in Table 4-26.

Overall Protection of Human Health and the Environment: This alternative would control the migration of contaminants from the source areas to the central area as well as control the migration downgradient. Extraction and treatment would remove contaminants of concern associated with ingestion of contaminated water to MCL goals and restore the overburden aquifer everywhere at the site and most of the bedrock aquifer. Toxicity, mobility and volume of contaminants in groundwater would be greatly reduced. In the central area this alternative is anticipated to meet the remedial objective of rapid aquifer restoration to MCLs. Volatile organics removed from groundwater will be ultimately destroyed by UV/chemical oxidation and spent carbon regeneration. Iron and manganese removed by pretreatment would be disposed at an off-site facility. Some uncertainties regarding performance of the UV/chemical oxidation system exists due to a lack of full scale information. This alternative will result in overall protection of human health and environment.

4.5 COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES

Nine source control (SC) remedial alternatives and 12 management of migration (MOM) remedial alternatives were evaluated in the detailed evaluation. Sections 4.3 and 4.4 compared each of the SC and MOM remedial alternatives, respectively relative to the SARA criteria. Section 4.5 discusses the key factors and differences among the remedial alternatives relative to each of the criteria. In Section 4.6.4, an assessment of the evaluation criteria for each remedial alternative is presented in summary tables showing the nine criteria and the assessment of each.

4.5.1 Source Control (SC) Alternatives

The following presents an overall comparison of the SC alternatives for each criteria as summarized in Table 4-36.

Short-Term Effectiveness

Alternative SC-1 (No Action) presents no short-term risks to on-site workers or the community. Alternatives SC-3, SC-4, SC-5, SC-7 and SC-8 and SC-9 all involve soil excavation which requires dust control to protect workers and the community. These alternatives, except for SC-4 (off-site incineration) involve on-site treatment therefore, air emission control measures are required to protect the workers and the community. All the alternatives involving excavation of soil have potential adverse environmental impacts during remediation activities such as air emissions and stormwater runoff to the river and wetlands for which proper controls can be provided to protect the environment. Alternative SC-4 which includes off-site incineration has less air quality impacts since the soil would be treated at another location. However, this alternative would have negative environmental impacts by increasing traffic in the

TABLE 4-36

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-1 No Action	SC-3 Excavation/On-Site Incineration/Backfill On-Site	SC-4 Excavation/Off-Site Incineration/Backfill with Clean Off-site Soil	SC-5 Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site	SC-7 Excavation/On-Site Supercritical Fluid Extraction/Backfill On-site
1. Short-Term Effectiveness					
o Protection of community during remedial actions.	No risks, since no remedial action	Dust control and air emissions controls required for soil handling and incineration	Dust control and air emissions control required for soil handling; traffic control required	Dust control and air emissions controls required for soil handling and treatment.	Dust control and air emissions controls required for soil handling and soil slurry system.
o Protection of workers during remedial actions	No risk, since no remedial action	Health and safety protection and air emission control required	Health and safety protection required	Same as SC-3	Same as SC-3
o Environmental impacts	Wildlife continues to be impacted	Potential adverse air quality impacts from soil handling and incineration emissions; clearing of plants and trees required; impact to wetlands	Potential air quality impacts from soil handling; clearing of plants and trees required; impact to wetlands	Same as SC-3	Potential adverse air quality impacts from soil handling; clearing of plants and trees required; impact to wetlands
o Time until remedial response objectives are achieved.	Long period of time; may never be achieved	Overall remediation period approx 4 yrs; Actual cleanup period 15 months	Overall remediation period approx 3.5 yrs; Actual cleanup period 15 months.	Overall remediation period approx 3 yrs; Actual cleanup period 9 months.	Overall remediation period approx 3.5 yrs Actual cleanup period 1 year.
2. Long-term effectiveness and permanence					
o Magnitude of residual risks.	Long-term risk remains	Risk would be reduced to selected target levels	Same as SC-3	Expected to achieve target levels but some uncertainty exists for cPAHs and chlordane	Need pilot test to determine residual risk; may reduce risk to selected target levels but uncertainty exist for VOCs and chlordane

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-1 No Action	SC-3 Excavation/On-Site Incineration/Back-fill On-Site	SC-4 Excavation/Off-Site Incineration/Backfill with Clean Off-site Soil	SC-5 Excavation/On-Site High Temperature Enhanced Vola-tilization/Back-fill On-Site	SC-7 Excavation/On-Site Supercritical Fluid Extraction/Backfill On-site
o Adequacy of Controls.	Fence and institution-al controls prevent ingestion, inhalation and/or direct contact	No long-term controls required	Same as SC-3	Same as SC-3	Same as SC-3
o Reliability of Control	Fence subject to vandalism	No long-term controls involved	Same as SC-3	Same as SC-3	Same as SC-3
3. Reduction of Toxicity, Mobility or Volume					
o Treatment process and remedy	No treatment employed except fence around contaminated soil area and institutional controls	Incineration of all contaminated soil and backfill treated soil on-site	Incineration of all contaminated soil off-site, backfill with clean soil from off-site	Volatilization of soil and backfill with treated soil on-site	Extraction of soil contaminants and backfill treated soil on-site
o Amount of hazardous material destroyed or treated	None by treatment Natural attenuation continues to take place	9500 cubic yards of contaminated soils exceeding target levels to be treated.	Same as SC-3	Same as SC-3	Same as SC-3
o Reduction in toxicity, mobility or volume	None by treatment Natural migration might increase volume of contami-nated groundwater	Would achieve signifi-cant and permanent re-duction in toxicity, mobility & volume of VOCs, PAHs, PCBs and chlordane.	Contaminated soil is completely removed from the site	Expected to achieve significant and permanent reduction in toxicity, mobil-ity and volume of, VOCs, PAHs, PCBs and chlordane; but some uncertainty exists in achieving target levels for cPAHs, and chlordane	May achieve signific-ant and permanent re-duction in toxicity, mobility and volume of VOCs, PAHs, PCBs and chlordane
o Irreversibility of the treatment	No treatment involved	Irreversible treatment	Same as SC-3	Same as SC-3	Same as SC-3
o Type and quantity of treatment residual	No treatment in-volved	Scrubber water, treated soil	No residuals	Scrubber water, treated soil	Extracted organics, treated soil, spent carbon

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-1 No Action	SC-3 Excavation/On-Site Incineration/Back-fill On-Site	SC-4 Excavation/Off-Site Incineration/Backfill with Clean Off-site Soil	SC-5 Excavation/On-Site High Temperature Enhanced Vola-tilization/Back-fill On-Site	SC-7 Excavation/On-Site Supercritical Fluid Extraction/Backfill On-site
4. Implementibility					
Technical Feasibility					
o Ability to construct technology	Fence and monitoring wells are easily con-structed	Easily implemented at site with mobile unit	Easily implementable at site, no construction involved, only exca-vation and packing of soil in drums	Same as SC-3	Difficult to imple-ment, depends on ven-dors ability to con-struct full scale mobile unit
o Reliability of technology	No technology	Highly reliable technology, target levels would be achieved	Off-site technology is reliable, target levels would be achieved by removing soil from site	Reliable technology some uncertainty. Although target levels are expected to be achieved	May need some modifi-cation in scaling up sizes. Some uncer-tainty that target levels can be achieved due to innovative technology.
o Ease of undertaking additional remedial action, if necessary	Easy to undertake	Easy to undertake	Same as SC-3	Same as SC-3	Same as SC-3
o Monitoring Considerations	Migration or exposure pathways can be monitored	Migration or exposure pathways can be monitored	Same as SC-3	Same as SC-3	Same as SC-3
Administrative Feasibility					
o Coordination with other agencies	Coordination required with all agencies for long period of time	Coordination required with all agencies and no coordination needed after remediation	Same as SC-3	Same as SC-3	Same as SC-3
Availability of Services and Materials					
o Availability of treatment, storage, capacity,and disposal services.	No treatment, storage or disposal services required	Availability is good.	Available capacity is uncertain	Availability is good for off-site regeneration of spent carbon	Availability is good for off-site incin-eration of extractant
o Availability of technologies, necessary equipment and specialists	Equipment and specialists are locally available	Availability is good many vendors	Available capacity is uncertain. Limited facilities in U.S.	Limited number of vendors	Only one vendor. Full scale unit is not readily available.

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-1 No Action	SC-3 Excavation/On-Site Incineration/Back-fill On-Site	SC-4 Excavation/Off-Site Incineration/Backfill with Clean Off-site Soil	SC-5 Excavation/On-Site High Temperature Enhanced Vola-tilization/Back-fill On-Site	SC-7 Excavation/On-Site Supercritical Fluid Extraction/Backfill On-site
5. Cost					
o Capital Cost	0	$7.5 Million	22.1 Million	$6.6 Million	$7.5 Million
o Operation and maintenance cost	$ 50,200	0	0	0	0
o Present worth	$0.80 Million	$7.5 Million	22.1 Million	$6.6 Million	$7.5 Million
6. Compliance with ARARs					
o Contaminant-specific ARARs	Does not comply	Complies in combination with MOM alternative	Same as SC-3	Same as SC-3	Same as SC-3
o Action-specific ARARs	None identified	Complies	Complies	Complies	Complies
o Location-specific ARARs	Does not comply with wetlands ARARs	Complies; but difficulty in meeting wetlands ARARs due to need to replicate habitat	Same as SC-3	Same as SC-3	Same as SC-3C
o Compliance with criteria, advisories and guidances	Does not comply	Complies	Complies	Complies	Complies
7. Overall Protection of Human Health and Environment					
o How risks are eliminated, reduced or controlled	Risk continues to exist at site, does not achieve overall protection of public health and environment; does not reduce toxicity, mobility and volume of contaminants	Would achieve overall protection of public health and environment. Excavation may disturb wildlife and vegetation temporarily. Would reduce toxicity, mobility and volume of contaminants to target levels	Would achieve overall protection of public health and environment. Excavation may disturb wildlife and vegetation temporarily. Would reduce toxicity, mobility and volume of contaminants to target levels	Expected to achieve overall protection of public health and environment Excavation may disturb wildlife and vegetation temporarily. Expected to reduce toxicity, mobility and volume of contaminants to target levels.	May achieve overall protection of public health and environment. Excavation may disturb wildlife and vegetation temporarily. May reduce toxicity, mobility, and volume of contaminants to target levels.

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-8 Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/ Backfill On-Site	SC-9 Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/ Backfill with Treated and Clean Off-site Soil	SC-10 In Situ Volatilization/ Excavation/On-Site Incineration/Back-fill On-Site	SC-11 In Situ Volatilization/ Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
1. Short-Term Effectiveness				
o Protection of community during remedial actions.	Dust control and air emission controls required for soil handling, enhanced volatilization and incineration	Dust control and air emission controls required for soil handling, and enhanced volatilization; traffic control required for off-site disposal	Less dust control and air emissions controls required for soil handling, due to in situ technique	Less dust control and air emission control required for soil handling due to in situ technique; traffic control required for off-site disposal
o Protection of workers during remedial actions	Health and safety protection and air emission control required	Same as SC-8	Same as SC-8	Same as SC-8
o Environmental impacts	Potential adverse air quality impacts from soil handling; clearing of plants and trees required	Potential air quality impacts from soil handling, and enhanced volatilization emission; clearing of plants and trees required.	Less excavation required. Potential air quality impacts from soil handling, in situ volatilization and incineration emissions; less damage to environment	Less excavation required. Potential air quality impacts from soil handling, in situ volatilization emissions; less damage to environment
o Time until remedial response objectives are achieved.	Overall remediation period approx 4 yrs. Actual cleanup period 16 months.	Overall remediation period approx 3.5 yrs. Actual cleanup period 10 months.	Overall remediation period approx 4 yrs. Actual cleanup period 16 months.	Overall remediation period 3.5 years. Actual cleanup period 10 months.
2. Long-term effectiveness and permanence				
o Magnitude of residual risks.	Need treatability test to determine if all target levels would be acheived.	Same as SC-8	Risk would be reduced to selected target levels	Same as SC-10

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-8 Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/ Backfill On-Site	SC-9 Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/ Backfill with Treated and Clean Off-site Soil	SC-10 In Situ Volatilization/ Excavation/On-Site Incineration/Back-fill On-Site	SC-11 In Situ Volatilization/ Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
o Adequacy of Controls.	No long-term controls required	Same as SC-8	Same as SC-8	Same as SC-8
o Reliability of Control	No long-term controls involved	Same as SC-8	Same as SC-8	Same as SC-8
3. Reduction of Toxicity, Mobility or Volume				
o Treatment process and remedy	Enhanced volatilization of soil contaminated with VOCs only and incineration of mixed contaminant soil; backfill with treated soil on-site	Enhanced volatilization of soil contaminated with VOCs only and off-site incineration of mixed contaminant soil; backfill clean and treated soil on-site	In situ volatilization of soil contaminated with VOCs only and incineration of mixed contaminant soil; backfill treated soil on-site	In situ volatilization of soil contaminated with VOCs only and off-site incineration of mixed contaminant soil; back-fill clean off-site soil
o Amount of hazardous material destroyed or treated	9500 cubic yards of contaminated soils exceeding target levels	Same as SC-8	Same as SC-8	Same as SC-8
o Reduction in toxicity, mobility or volume	Significant and permanant reduction in toxicity, mobility, & volume of contaminants	Same as SC-8	Same as SC-8	Same as SC-8
o Irreversibility of the treatment	Irreversible treatment	Same as SC-8	Same as SC-8	Same as SC-8
o Type and quantity of treatment residual	Scrubber water from incineration and/or spent carbon from enhanced volatilization	Scrubber water and/or spent carbon from enhanced volatilization	Spent carbon from in situ volatilization and scrubber water from incineration	Spent carbon from in situ volatilization

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-8 Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/ Backfill On-Site	SC-9 Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/ Backfill with Treated and Clean Off-site Soil	SC-10 In Situ Volatilization/ Excavation/On-Site Incineration/Back-fill On-Site	SC-11 In Situ Volatilization/ Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
4. Implementibility				
Technical Feasibility				
o Ability to construct technology	Easily constructed or mobilized units. Site clearing can be easily accomplished.	Mobile enhanced volatilization units are easily mobilized; No construction involved, only excavation and packing for off-site incineration. Site clearing can be easily accomplished	In situ volatilization pipe and vent system can be easily constructed at the site. Mobile incineration units are easily mobilized. Site clearing can be easily accomplished.	Insitu volatilization pipe and vent system can be easily constructed at the site. No construction involved, only excavation and packing for off-site incineration. Site clearing can be easily accomplished.
o Reliability of technology	Highly reliable; some uncertainty that action levels can be achieved with enhanced volatilization	Highly reliable; some uncertainty that action levels can be achieved with enhanced volatilization	Highly reliable; Pilot tests required to optimize operating conditions	Highly reliable; pilot tests required to optimize operating conditions
o Ease of undertaking additional remedial action, if necessary	Easy to undertake	Same as SC-8	Same as SC-8	Same as SC-8
o Monitoring Considerations	Migration or exposure pathways can be monitored	Same as SC-8	Same as SC-8	Same as SC-8
Administrative Feasibility				
o Coordination with other agencies	Coordination required with all agencies and no coordination needed after remediation	Same as SC-8	Same as SC-8	Same as SC-8
Availability of Services and Materials				
o Availability of treatment, storage, capacity,and disposal services.	Availability is good for off-site regeneration of spent carbon	Off-site incineration capacity availability is uncertain	Availability is good for off-site regeneration of spent carbon	Off-site incineration capacity availability is uncertain. Availability is good for off-site regeneration of spent carbon.

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-8 Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/ Backfill On-Site	SC-9 Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/ Backfill with Treated and Clean Off-site Soil	SC-10 In Situ Volatilization/ Excavation/On-Site Incineration/Back-fill On-Site	SC-11 In Situ Volatilization/ Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
o Availability of technologies, necessary equipment and specialists	Availability is good for both mobile ehanched volatilization and incineration units.	Off-site incineration facilities availability is uncertain. Availability of mobile enhanced volatil-ization unit is good.	Limited equipment available for in situ volatilization. Avail-ability of mobile incineration is good.	Off-site incineration facilities availability is uncertain. Availability of in situ volatil-ization unit is limited.
5. Cost				
o Capital Cost	$6.2 Million	$9.0 Million	$3.2 Million	$6.2 Million
o Operation and maintenance cost	0	0	0	0
o Present worth	$6.2 Million	$9.0 Million	$3.2 Million	$6.2 Million
6. Compliance with ARARs				
o Contaminant-specific ARARs	Complies in combination with MOM alternative	Complies in combination with MOM Alternative	Complies in combination with MOM alternative	Complies in combination with MOM alternative
o Action-specific ARARs	Complies	Complies	Complies	Complies
o Location-specific ARARs	Complies; but difficulty in meeting, wetlands ARAR due to replicate habitat	Same as SC-8	Same as SC-8	Same as SC-8
o Compliance with criteria advisories and guidances	Complies	Complies	Complies	Complies
7. Overall Protection of Human Health and Environment				
o How risks are eliminated, reduced or controlled	Expected to achieve overall protection of public health and envir-oment. Excavation will disturb wildlife and vegetation for a short period of time; Incineration	Expected to achive overall protection of public health and environment; Excavation will disturb wildlife and vegetation for a short period of time;	Would achieve overall protection of public health and environment. Excavation will dis-turb wildlife and vegetation for a short	Would achieve overall protection of public health and environment; Excavation will disturb wildlife and vegetation for a short period of

TABLE 4-36 (Cont'd)

COMPARISON OF SOURCE CONTROL ALTERNATIVES

Criteria	SC-8 Excavation/On-Site Enhanced Volatilization/ On-Site Incineration/ Backfill On-Site	SC-9 Excavation/On-Site Enhanced Volatilization/ Off-Site Incineration/ Backfill with treated and Clean Off-site Soil	SC-10 In Situ Volatilization/ Excavation/On-Site Incineration/Back-fill On-Site	SC-11 In Situ Volatilization/ Excavation/Off-Site Incineration/Backfill with Clean Off-Site Soil
	would reduce toxicity, mobility and volume of contaminants to target levels. Some uncertainity with enhanced volatilization achieving target levels for VOCs based on leaching model.	Both technologies can reduce toxicity, mobility and volume of contaminants. Some uncertainty with enhanced volatilization achieving target levels for VOCs based on leaching model.	period of time but to a lesser degree; both technologies would reduce toxicity, mobil-ity and volume of contaminants to target levels for VOCs based on leaching model and mixed contaminants based on direct contact pathway.	time but to a lesser degree; Both technologies would reduce toxicity, mobility and volume of contaminants to target levels for VOCs based on leaching model and mixed contaminants based on direct contact pathway.

community from the transportation of contaminated soil to a hazardous waste treatment facility. The alternatives that include in situ volatilization SC-10 and SC-11 would have fewer adverse effects since they only require excavation of the mixed contaminant areas. No excavation would be required for the VOC contaminated areas on the Wildwood property.

All the SC alternatives are estimated to require total remediation periods of approximately 3 to 4 years to complete the remedial design, treatability tests, procurement of remediation contractors and actual site cleanup. Actual cleanup periods range from 9 to 16 months.

Long-Term Effectiveness and Permanence

The long term risk to groundwater remains for Alternative SC-1 (No Action). The other alternatives would all treat the soil to reduce its ability to leach contaminants into the groundwater. Pilot tests would be performed to determine the actual removal efficiencies and feasibility of achieving the target levels. All the SC alternatives except for SC-1 No Action would achieve a permanent remedy by reduction of toxicity mobility and volume of contaminants. No long term management would be required since the contaminants in the soils would have been removed and/or destroyed.

Reduction of Toxicity, Mobility and Volume

Alternative SC-1 would not treat or destroy any of the contaminanted soil exceeding target risk levels and therefore would not achieve any reduction in toxicty, mobility or volume. Natural attenuation and degradation would achieve some reduction in the concentration of contaminants in the soil over a period of time. The other SC alternatives would all achieve a reduction in toxicity, mobility and volume of the contaminated soil via treatment and destruction of the contaminants in the soil media. Incineration provides the most effective destruction of all of the contaminants. In situ volatilization would be effective for VOC removal. Several other alternatives including high temperature enhanced volatilization would be generally expected to achieve the target levels but would require treatability and/or pilot tests to confirm this.

Implementability

The no action alternative is easily implemented since it does not involve any soil excavation or treatment. The incineration, high temperature enhanced volatilization, enhanced volatilization and in situ volatilization technologies are all commercially available, and have been demonstrated at hazardous waste sites and for treating the contaminants in the soil. The most proven and commonly used technology is incineration. The enhanced volatilization and high temperature enhanced volatilization technologies have been used to a lesser extent. The in situ volatilization process has been demonstrated at more than one site to remove PCE in soil to the range of soil target levels developed in this report. Supercritical fluid extraction

is being tested in the SITE program for hazardous waste at pilot scale and has been used at refineries to treat sludges. All the technologies except for the supercritical fluid extraction are available in mobile transportable units which can be transported to the site to clean up the soil in a period of 3 to 4 years. A modified supercritical fluid extraction full scale system would have to be designed and constructed for this site. There is some uncertainty about the availability of capacity of off-site permitted commercial incineration facilities and therefore the implementability of that alternative is uncertain.

There is some uncertainty that alternatives involving enhanced volatilization technology (SC-5, SC-8, SC-9) and supercritical fluid extraction (SC-7) can achieve the target levels in soil for the volatile organics based on leaching model, particularly TCE (12.7 ug/kg). The removal percentage required is 99.8% based on the average TCE concentration in the soil.

Temperature is the main process variable which differentiates the efficiency of soil technologies. Incineration which utilizes the highest temperatures (1200 to 1800°F) for primary combustion and 1400 to 2400°F in the secondary afterburner would meet the target levels in soil for the volatile organics, PCBs, cPAHs and chlordane. The high temperature enhanced volatilization technology at 700 to 1000°F is also expected to achieve the target levels but some treatabilty testing would be required to confirm this. The enhanced volatilization technology at 400 to 500° F has been shown to achieve 99.99% volatile organics removal at ten times the concentrations that are present at this site. Testing is required to determine if the same removal efficiencies can be obtained for the concentration of volatile organic contaminants at this site. No PCBs, cPAHs and chlordane removal will be achieved at these temperatures. The supercritical fluid extraction technology combines temperature (70 to 100°F) with high pressure (150 to 3000 psi) to extract all the organics from the soil to a small volume of extractant fluid which has to be disposed off-site by incineration. This technology would remove the volatile organics, cPAHs, PCBs and chlordane but there is a strong possibility that it may not achieve the target levels.

In situ volatilization using a pipe and vent vapor extraction system has been used successfully at a number of sites to treat volatile organics in soil to concentrations in the range of the proposed soil target levels. This technology is conducted at ambient soil temperatures In situ volatilization would be feasible at the Wildwood property but may not be considered practical for the small volumes of contaminated soil at Unifirst and New England Plastics. This technology will only remove the volatile organics but not the cPAHs, PCBs and chlordane. Therefore a second technology or off-site disposal for the remaining contaminated soil is also required.

The in situ volatilization technology is available from two vendors while supercritical fluid extraction technologies may only be available from one vendor at present time. Therefore, competitive bidding may not be possible. Enhanced volatilization is available from a few vendors and mobile incineration is available from several vendors.

All SC Alternatives except SC-1 No Action have the same degree of administrative feasibilities and institutional management requirements for the implementation activities. No long-term post-construction management would be required for these permanent remedial alternatives. Long-term monitoring would be required for the no action alternative.

Cost

Alternative SC-1, No Action, has a present worth cost of $0.80 million. Alternatives SC-3, SC-5, SC-7 representing single on-site treatment technologies have total present worth costs of $7.5, $6.6, and $7.5 million, respectively. The dual technology alternatives including SC-8, SC-9, SC-10 and SC-11 have present worth costs of $6.2, $9.0, $3.2, and $6.2 respectively. Alternative SC-4, off-site incineration is the most expensive remedial alternative at $22.1 million.

A comparison of the present worth costs for the various target levels for each SC alternative is presented in Table 4-37. Target levels were based on human exposure by risks from direct contact, ingestion and protection of groundwater. It should be noted that a reduction in target risk levels from 10^{-6} to 10^{-5} would reduce the costs for source control only for those alternatives using two technologies SC-8, SC-9, SC-10, SC-11. At a target level of 10^{-4}, on-site treatment of mixed contaminant soils may not be practicable due to the small volume of soil (460 cy) involved.

A sensitivity analysis was also performed for the soil target levels developed for ground water protection based on the leaching model (see Table 1-5). The target levels for the volatile organics were calculated based on a total organic carbon (TOC) content in soil of one percent which may be a conservative estimate for calculating leaching rates. The soil target level is a linear function of the TOC content. For a TOC of 5 percent, the action level for TCE on soil would increase from 12.7 to 63.5 ug/kg. This increase in target level would decrease the required process efficiency only slightly from 99.8% to 99.2% for the TCE. Therefore the uncertainty in achieving the required process efficiencies and target levels still exists for the previously mentioned technologies. The volume of soil requiring remediation would decrease slightly from 9500 to 8540 cubic yards, approximately a 10% reduction, for soil target levels based on the 5% TOC content.

TABLE 4-37

SUMMARY OF PRESENT WORTH COSTS FOR
SOURCE CONTROL ALTERNATIVES

Alternative		Total Present Worth (1988) Dollars		
		10^{-4} Target Level	10^{-5} Target Level	10^{-6} Target Level
SC-1:	No Action*	799,500	799,500	799,500
SC-3:	Excavation On-Site Incineration/Backfill On-Site	7,301,800	7,465,900	7,468,600
SC-4:	Excavation/Off-Site Incineration/Backfill With Clean Off-Site Soil	21,597,100	22,138,600	22,149,700
SC-5:	Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site	6,424,800	6,567,600	6,570,300
SC-7:	Excavation/On-Site Supercritical Fluids Extraction/Backfill On-site	7,372,700	7,536,800	7,540,100
SC-8:	Excavation/On-Site Enhanced Volatilization/On-Site Incineration/Backfill On-Site	5,733,100	6,136,000	6,181,400
SC-9:	Excavation/On-Site Enhanced Volatilization/Off-Site Incineration/Backfill with Treated and Clean Off-Site Soil	6,386,800	8,610,300	9,020,900
SC-10:	In Situ Volatilization/Excavation/On-Site Incineration/ Backfill On-Site	2,285,800	3,014,800	3,155,300
SC-11	In Situ Volatilization/Excavation/Off-Site Incineration/ Backfill with Clean Off-Site Soil	3,111,000	5,734,400	6,239,700

* Present worth analysis based on 30 year period and 5% discount rate for No Action alternative only. No O&M required for all other alternatives. Therefore, present worth equals capital cost.

Table 4-38 shows the total present worth for the source control alternative for the target levels based on using 5% TOC in soil. It should be noted that the 10^{-6} costs are reduced by approximately 2 to 13 percent depending on the alternative when compared with the Table 4-37 costs which are based on 1% TOC.

Compliance with ARARs

Excluding no action, the source control alternatives that involve soil treatment, are expected to ensure that the site would not contribute to future contamination in excess of target levels. In order to ensure full compliance with contaminant-specific ARARs at the end of the remediation period, a management of migration alternative must supplement cleanup accomplished by source control alternatives.

Specific treatment technologies employed in various source control alternatives are assumed to comply with Federal and Massachusetts RCRA design and operation requirements for hazardous waste treatment and disposal facilities. It is assumed that requirements under TSCA, OSHA, and CAA will also be complied with.

Activities affecting wetlands and floodplain areas would be performed to ensure minimum adverse impacts. If excavations are performed in the Massachusetts 100 foot buffer zone, the alternative would not comply with CWA, Section 404 Dredge and Fill requirements and the Massachusetts Wetlands Protection Requirements. In situ volatilization/incineration alternatives are likely to result in the least adverse impacts on wetlands since excavation is minimized. All other SC alternatives would not meet the Wetlands Executive Order, if chosen, because there is a practical alternative that does not impact the wetlands. In addition, under the Massachussetts Wetlands Protetion Act all SC alternatives except for in situ volatilization would require replication of wetlands lost due to excavation and this is expected to be difficult to do.

Overall Protection of Human Health and the Environment

For Alternative SC-1 No Action, the target levels would not be achieved and the contamination in the soil would continue to leach contaminants to the groundwater aquifer. Alternatives SC-3 and SC-4, SC-10 and SC-11 would result in overall protection of human health and the environment. Alternatives SC-5, SC-8 and SC-9 are expected to result in overall protection of human health and environment. Alternative SC-7 may result in overall protection of human health and the environment.

TABLE 4-38

SUMMARY OF PRESENT WORTH COSTS FOR
SOURCE CONTROL ALTERNATIVES
(5% Total Organic Carbon)

Alternative		Total Present Worth (1988) Dollars		
		10^{-4} Target Level	10^{-5} Target Level	10^{-6} Target Level
SC-1:	No Action*	799,500	799,500	799,500
SC-3:	Excavation On-Site Incineration/Backfill On-Site	6,645,800	6,809,900	6,813,100
SC-4:	Excavation/Off-Site Incineration/Backfill With Clean Off-Site Soil	19,453,400	19,995,000	20,029,000
SC-5:	Excavation/On-Site High Temperature Enhanced Volatilization/Backfill On-Site	5,857,700	5,999,800	6,008,200
SC-7:	Excavation/On-Site Supercritical Fluids Extraction/Backfill On-Site	6,717,400	6,880,900	6,890,800
SC-8:	Excavation/On-Site Enhanced Volatilization/On-Site Incineration/Backfill On-Site	5,314,100	5,656,200	5,793,700
SC-9:	Excavation/On-Site Enhanced Volatilization/Off-Site Incineration/Backfill with Treated and Clean Off-Site Soil	5,907,400	8,130,900	8,541,500
SC-10:	In Situ Volatilization/Excavation/On-Site Incineration/ Backfill On-Site	2,194,400	2,923,500	3,084,900
SC-11	In Situ Volatilization/Excavation/Off-Site Incineration/ Backfill with Clean Off-Site Soil	3,019,600	5,630,800	6,169,200

* Present worth analysis based on 30 year period and 5% discount rate for No Action alternative only. No O&M required for all other alternatives. Therefore present worth equals capital cost.

4.5.2 Management of Migration (MOM) Alternatives

The following presents an overall comparison of the MOM alternatives for each criterion. Table 4-39 compares different alternatives using the same pretreatment and air stripping treatment scheme as an example. Table 4-40 compares the three treatment schemes for the MOM-3 alternatives.

Short-Term Effectiveness

Alternative MOM-1 (No Action) does not include any active remediation and therefore does not present a risk to the community or to workers at the site. All other MOM alternatives require construction of pumping systems and treatment plants. Therefore, protection and controls would be provided to protect the community and on-site workers using measures such as dust control, personal protection equipment, and air monitoring during construction activities. No major environmental impacts would be expected for these alternatives. Construction of force mains and discharge lines through the wetlands and across the river would be required in all the alternatives. This may have temporary adverse impacts on the wetlands vegetation, wildlife and aquatic biota. Ratios of treatment plant discharge to the river flow during 7 day 10 year low flows range from 2.5 to 5.1 depending on the alternative, except for the no action alternative. However, during average flow conditions no major impacts to the river are expected.

The groundwater treatment schemes have been designed with the objective of meeting MCLs in the aquifer. Pumping rate estimates were based on removal of approximately one plume volume per year from source areas in the contaminated aquifer. Specific rates will be developed during remedial design. A significant portion of the groundwater contamination is present in the fractured bedrock aquifer where the extent of contamination and the volume of contaminated groundwater to be extracted and treated are difficult to define. There is uncertainty, therefore in estimating the overall time frame of cleanup for both the overburden and the bedrock. For alternatives MOM-2 and MOM-4 it is assumed that the bulk of the bedrock contamination can be remediated within the estimated time frames developed for the overburden since direct bedrock pumping is included in these alternatives. Long term monitoring of the groundwater would be required to track the performance and effectiveness of the various pump and treatment systems. It is possible that long term pumping of the bedrock would be required after the remediation period to control the potential for leaching of contaminants from the bedrock to the overburden.

The MOM-1 alternative (No Action) is estimated to achieve MCLs in groundwater in approximately 200 years by natural attenuation. The MOM-2 alternatives are anticipated to achieve the aquifer restoration goal in approximately 20-50 years in the source areas although the central area may be cleaned up in approximately 22 years. The remediation of the source areas of the site controls the overall time frame for this alternative.

TABLE 4-39

COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	MOM-1 No Action	MOM-2A (i) Pump Source Areas Pretreatment and Air Stripping at Separate Treatment Plants	MOM-2A (ii) Pump Source Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-4A (i) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Separate Treatment Plants	MOM-4A (ii) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Central Treatment Plant
1. Short-Term Effectiveness						
o Protection of community during remedial actions.	No major construction or treatment. No short-term risk.	Fugitive dust at five locations during construction. Air monitoring required.	Fugitive dust at one location during construction. Air monitoring required.	Fugitive dust at one location during construction. Air monitoring required	Fugitive dust at six locations during construction. Air monitoring required.	Fugitive dust at one location during construction. Air monitoring required
o Protection of workers during remedial actions	No major construction or treatment. No short-term risk	Health and safety training and personal protection equipment required.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
o Environmental impacts	Continued migration of contaminants in groundwater within the site and to downgradient	Construction required in wetlands for piping. Some clearing of trees may be necessary at five locations. Impact during average river flow is expected to be minimal.	Construction required in wetlands and river for piping. Some clearing of trees may be necessary at one location. Impact during average river flow is expected to be minimal.	Construction required in wetlands and river for piping. Some clearing of trees may be necessary at one location. Impact during average river flow is expected to be minimal.	Construction required in wetlands for piping. Some clearing of trees may be necessaary at six locations. Impact during average river flow is expected to be minimal.	Construction required in wetlands for piping. Some clearing of trees may be necessaary at one location. Impact during average river flow is expected to be minimal.
o Time until remedial response objectives are achieved.	approximately 210 years	20-50 years for source areas and also approximately 20-50 years for entire aquifer	20-50 years for source area, approximately 20-50 years for entire aquifer	In excess of 60 years for entire aquifer	10 years for central area; 20-50 years for entire aquifer	10 years for central area; 20-50 years for entire aquifer
2. Long-Term Effectiveness and Permanence						
o Magnitude of residual risks.	Contaminated groundwater remains untreated.	Some contaminated groundwater may remain in fractured bedrock.	Some contaminated groundwater may remain in fractured bedrock.	Contaminated groundwater would probably remain in fractured bedrock in source areas.	Some contaminated groundwater may remain in fractured bedrock.	Some contaminated groundwater may remain in fractured bedrock.

TABLE 4-39 (Cont'd)

COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	MOM-1 No Action	MOM-2A (i) Pump Source Areas Pretreatment and Air Stripping at Separate Treatment Plants	MOM-2A (ii) Pump Source Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-4A (i) Pump and Treat Source Areas on Central Area Pretreatment and Air Stripping at Separate Treatment Plant	MOM-4A (ii) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Central Treatment Plant
o Adequacy of Controls	Long-term institutional controls and monitoring required.	Long-term bedrock pumping may be required after 20-50 years to prevent recontamination of overburden.	Same as MOM-2A(i)	Long-term pumping may be required after 60 years.	Same as MOM-2A (i)	Same as MOM-2A (i)
o Reliability of Control	No controls provided except monitoring.	Some uncertainty in whether control of leaching from bedrock to overburden would be needed	Same as MOM-2A (i)	The effectiveness of extraction of contaminated groundwater from fractured bedrock is uncertain.	Same as MOM-2A (i)	Same as MOM-2A (i)
3. Reduction of Toxicity, Mobility or Volume						
o Treatment process and remedy	No treatment employed.	Air stripping removes VOCs in source areas from overburden and bedrock.	Same as MOM-2A (i)	Air stripping removes VOCs from central areas from overburden only.	Air stripping removes VOCs from source and central areas from overburden and bedrock.	Same as MOM-4A (i)
o Amount of hazardous material destroyed or treated	None	Approximately 271 MG of contaminated groundwater in source areas treated per year.	Same as MOM-2A (i)	Approximately 284 MG contaminated groundwater in central area treated per year, source areas treated slowly.	Approximately 555 MG contaminated groundwater in central and source areas treated per year.	Same as MOM-4A (i)
o Reduction in toxicity, mobility, or volume	No reduction in toxicity, mobility or volume.	Reduction of toxicity mobility and volume in source areas and in central area. Approximately 99.9% VOC removal would be achieved by treatment.	Same as MOM-2A (ii)	Reduction of toxicity, mobility and volume in central area and more slowly in source areas. Approximately 99.9% VOC removal would be achieved by treatment.	Reduction of toxicity, mobility and volume in both source and central areas. Approximately 99.9% VOC removal would be achieved by treatment.	Same as MOM-4A (i)

TABLE 4-39 (Cont'd)

COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	MOM-1 No Action	MOM-2A (i) Pump Source Areas Pretreatment and Air Stripping at Separate Treatment Plants	MOM-2A (ii) Pump Source Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-3A Pump and Treat Central Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-4A (i) Pump and Treat Source Areas on Central Area Pretreatment and Air Stripping at Separate Treatment Plant	MOM-4A (ii) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Central Treatment Plant
o Irreversibility of the treatment	No treatment.	Irreversible treatment.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
o Type and quantity of treatment residual	No treatment	Significant quantities of pretreatment sludge	Same as MOM-2A (i)	Same as MOM-2A(i)	Same as MOM-2A(i)	Same as MOM-2A (i)
4. Implementability						
Technical Feasibility						
o Ability to construct technology	No construction involved.	More coordination of construction required. Five treatment plants to be built. Piping construction required in wetlands area. Oversight of 5 treatment plants required.	Only one treatment plant to be built. Piping construction required across the river.	Only one treatment plant to be built. Piping construction required in wetlands area.	More coordination of construction required. Six treatments plants to be built. Piping construction required in wetlands area.	Only one treatment plant to be built. Piping required in wetlands area.
o Reliability of technology	No technology involved.	Highly reliable and well proven treatment technology.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
o Ease of undertaking additional remedial action, if necessary.	May require major construction in future if five year reviews indicate the need.	Additional treatment capacity and/or longer operation period can be undertaken.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
o Monitoring Considerations	Migration downgradient needs to be monitored.	Treatment plant efficiency and groundwater MCLs need to be monitored.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
Administrative Feasibility						
o Coordination with other agencies	No major coordination required.	Coordination required with federal, state and local agencies.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)

TABLE 4-39 (Cont'd)

COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	MOM-1 No Action	MOM-2A (i) Pump Source Areas Pretreatment and Air Stripping at Separate Treatment Plants	MOM-2A (ii) Pump Source Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-4A (i) Pump and Treat Source Areas and on Central Area Pretreatment and Air Stripping at Separate Treatment Plant	MOM-4A (ii) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Central Treatment Plant
Availability of Services and Materials						
o Availability of treatment, storage capacity, and disposal services.	No treatment, storage or disposal services required.	Availability is good	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
o Availability of technologies necessary, equipment and specialists	No special equipments or specialists required.	Availability is good many vendors available.	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)	Same as MOM-2A (i)
5. Cost						
o Capital Cost	0	$ 8.1 million	$ 4.6 million	$ 3.1 million	$11.4 million	$ 7.0 million
o Annual Operation and Maintenance Cost	$26,700) (1-30 yrs)	$ 3.7 million (1-30 yrs)	$ 1.5 million (1-30 yrs)	$ 1.4 million (1-30 yrs)	$ 5.1 million (1-30 yrs) $3.7 million (11-30 yrs)	$ 2.3 million (1-30 yrs) $1.6 million (11-30 Yrs)
o Present Worth	$ 0.44 million	$65.2 million	$27.4 million	$24.2 million	$79.1 million	$37.1 million
6. Compliance with ARARs						
o Contaminant Specific ARARs	Does not comply.	Anticipated to comply with groundwater MCLs when remediation is completed in 20-50 years (see Appendix-C)	Anticipated to comply with groundwater MCLs when remediation is completed in 20-50 years (see Appendix-C)	Not anticipated to comply with groundwater MCLs in source areas within 60 years (see Appendix-C)	Anticipated to comply with MCLs in the central area in approximately 10 years and in the source areas in 20-50 years (see Appendix-C)	Anticipated to comply with MCLs in the central area in approximately 10 years and in the source areas in 20-50 years (see Appendix-C)
o Action-specific ARARs	Does not comply	Complies	Complies	Complies	Complies	Complies
o Location-specific ARARs	Complies	Complies	Complies	Complies	Complies	Complies
o Compliance with criteria, advisories, and guidances	Does not comply	Complies	Complies	Complies	Complies	Complies

TABLE 4-39 (Cont'd)

COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	MOM-1 No Action	MOM-2A (i) Pump Source Areas Pretreatment and Air Stripping at Separate Treatment Plants	MOM-2A (ii) Pump Source Areas Pretreatment and Air Stripping at Central Treatment Plant	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-4A (i) Pump and Treat Source Areas on Central Area Pretreatment and Air Stripping at Separate Treatment Plant	MOM-4A (ii) Pump and Treat Source Areas and Central Area Pretreatment and Air Stripping at Central Treatment Plant
7. Overall Protection of Human Health and Environment						
o How risks are eliminated, reduced or controlled	Risks from ingestion would not be eliminated.	Toxicity, mobility and volume of contaminants in groundwater would be reduced in source areas. Central area cleanup to MCLs relies on natural attenuation. Some bedrock contamination may remain uncaptured. Expected to result in eventual overall protection of human health and the environment. Would not completely achieve the objective of rapid aquifer restoration to MCLs in all parts of the site.	Same as MOM-2A (i)	Toxicity, mobility and volume of contaminants in overburden would be reduced in central area and most of the source areas but would not be effective in removing contaminated groundwater from fractured bedrock in absence of bedrock pumping. Overburden may be recontaminated through migration of bedrock contaminants. Would not result in overall protection of human health and the environment in a reasonable time frame.	Toxicity, mboility and volume of contaminants in source areas and central area would be greatly reduced. Some contaminated groundwater may remain uncaptured in bedrock. Would result in maximum protection of human health and the environment. Would achieve the objective of rapid aquifer restoration to MCLs in central part of the site.	Same as MOM-4A (i)

TABLE 4-40

COMPARISON OF GROUNDWATER TREATMENT TECHNOLOGIES FOR ALTERNATIVE MOM-3

Criteria	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-3B Pump and Treat Central Area Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	MOM-3C Pump and Treat Central Area Pretreatment and Carbon Adsorption at Central Treatment Plant
1. Short-Term Effectiveness			
o Protection of community during remedial actions.	Fugitive dust at one location during construction. Air monitoring required.	Same as MOM-3A	Same as MOM-3A
o Protection of workers during remedial actions	Health and safety training and personal protection equipment required	Same as MOM-3A Potential danger of high voltage power.	Same as MOM-3A Potential exposure to contaminants while replacing spent carbon.
o Environmental impacts	Construction required in wetlands and river for piping. Some clearing of trees may be necessary at one location. Impact during average river flow is expected to be minimal	Same as MOM-3A	Same as MOM-3A
o Time until remedial response objectives are achieved.	In excess of 60 years for entire aquifer	Same as MOM-3A	Same as MOM-3A
2. Long-term effectiveness and permanence			
o Magnitude of residual risks.	Contaminated groundwater would probably remain in fractured bedrock in source areas.	Same as MOM-3A	Same as MOM-3A
o Adequacy of Controls.	Long-term pumping may be required after 60 years.	Same as MOM-3A	Same as MOM-3A
o Reliability of Control	Effectiveness of extraction of contaminated groundwater from fractured bedrock is uncertain.	Same as MOM-3A	Same as MOM-3A
3. Reduction of Toxicity, Mobility or Volume			
o Treatment process and remedy	Air stripping removes VOCs from central area from overburden only.	UV/chemical oxidation destroys VOCs from central area from overburden only.	Carbon adsorption removes VOCs from central area from overburden only.

TABLE 4-40 (Cont'd)

COMPARISON OF GROUNDWATER TREATMENT TECHNOLOGIES FOR ALTERNATIVE MOM-3

Criteria	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-3B Pump and Treat Central Area Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	MOM-3C Pump and Treat Central Area Pretreatment and Carbon Adsorption at Central Treatment Plant
o Amount of hazardous material destroyed or treated.	Approximately 284 MG contaminated groundwater in central area treated per year, source areas treated slowly.	Same as MOM-3A	Same as MOM-3A
o Reduction in toxicity, mobility or volume	Reduction of toxicity, mobility, and volume in central area and more slowly in source areas. Approximately 99.9% VOC removeal would be achieved by treatment.	Same as MOM-3A	Same as MOM-3A
o Irreversibility of the treatment	Irreversible treatment.	Same as MOM-3A	Can be reversible since desorption of adsorbed organics can occur under certain condition.
o Type and quantity of treatment residual	Significant quantities of pretreatment sludge. On-site regeneration of carbon from vapor phase adsorption system.	Same as MOM-3A	Significant quantities of pretreatment sludge and spent liquid phase carbon. On-site regeneration of vapor phase activated carbon.
4. Implementability			
Technical Feasibility			
o Ability to construction technology	Only one treatment plant to be built. Piping construction required in wetland area.	Only one treatment plant to be built. Piping construction required in wetland area. High voltage power line required.	Same as MOM-3A
o Reliability of technology	Highly reliable and well proven technology.	Innovative technology, reliability is uncertain.	Same as MOM-3A
o Ease of undertaking additional remedial action, if necessary	Easy to undertake.	Same as MOM-3A	Same as MOM-3A
o Monitoring Considerations	Treatment plant efficiency and groundwater MCLs need to be monitored.	Same as MOM-3A	Same as MOM-3A
Administrative Feasibility			
o Coordination with other agencies	Coordination required with federal, state and local agencies.	Same as MOM-3A	Same as MOM-3A

TABLE 4-40 (Cont'd)

COMPARISON OF GROUNDWATER TREATMENT TECHNOLOGIES FOR ALTERNATIVE MOM-3

Criteria	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-3B Pump and Treat Central Area Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	MOM-3C Pump and Treat Central Area Pretreatment and Carbon Adsorption at Central Treatment Plant
Availability of Services and Materials			
o Availability of treatment, storage capacity, and disposal services.	Availability is good.	Availability is limited	Same as MOM-3A
o Availability of necessary technologies, equipment and specialists	Availability is good.	Availability is limited.	Same as MOM-3A
5. Cost			
o Capital Cost	$3.1 million	$3.3 million	$ 2.8 million
o Annual Operation and Maintenance Cost	$1.4 million	$1.6 million	$ 1.6 million
o Present Worth	$24.2 million	$28.2 million	$ 26.9 million
6. Compliance with ARARs			
o Contaminant Specific ARARs	Not anticipated to comply with groundwater MCLs in source areas within 60 year time frame (see Appendix - C)	Same as MOM-3A	Some as MOM-3A
o Action-specific ARARs	Complies	Same as MOM-3A	Same as MOM-3A
o Location-specific ARARs	Complies.	Same as MOM-3A	Same as MOM-3A
o Compliance with criteria, advisories and guidances	Complies	Same as MOM-3A	Same as MOM-3A

TABLE 4-40 (Cont'd)

COMPARISON OF GROUNDWATER TREATMENT TECHNOLOGIES FOR ALTERNATIVE MOM-3

Criteria	MOM-3A Pump and Treat Central Area Pretreatment and Air Stripping at Central Treatment Plant	MOM-3B Pump and Treat Central Area Pretreatment and UV/Chemical Oxidation at Central Treatment Plant	MOM-3C Pump and Treat Central Area Pretreatment and Carbon Adsorption at Central Treatment Plant
7. Overall Protection of Human Health and Environment			
o How risks are eliminated, reduced or controlled	Toxicity, mobility and volume of contaminants in overburden would be reduced in central area and most of the source areas but would not be effective in removing contaminated groundwater from fractured bedrock in absence of bedrock pumping. Overburden may be recontaminated through migration of bedrock contaminants. Would not result in overall protection of huamn health and the environment. Would not achieve the objective of rapid aquifer restoration to MCLs in all parts of the site.	Same as MOM-3A	Same as MOM-3A

The MOM-3 alternatives are less effective in remediating the bedrock contamination and are assumed to take in excess of 60 years to achieve the aquifer restoration goals. Since no bedrock pumping is provided there is a possibility that leaching of contaminants from the bedrock could recontaminate the overburden during and after the treatment period.

The MOM-4 alternatives provide the most extensive groundwater pumping and treatment scenario for aquifer remediation. This alternative would remediate the central area aquifer in the shortest time frame (estimated at 10 years). The source areas would be remediated in 20-50 years. There is uncertainty as to how much bedrock contamination can be remediated in 20-50 years. Because of this uncertainty there is a possibility that additional bedrock pumping would be needed after the 20-50 year aquifer restoration period.

Long-Term Effectiveness and Permanence

For MOM-1 (No Action) the future risk of exposure to groundwater contamination remains although continued use of the alternative water supply (MWRA) and continued restriction on Wells G and H aquifer use would continue to reduce this risk. All the MOM alternatives reduce the long term risk by reducing the level of contaminants in the aquifer during the remediation period by treating the contaminated groundwater over a long period of time. Alternatives MOM-2A and MOM-2B treat the main source areas of contamination at the individual properties but do not directly clean up the central area of the site. The central area is anticipated to exceed target risk levels for a period of approximately 22 years. Aquifer use downgradient of the site would have to be restricted for many years.

Alternatives MOM-3A, MOM-3B, and MOM-3C by pumping at the central area of the site (Wells G and H) would eventually capture and remediate the overburden aquifer contaminants. Remediation is anticipated to require a period of in excess of 60 years since this alternative does not address the individual source areas and leaves them to eventually migrate to be captured at Wells G and H. This alternative would not be as effective in remediating the fractured bedrock contaminants as Alternative MOM-2 which would extract contaminated groundwater directly from the fractured bedrock. Treatability study results have demonstrated the effectiveness of the pretreatment and air stripping treatment scheme to achieve low concentrations of volatile organics so that treated water could be discharged to the river. Neither the MOM-2 or MOM-3 alteratives completely meet the objective of rapid aquifer restoration to MCLs in all parts of the site. In addition, under both the MOM-2 and MOM-3 alternatives a small portion of contaminated groundwater could migrate off site.

MOM-4 would more rapidly reduce the residual risks more thoroughly throughout the entire aquifer since it would provide the largest capture zone area by pumping at the source areas and in the central area (see Appendix C). Therefore, the MOM-4 Alternatives more completely meet the objective of rapid aquifer restoration to MCLs in all parts of the site than do either the MOM-2 or MOM-3 alternatives.

Long term groundwater monitoring would be required for all of the MOM alternatives to track the performance and effectiveness of the groundwater pump and treatment systems and to determine if there is any off-site migration of contaminants downgradient from the site.

Reduction of Toxicity, Mobility, and Volume

Alternative MOM-1 does not provide any extraction pumping and treatment of contaminated groundwater and therefore does not provide any reduction in the toxicity, mobility, or volume of contaminants other than through natural attenuation. The MOM-2 alternatives provide significant reduction in the toxicity, mobility, and volume of contaminants in the groundwater at the source areas. Toxicity is reduced as the volatile organic contaminants are transferred in the air stripping process from the groundwater to the vapor phase for adsorption onto activated carbon. These adsorbed volatile organics would be ultimately destroyed during regeneration of spent activated carbon. The UV/chemical oxidation treatment technology (such as in MOM-2B) would oxidize the volatile organic contaminants to carbon dioxide and water. Carbon adsorption in MOM-3 would remove organic contaminants and the contaminants would be ultimately destroyed during off-site regeneration of spent carbon. The mobility of the contaminants in the aquifer is reduced as the contaminants are extracted by the pumping system. The volume of contaminated groundwater is gradually reduced as the plume area and volume is decreased by the extraction pumping.

The MOM-3 alternatives provide reduction in the toxicity, mobility, and volume of groundwater contamination gradually over a period of in excess of 60 years. These alternatives pump groundwater from the central area of the site where the contaminant concentrations are much lower. They do not control the mobility of the contaminants from the highest concentration areas at the individual properties, but do control the mobility of contaminants migrating downgradient of the site (due to the large capture zone for Wells G and H).

The MOM-4 alternatives would achieve the maximum removal of contaminants since they provide the largest capture zone. All the alternatives would have treatment residuals and secondary waste management requirements for the pretreatment sludges and the spent activated carbon.

Implementability

All the pump and treatment alternatives except MOM-1 (No Action) can be easily constructed at the individual properties and in the central area of the site. Alternative MOM-1 would not require any construction. Extraction of the contaminants from the bedrock aquifer may be technically difficult and would be less effective than the pumping of the overburden. All the groundwater treatment technologies are well proven, reliable, and available from several vendors except for the UV/chemical oxidation technology. This technology has been extensively tested on pilot scale. Only two full scale plants have been designed and no full scale performance data is available for Superfund sites. The UV/chemical oxidation is apparently available from only two vendors at present time. The operation of the UV/chemical oxidation system requires significant power and maintenance requirements. The carbon adsorption system would require occasional replacement of spent activated carbon.

Cost

Alternative MOM-1 (No Action) which involves only groundwater monitoring has a total present worth of $0.44 million based on a time frame of 30 years. Alternatives MOM-2A (i) and MOM-2B (i) have total present worth of $65.2 and $89.1 million, respectively including five pump and treat systems and an estimated pumping time frame of 30 years. Alternatives MOM-2A(ii) and MOM-2B(ii) have present worths of $27.4 million and 44.2 million, respectively. Alternatives MOM-3A, MOM-3B, and MOM-3C, have total present worths of $24.2, $28.2, and $26.9, million, respectively (based on a 30 year remediation time frame). Alternatives MOM-4A(i) and MOM-4B(i) have total present worth costs of $79.1 and $104.8 million based on a 30 year time frame. Alternatives MOM-4A(ii), and MOM-4B(ii) have total present worth costs of $37.1, and $60.2 Million, respectively.

Table 4-41 presents a cost sensitivity analysis for the MOM alternatives with respect to utilization of a higher pumping rate. A 15 year restoration has been used for cost comparison with the assumed 30 year period for the assumed pumping rates of aproximately two plume volumes per year and one plume volume per year respectively. (It should be noted that the actual restoration times will differ from these assumed values as discussed in Appendix C.) The main difference in a hypothetical fifteen year aquifer restoration rate is that higher pumping rates and therefore larger treatment plants have to be constructed at the site. This increases the capital costs of the various alternatives. The annual operating and maintenance costs are also increased for the fifteen year scenario since the larger plants require more labor, power, chemicals, maintenance, and secondary waste management. The fifteen year restoration could achieve a more rapid aquifer cleanup and does present cost advantages for certain alternatives. However, the results of the hydrogeological evaluation indicate that the pumping rates

TABLE 4-41

SENSITIVITY OF MANAGEMENT OF MIGRATION ALTERNATIVE COSTS TO PUMPING RATES[1]

	Two Plume Volumes /Year Pumping Rate[3] 15 Year Restoration Rate (1988 Million Dollars)				One Plume Volume Per Year Pumping Rate [4] 30 Year Restoration Rate (1988 Million Dollars)			
Alternative	Capital Cost	Annual O&M Cost		Present Worth	Capital Cost	Annual O&M Cost		Present Worth
MOM-2A(i)	9.8	4.4 (1-15 yrs)		55.5	8.1	3.7 (1-30 yrs)		65.2
MOM-2A(ii)	5.3	1.9 (1-15 yrs)		25.0	4.6	1.5 (1-30 yrs)		27.4
MOM-2B(i)	11.5	6.0 (1-15 yrs)		73.8	10.3	5.1 (1-30 yrs)		89.1
MOM-2B(ii)	7.2	3.9 (1-15 yrs)		47.7	5.4	2.5 (1-30 yrs)		44.2
MOM-3A	5.4	2.2 (1-15 yrs)		28.2	3.1	1.4 (1-30 yrs)		24.2
MOM-3B	5.8	2.7 (1-15 yrs)		33.8	3.3	1.6 (1-30 yrs)		28.2
MOM-3C	4.9	2.6 (1-15 yrs)		31.9	2.8	1.6 (1-30 yrs)		26.9
MOM-4A(i)	15.2	6.5 (1-5 yrs)	4.3 (6-15 yrs)	69.4	11.4	5.1 (1-10 yrs)	3.7 (11-30 yrs)	79.1
MOM-4A(ii)	8.8	3.4 (1-5 yrs)	2.4 (6-15 yrs)	38.0	7.0	2.3 (1-10 yrs)	1.6 (11-30 yrs)	37.1
MOM-4B(i)	17.3	8.7 (1-5 yrs)	6.0 (6-15 yrs)	91.3	13.7	6.7 (1-10 yrs)	5.1 (11-30 yrs)	104.8
MOM-4B(ii)	11.6	6.3 (1-5 yrs)	4.8 (6-15 yrs)	67.9	8.5	3.8 (1-10 yrs)	2.9 (11-30 yrs)	60.2

Notes: (1) Present worth analysis based on 5 percent discount rate.
For the 30 year restoration rate, actual restoration periods for each MOM alternative will vary as discussed in Appendix C. For 15 year restoration rate actual restoration periods will also vary. For 2 plume volumes per year cost calculation only overburden pump rates have been doubled. Bedrock pump rates remain unchanged.
For MOM-4 alternatives, O&M costs reflect the fact that the central area would be cleaned up before the source areas resulting in a reduction of O&M after 5 or 10 years.

TABLE 4-42

COST OF MANAGEMENT OF MIGRATION ALTERNATIVES WITH AND WITHOUT PRETREATMENT

	Cost with Pretreatment (1988 Million Dollars)				Cost Without Pretreatment (1988 Million Dollars)			
Alternative	Capital	Annual O&M		Present Worth	Capital	Annual O&M		Present Worth
MOM-2A(i)	8.1	3.7 (1-30 yrs)		65.2	6.5	2.1 (1-30 yrs)		38.8
MOM-2A(ii)	4.6	1.5 (1-30 yrs)		27.4	3.5	0.7 (1-30 yrs)		14.3
MOM-2B(i)	10.3	5.1 (1-30 yrs)		89.1	7.6	2.7 (1-30 yrs)		49.1
MOM-2B(ii)	5.4	2.5 (1-30 yrs)		44.2	4.1	1.8 (1-30 yrs)		31.8
MOM-3A	3.1	1.4 (1-30 yrs)		24.2	1.2	0.6 (1-30 yrs)		10.4
MOM-3B	3.3	1.6 (1-30 yrs)		28.2	1.9	0.8 (1-30 yrs)		14.2
MOM-3C	2.8	1.6 (1-30 yrs)		26.9	1.6	0.7 (1-30 yrs)		12.4
MOM-4A(i)	11.4	5.1 (1-10 yrs)	3.7 (11-30 yrs)	79.1	7.9	2.7 (1-10 yrs)	2.1 (11-30 yrs)	39.6
MOM-4A(ii)	7.0	2.3 (1-10 yrs)	1.6 (11-30 yrs)	37.1	4.7	1.0 (1-10 yrs)	0.9 (11-30 yrs)	15.6
MOM-4B(i)	13.7	6.7 (1-10 yrs)	5.1 (11-30 yrs)	104.8	9.6	3.6 (1-10 yrs)	2.8 (11-30 yrs)	52.8
MOM-4B(ii)	8.5	3.8 (1-10 yrs)	2.9 (11-30 yrs)	60.2	5.8	2.6 (1-10 yrs)	1.9 (11-30 yrs)	37.2

Note: (1) Present worth analysis based on 5 percent discount rate.

(2) Present worth analysis for all alternatives except MOM-4A(i), MOM-4A(ii), MOM-4B(i) and MOM-4B(ii) based on 5 percent discount rate and 30 year period. In case of MOM-4A(i), MOM-4A(ii), MOM-4B(i) and MOM-4B(ii) the central area will be pumped for 10 years with the objective of achieving MCLs.

required for the fifteen year restoration period for certain MOM alternatives may not be able to be sustained by the aquifer (see Appendix C).

Table 4-42 summarizes the sensitivity of the costs of the MOM alternatives with and without pretreatment. It should be noted that the total present worth costs are 28 to 57 percent lower without pretreatment. Equalization is included in both cases. It may be possible that pretreatment is not needed for all of the individual properties and this needs to be further evaluated during the Remedial Design.

Compliance with ARARs

With the exception of no action, all management of migration alternatives would eventually meet contaminant specific ARARs. MOM-2 alternatives would attain contaminant-specific ARARs in the groundwater underlying the central area slowly, MOM-3 alternatives would attain contaminant-specific ARARs in the groundwater underlying either the source areas or the central area only after lengthy remediation. MOM-4 alternatives would attain contaminant-specific ARARs in the groundwater underlying the overall site and would more rapidly attain ARARs in the central area than the MOM-2 or MOM-3 alternatives.

All management of migration alternatives would comply with action and location-specific ARARs. Treatment plants would not be located in wetlands or floodplains. Only pipe lines would be laid in wetlands.

Overall Protection of Human Health and Environment

Alternative MOM-1 (No Action) provides minimal protection of human health and the environment by monitoring the contaminant migration downgradient of the site. The present risk of groundwater ingestion remains, however, the continued use of the alternate water supply and restriction of aquifer pumping would minimize this risk. The other alternatives would meet the aquifer restoration objectives in different time frames for different remediation costs. Alternative MOM-4 provides the most overall protection of human health and the environment and the shortest overall time frame. There is some uncertainty in how effective the bedrock remediation would be and some residual bedrock contamination may therefore remain after the remediation period.

REFERENCES

Ahrishamian, Ramin, 1987. Organic Waste Reduction Using Critical Fluid Extraction, Haz Tech International Conference, August 26-28, 1987, St. Louis, Missouri.

Alliance Technologies Corp., 1987. Wells G & H Site Endangerment Assessment. Draft Final Report. Prepared for U.S. Environmental Protection Agency, Subcontract No. TES EMI-GCA Task No. 52, EPA Prime Contract No. 68-01-7037, Work Assignment No. 489, March, 1987.

Ebasco Services Incorporated, 1988. Draft Final Supplemental Remedial Investigation for Feasibility Study, Wells G&H Site, Woburn, Massachusetts. Prepared for Region I, U.S. Environmental Protection Agency, EPA Work Assignment Number: 132-I146, August 1988.

ICF/Clement Associates, 1988. Draft Final Endangerment Assessment for the Wells G&H Site, Woburn, Massachusetts. Prepared for Ebasco Services Incorporated, September, 1988.

Ghassinai, Mosood, R Baker, J Steinkle and F Manchok, 1986. In-Situ Treatment for Site Remediation, Third Annual Hazardous Waste Law and Management Conference, October 29-30, 1986, Seattle, Washington.

NUS Corporation, 1986. Wells G & H Site Remedial Investigation Report, Part I, Woburn, Massachusetts. Prepared for Region I, U.S. Environmental Protection Agency, Waste Management Division. TDD No. F1-8607-07, NUS Job No. MA11RF, EPA Site No. MAD980732168, Contract No. 68-01-6699, October 17, 1986.

Planning Research Corp. (PRC), 1986. Wells G & H Wetlands Assessment, Final Report. Prepared for U.S. Environmental Protection Agency, Office of Waste Programs Enforcement, Contract No. 68-01-7037, March 25, 1986.

Planning Research Corp. (PRC), 1986. Wells G & H Remedial Investigation Part II, Final Report. Prepared for U.S. Environmental Protection Agency, Office of Waste Programs Enforcement, Contract No. 68-01-7037, November, 1986.

Tose, M. K., 1987. Removal of Polychlorinated Biphenyls from Sludges and Sediments with BEST Extraction Technology, 1987 Annual Meeting, Biotechnology Conference, November 15-20, 1987, New York, New York.

REFERENCES (Cont'd)

U.S. Environmental Protection Agency, 1985. Handbook, Remedial Action at Waste Disposal Wastes, EPA Office of Emergency and Remedial Response, Office of Research and Development, Hazardous Waste Engineering Laboratory, EPA/625/6-85/006, June, 1985.

U.S. Environmental Protection agency, 1986. Mobile Treatment Technologies for Superfund Wastes, EPA Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, EPA/540/2-86/003(f), September, 1986.

U.S. Environmental Protection Agency, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response, OSWER Directive 9335.3-01, Draft. March, 1988.

U.S. Environmental Protection Agency, 1988. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites, Office of Solid Waste and Emergency Response, OSWER Directive 92831-2, Revised Draft. 1988.

U.S. Geological Survey, 1986. Area of Influence and Zone of Contribution to Wells G & H, Woburn, Massachusetts, Draft Report, 1986.

U.S. Environmental Protection Agency, (EPA) 1986. Air Quality Criteria for Lead Final Draft Report, Environmental Criteria and Assessment Office. Office of Research and Development, Research Triangle Park, North Carolina, EPA 600/8-83-028 AF.

U.S. Environmental Protection Agency, Additional Interim Guidance for FY-87 Records of Decision, Memorandum prepared by J. Winston Porter, in Superfund Newswatch, Vol. 1 No. 17. September 16, 1987.

Weston Geophysical Corp., 1986. J. J. Riley Site Activity Map, February, 1986.

Whitman and Howard, 1984. Sewage System Infiltration/ Inflow Analysis, City of Woburn, Massachusetts, WPC-MASS-785-S1, Whitman and Howard Inc., May 1984.