3 1993

FEASIBILITY STUDY

CAE-LINK CORPORATION
HILLCREST FACILITY

Binghamton, Broome County, New York
NYSDEC Site No. 704015

Prepared for:

New York State
Department of Environmental Conservation

On Behalf of:

CAE-Link Corporation

DECEMBER 1993

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Feasibility Study Report

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1.0 Introduction

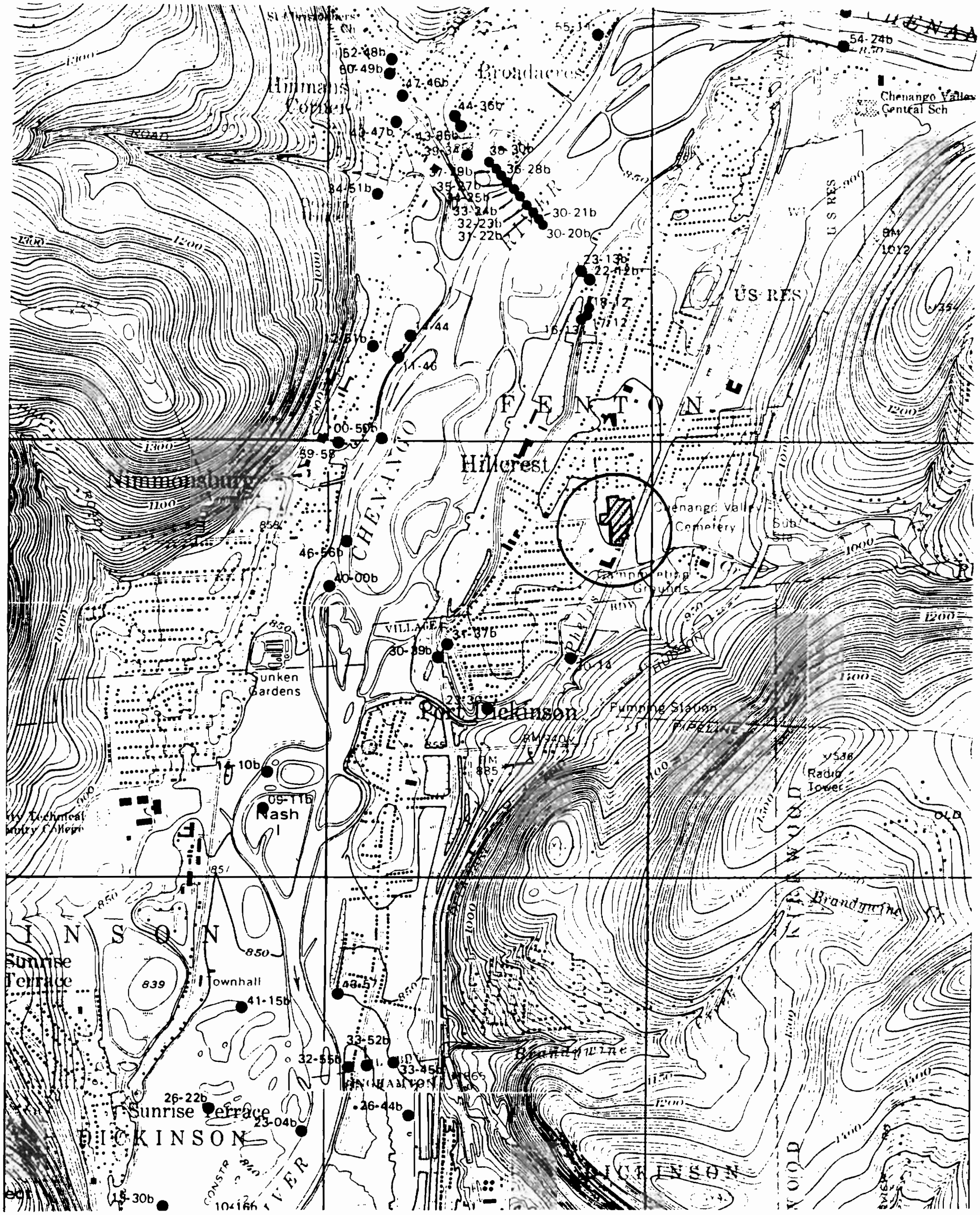
1.1 Objectives

The objective of the CAE-Link Feasibility Study (FS) Report is to develop, screen, and evaluate appropriate remedial actions which will minimize risks to public health and the environment and achieve Applicable or Relevant and Appropriate Requirements (ARARs) for site remediation.

Remedial action alternatives were developed and evaluated in accordance with the National Contingency Plan (NCP) objectives, requirements and guidelines set forth under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the New York State Department of Environmental Conservation's (NYSDEC's) Technical and Administrative Guidance Memorandum (TAGM) for the Selection of Remedial Actions at Inactive Hazardous Waste Sites (TAGM No. HWR-90-4040). Under these statutes, remedy selection at a site should meet one or both "threshold factors" as defined by EPA, namely compliance with ARARs, and/or to be protective of human health and the environment.

1.1.2 Background

The Hillcrest facility, presently owned by CAE-Link Corporation ("Link") is located at 11 Beckwith Avenue in the Town of Fenton, Broome County, New York. The 15-acre facility is located in a commercial/residential community approximately five miles northeast of the City of Binghamton as shown in Figure 1-1, Location Map, and Figure 1-2, Site Map. The Erie Lackawanna Railroad separates the site from the Chenango Valley Cemetery at the eastern site boundary. Link is involved in the manufacturing and production of flight simulators and peripheral equipment. The Chenango River is located approximately 2,500 feet west of the facility, and drains a significant portion of central New York State into the Susquehanna River, to the south.



CAE–LINK LOCATION MAP

SCALE:1:24000

BASE FROM USGS

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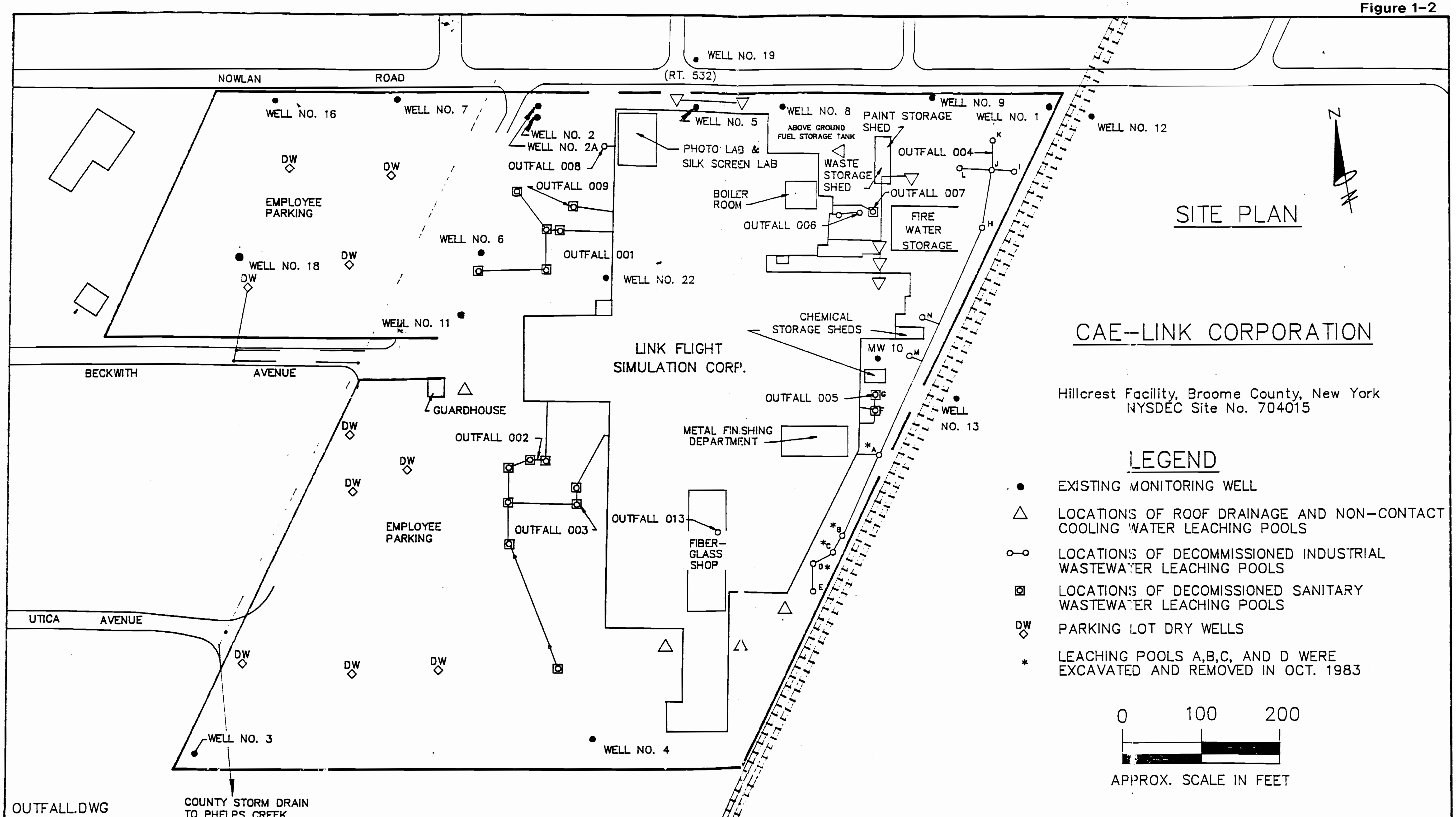
MELVILLE, N.Y. TOTOWA, N.J.

Figure 1-2



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The Singer Company and the NYSDEC entered into an Administrative Consent Order (ACO) in February 1988, which required SingerLink to undertake a Remedial Investigation/Feasibility Study (RI/FS) at its Hillcrest facility. CAE-Link Corp. acquired the Hillcrest facility in August 1988, and has cooperated in completing the RI/FS process. The focus of the RI was to determine the effect previous discharges from industrial processes may have had on the environment. These processes include plating (chromium, cadmium, silver, zinc, copper, nickel, rhodium, gold, and tin/lead alloy), degreasing, and paint stripping (trichloroethene, 1,1,1-trichloroethane, and methylene chloride). Wastewaters generated from these processes were formerly discharged to a SPDES permitted on-site disposal system of twelve outfalls, collectively known as Outfall 004. Four of the leaching pools in Outfall 004 were put out of service, excavated, and removed in October 1983. The remaining leaching pools in the system were rendered inactive by decommissioning in 1985.

H2M conducted the Remedial Investigation on behalf of Link during the summer of 1989; the final RI report was submitted to NYSDEC in September 1990. Additional RI work was performed during the summer of 1992 with the installation of two additional off-site monitoring wells and additional groundwater sampling requested by NYSDEC, as reported in the January 1993 Addendum to the RI.

1.1.3 Nature and Extent of Contamination

The results of the RI defined the nature and extent of contamination in soils, groundwater, and air. Soil gas sampling was utilized to investigate the vadose zone at the Hillcrest facility and adjacent area. With the exception of one sampling location, all concentrations of volatile organics were below the acceptable ambient air levels for specific contaminants. The one sampling location with an elevated concentration of volatile organics was determined to be a result of residual contamination from a nearby source other than the Hillcrest facility.

The RI confirmed the presence of an on-site groundwater plume, confined to the thin (10 to 25 feet thick) upper water table aquifer, consisting of volatile organic and inorganic contamination, as well as defined the configuration of an off-site volatile organic plume. Volatile organic compounds, predominantly trichloroethene, were quantified above New York State drinking water standards. The highest concentrations of trichloroethene, averaging 370 ppb in 1992, have been found on-site downgradient of Outfall 004. Off-site concentrations of trichloroethene averaged 40 ppb in 1992. A silt unit approximately 140 feet thick creates a lower boundary to the shallow aquifer, separating the upper water table aquifer from the deeper aquifer used 2,500 feet to the north of the Hillcrest facility for drinking water purposes.

The majority of inorganic contaminants in groundwater found above background and not attributable to sample turbidity appear to be limited in mobility, and were found on-site in the vicinity of the source area, decommissioned Outfall System 004. These compounds included antimony, beryllium, cadmium, chromium, copper, silver, and cyanide. During the 1992 RI Addendum work, chromium was the only inorganic compound analyzed. It was found consistently above background concentrations on-site in both rounds, in two monitoring wells downgradient of Outfall 004. The concentration at these locations averaged 860 ppb. The natural organic material in the silt layer most likely promotes sorption of the contaminants via the formation of hydrophobic bonding between the contaminants and the organic material in the silt, thus limiting contaminant mobility.

Soils in the twelve leaching pools within Outfall System 004 were sampled as part of the RI; background soil samples were also obtained for comparison purposes. Concentrations of antimony, barium, beryllium, cadmium, calcium, chromium, copper, magnesium, manganese, mercury, nickel, zinc, and lead were elevated in the majority of leaching pool soils, with highest concentrations present at leaching pools H, I, J, K, L and M. Volatile organic compounds (primarily trichloroethene, 1,1,1-trichloroethane, and some breakdown compounds) were predominantly found in soils obtained from leaching pools E, N, J K, M and excavated leaching pool A. The area of Outfall 004 was demonstrated to be the source of groundwater contamination.

1.1.4 Contaminant Fate, Transport, and Exposure Pathways

The primary contaminants associated with the site are volatile organic compounds and heavy metals. The ultimate fate of these contaminants might include sorption, hydrolysis, biodegradation, oxidation/reduction, photolysis and/or volatilization. Groundwater is the key transport medium of these contaminants, via percolation of rainfall in the vicinity of Outfall 004 down to the water table. The primary environmental exposure route of chemical contaminants is also through the water table aquifer. According to public records and available information, all buildings in the area under consideration are currently connected to a public water supply for drinking, showering and cooking purposes. The volatile organic plume extends off-site and discharges locally to the Chenango River, located 2,500 feet west of the facility. Inorganics in groundwater have not migrated off-site.

The Chenango River is rated as Class B, which is suitable for primary contact recreation. The area of probable groundwater discharge is open to fishing. Contaminants contained in groundwater discharging to the river are expected to volatilize to some extent, or precipitate and adsorb onto sediment. Some contaminants can also remain in solution and be eventually transported downstream. Organisms that might bioaccumulate substances from the soils, sediment or surface waters at the site could also be considered as carriers of contamination to off-site areas. However, the contaminant loading to the river resulting from groundwater discharge is expected to be insignificant, because of the high flow rate of the river relative to discharge from groundwater.

Direct ingestion of soil and exposure to contaminated soil is a potential exposure route only during remedial activities at the site. This pathway is also directly related to air exposure via wind erosion of contaminated subsurface soils brought to the surface during excavation, and volatilization and resuspension of dust particles during excavation and stockpiling of contaminated soils. Other than during remedial activities, no other mechanisms for the soil or air exposure route were found to exist.

1.1.5 Ecological Assessment

An ecological assessment was performed as part of the remedial investigation. The ecological assessment evaluated the flora and fauna in the vicinity of site, and characterized ecological habitat types and related fish and wildlife. The ecological assessment was done at the habitat level. Five major habitat types were identified: the Link site, surrounding woodland/forested areas, freshwater wetlands, open water, and flood plains. Flora and fauna traditionally associated with each particular habitat were listed; their presence was verified utilizing existing local literature and by telephone conversations with State and local agencies. The listed species were then compared to the New York State lists of "Endangered, Threatened and Special Concern Species" and "Species of Special Concern". No species on these lists were identified as present in the vicinity of the facility.

1.1.6 Baseline Risk Assessment

A baseline risk assessment (BRA) was performed as part of the remedial investigation. The assessment assessed the potential risks to human health associated with the CAE-Link facility if remediation is not conducted.

The BRA was performed using conservative assumptions according to the general guidelines outlined by the United State Environmental Protection Agency (USEPA) as detailed in Superfund Public Health Evaluation Manual (SPHEM) 1986 guidelines. The purpose of using conservative assumptions was to explore the potential for adverse health and environmental effects using conditions that tend to overestimate risk.

The indicator chemicals used in the BRA were selected from the groundwater and subsurface unsaturated soil media, and includes organic and inorganic chemicals. As a conservative approach in the BRA, all organic chemicals that were detected and quantified in soil or groundwater, and those inorganic contaminants which were present at concentrations greater than twice the maximum background levels were selected as an indicator chemical.

Exposure Pathways:

The primary and only complete pathway for potential exposure to human health from contaminants at the site is through direct contact or ingestion of surface water in the river. Impacted groundwater from under the CAE-Link facility eventually discharges to the Chenango River. Groundwater in itself is not a completed pathway since all residents in the downgradient area are supplied by municipal water, and therefore, are not exposed to the contaminated medium. However, contaminated groundwater may be discharged to the Chenango River Therefore, exposure could occur to anyone who swims or wades in the river or who may consume fish from the river downstream of the point of potentially contaminated groundwater discharge.

To quantitatively assess the potential risks to human health, chronic daily intakes (CDIs) values were estimated. Exposure to surface water may occur through ingestion of water from the Chenango River by people who wade or swim downstream of the point of discharge of potentially contaminated groundwater. The chronic daily intake (CDI) estimate of surface water ingestion is based on the following expression:

$$CDI = (Cp) * (I)$$

Where, CDI = chronic daily intake (mg/kg/d)

Cp = predicted concentration in surface water (mg/L)

I = surface water ingestion rate (L/kg/day)

Maximum concentrations of contaminants in groundwater were used to predict concentrations of these same contaminants in surface water. The rate of surface water ingestion (or human intake factor) was estimated to be 0.029 L/kg/day, based on the standard drinking water intake per day (roughly 2 L/day) per standard adult body weight (70 kg).

For potential carcinogens, excess lifetime cancer risks are obtained by multiplying the daily intake of the contaminant under consideration by its cancer potency factor. A risk level of 10^{-6}, which represents a probability of one in 1,000,000 that an individual could contract cancer due to exposure to the potential carcinogen, is often used as a benchmark by regulatory agencies.

Potential risks for non-carcinogens are presented as the ratio of the chronic daily intake exposure to the reference dose (CDI:RfD). The sum of the ratios of chemicals under consideration is called the hazard index. In general, hazard indices which are less than one are not likely to be associated with any health risk and are therefore less likely to be of concern than hazard indices greater than one.

In accordance with USEPA's guidelines for evaluating the potential toxicity of complex mixtures (USEPA, 1986c), it was assumed that the toxic effects of the site-related chemicals would be additive.

The estimated cumulative risks due to non-carcinogens (hazard index) and carcinogens (cancer risk) are summarized below for predicted surface water concentrations of indicator chemicals, compared to background and reference values:

	Estimated Cumulative Non-Carcinogen Hazard Index	Estimated Cumulative Cancer Risk
Site	4.53E-01	5.39E-07
Background	1.95E-02	0.00E+00
Reference Value	1.0 E+00	1.0 E-06

The risk due to estimated cumulative non-carcinogens does not exceed the reference value (1.0E+00) for the hazard index for either the site or background conditions. The estimated cumulative risk due to carcinogens also does not exceed the reference value of 1.0E-06 for either the site or background conditions. This level of risk characterization indicates that there are no increased risks due to either estimated cumulative non-carcinogens or carcinogens.

Based upon the potential exposure concentrations in surface water and risks predicted by the assessment, the risks due to non-carcinogens and carcinogens do not exceed the reference values or hazard index established for these compounds. Therefore, using the above criteria, no increased risk is evident due to impacted groundwater discharging into the Chenango River. Remediation of surface water and groundwater are not warranted based on the assumptions and scenarios used. Soil remediation may be warranted in order to prevent future contaminant loading to groundwater in order to accelerate aquifer restoration.

2.0 Identification and Screening of Remedial Technologies

2.1 Introduction

The purpose of this section is to identify and screen potentially feasible technologies applicable to site remediation at Link's Hillcrest facility. These technologies will be chosen based on their ability to meet the remedial action objectives, which are defined with respect to the contaminants of concern, contaminant transport media, routes of exposure, and allowable exposure levels. These objectives are developed on the basis of chemical specific applicable or relevant and appropriate requirements (ARARs), and site-specific risk-related factors defined in the baseline risk assessment. Technology types are initially chosen for broad general response actions for each media, such as institutional controls, containment, treatment, etc. Various process options for each potentially feasible remedial technology are subsequently presented and evaluated for their applicability. Remedial technologies and process options potentially applicable to site remediation at the Link facility will be retained for the preliminary screening of alternatives.

2.2 Remedial Action Objectives

Remedial action objectives identify media-specific goals aimed at protecting human health and the environment. Objectives protective of human receptors should express both contaminant levels and exposure routes, since protectiveness may be achieved by minimizing exposure as well as by reducing contaminant levels. Remedial action objectives protective of the environment typically seek to preserve or restore groundwater or soil to target cleanup levels. The preferred treatment technologies associated with the objectives are those which, in whole, or in part, provide for a permanent solution, and which decrease the toxicity, mobility, or volume of the hazardous contaminants.

The preliminary remedial action goals and general response actions for the Link site, as well as the choice of potentially applicable technologies to achieve these goals, will be established based on ARARs for specific contaminants, and acceptable exposure levels for human health as determined by the risk assessment. These levels should be compared to contaminant levels present in each environmental media associated with the Link site.

2.3 Applicable and Relevant or Appropriate Requirements

The Superfund Amendment and Reauthorization Act of 1986 (SARA) requires that remedial actions should at least attain Applicable or Relevant and Appropriate Requirements (ARARs), unless one or more of six circumstances defined by CERCLA is identified as applicable to the site, allowing a waiver of ARARs. ARARs are Federal, State, or other environmental and public health advisories, guidance and/or standards which are applicable or relevant in determining allowable exposure levels for human health. ARARs are used for all remedial alternative assessments (including no action) for the protection of human health and the environment during remediation. Applicable requirements are defined as "those clean-up standards, standards of control, and other substantive environmental protective requirements, criteria, or limitations promulgated under Federal and State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site." These applicable requirements would be legally enforceable by a Federal or an authorized State program even if this response was not undertaken pursuant to CERCLA. Relevant and appropriate requirements are defined as "those clean-up standards that address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the site." Relevant and appropriate requirements are not "legally applicable"; however, they should be considered in the development of remedial clean-up levels relying on professional judgment and taking into consideration environmental and technical factors at the site.

ARARs may be grouped into two categories which determine: (1) remedial action clean-up levels, and (2) implementation of remedial actions. ARARs affecting selection of clean-up levels may either be chemical-specific or location specific. ARARs which pertain to remedial action implementation are action-specific ARARs. The three types of ARARs are described below:

1. Chemical-specific ARARs are health based or risk based concentration limits or ranges for specific contaminants in various environmental media.

2. Location-specific ARARs are regulatory restrictions, requirements, or limitations for a contaminant release strictly based upon location of the site and its immediate environment.

3 Action-specific ARARs are regulatory requirements or limitations based on implementation of the remedial action technologies selected for a site.

There are no location-specific ARARs applicable to the Link site, due to the absence of endangered species or species of special concern in the immediate area. Sensitive environments such as wetlands that would be directly affected by remedial actions at the site are also not present. Chemical-specific and action-specific ARARs for the site are discussed in the following sections.

<u>2.3.1 Chemical-Specific ARARs</u>

The RI for the Link site investigated several environmental media, which included water, soil and air. Two environmental medias, soil and groundwater, were found to be affected with volatile organic compounds and some inorganic compounds. Therefore, discussion of chemical-specific ARARs is limited to these two media. A list of the chemical-specific Federal and State ARARs are presented in Table 2-1.

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Table 2-1
Chemical Specific ARARs
CAE-Link
Hillcrest Facility

	Federal Safe Drinking Water Act		RCRA Subpart S 40 CFR 264		NYSDOH	New York State	USEPA	NYSDEC TAGM HWR92-4046 (Soils)				DRINKING WATER EPA HEALTH ADVISORIES & NAS SNARLS				
					Standards for Drinking Water Sources	Gdwater Quality Standards for Class GA Waters	HEAST Soil - Direct Ingestion	East USA Typ. Concentration Ranges	Link Background Concentrations		Cleanup Objective	10-kg child	10-kg child	10-kg child Long	70-kg Adult Long	70-kg Adult
Parameter	MCLs (ug/l)	MCLGs (ug/l)	Soil (mg/kg)	Water (ug/l)	(ug/l)	(ug/l)	(mg/kg)	(mg/kg)	Mean (mg/kg)	Maximum (mg/kg)	(mg/kg)	One -day (a) (ug/l)	Ten Day (b) (ug/l)	Term (c) (ug/l)	Term (c) (ug/l)	ADI ug/kg/day
Chloromethane	NA	NA	NA	NA	5	5	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	7	7	10	7	5	5	12	NA	ND	ND	0.4	2,000	1,000	1,000	4,000	9
1,1-Dichloroethane	NA	NA	NA	NA	5	5	8,000	NA	ND	ND	0.1	NA	NA	NA	NA	NA
1,2-Dichloroethene (trans-)	NA	100	NA	NA	5	5	2,000	NA	ND	ND	0.3	20,000	2,000	2,000	6,000	20
1,2-Dichloroethene (cis-)	NA	70	NA	NA	5	5	800	NA	ND	ND	NA	4,000	1,000	3,500	1000	10
1,1,1-Trichloroethane	200	200	7,000	200	5	5	7,000	NA	ND	ND	0.8	100,000	40,000	40,000	100,000	90
Trichloroethene	5	0	60	5	5	5	64	NA	3	3	0.7	NA	NA	NA	NA	7
Xylene (1,2-)	NA	NA	NA	NA	5	5	200,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (1,3-)	NA	NA	NA	NA	5	5	200,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (1,4-)	NA	NA	NA	NA	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (Total)	10,000	10,000	200,000	10,000	5	5	200,000	NA	ND	ND	1.2	40,000	40,000	40,000	100,000	2,000
Antimony	NA	NA	30	0.01	3	3	30	NA	4.7	6.4	SB	15	15	15	15	0.4
Barium	1,000	2,000	4,000	1,000	1,000	1,000	4,000	15 - 600	46.5	52.7	300 or SB	5,000	5,000	5,000	5,000	NA
Beryllium	NA	NA	0.008	0.2	3	3	0.16	0 - 1.75	0.48	0.5	1.0 or SB	30,000	30,000	4,000	20,000	5
Cadmium	10	5	10	10	10	10	80	.1 - 1	2.75	3.2	1 or SB	40	40	5	20	0.5
Chromium	50	100	NA	50	50	50	80,000	1.5 - 40	33.3	34.2	10 or SB	1,000	1000	200	800	5
Hexavalent Chromium	50	NA	400	50	50	50	400	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	1,000	1,000	NA	1 - 50	35.85	37.7	25 or SB	NA	NA	NA	NA	NA
Cyanide	NA	NA	2,000	700	NA	NA	2,000	NA	66.85	132	NA	200	200	200	800	22
Lead	50	0	NA	50	25	25	250	4 - 61	14.05	15.3	30 or SB	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	35,000	35,000	NA	100 - 5,000	3515	3920	SB	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	300	300	20,000	50 - 5,000	621	705	SB	NA	NA	NA	NA	NA
Mercury	2	2	20	2	2	2	20	0.001 - 0.2	ND	ND	0.1	NA	NA	NA	2	0.3
Nickel	NA	NA	2,000	700	NA	NA	2,000	0.5 - 25	35.65	37	13 or SB	1,000	1,000	100	600	20
Silver	50	NA	200	50	50	50	200	NA	ND	ND	SB	200	200	200	200	5
Zinc	NA	NA	NA	NA	5,000	5,000	20,000	9 - 50	77.45	80.6	20 or SB	NA	NA	NA	NA	NA

Notes:

MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
(a) - Established based on 10 kg child exposed over a one day period
(b) - Established based on a 10 kg child exposed over a ten day period
(c) - Established based on a 10 kg child/ 70 kg adult exposure for an extended period of time

ADI - Acceptable Daily Intake
SB - Site Background
NA - Not Applicable
ND - None Detected

Cleanup Objectives for soils are unenforcable goals.

2.3.1.1 Federal Safe Drinking Water Act (40 CFR 141, 40 CFR 143)

Originally established in 1974, the Federal Safe Drinking Water Act primarily addresses chemical concentrations using health-based criteria, and also establishes secondary standards based on aesthetic (taste, color, odor) criteria. This act establishes maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs), which define the standards for volatile organic and inorganic concentrations, not known to have adverse health effects, in drinking water . The MCLs were established in accordance with the technological and economical feasibility of contaminant removal. According to the act, MCLGs should be considered but MCLs are more relevant. Although there are no current receptors, these regulations are considered applicable to the Link site since groundwater has been locally affected. The MCLs and MCLGs are presented for the subject compounds in Table 2-1.

This EPA developed guidance document classifies aquifers based on their current use, as well as their potential use as a drinking water source, ecological use, or other beneficial uses. Under this classification system, the aquifer underlying the Link facility would be classified as Class 2, Current and Potential Sources of Drinking Waters Having Other Beneficial Use. Therefore, target cleanup levels should include Federal and State drinking water standards.

2.3.1.2 RCRA Requirements (40 CFR 264)

RCRA requirements could possibly be applicable to the Link site if sludges remaining in the outfall system were considered as either listed or characteristically hazardous wastes. Regulations promulgated under this act generally establish technology-based requirements for active or proposed hazardous waste facilities. These requirements might include groundwater protection or closure. Soil and groundwater action levels were also proposed in 40 CFR 264 Subpart S, Corrective Action for Solid Waste Management Units. These action levels were suggested to determine concentrations at which no other corrective actions would be necessary at RCRA sites. Table 2-1 presents the action levels for the contaminants of concern addressed under RCRA Subparts S.

2.3.1.3 New York State Dept. of Health Drinking Water Standards (10 NYCRR Subpart 5-1)

The New York State Department of Health (NYSDOH) has adopted standards to limit organic chemical contamination of public drinking water supplies. Although there are no current receptors of volatile organic contamination in the groundwater, these regulations are considered applicable to the Link site since groundwater has been locally affected, and existing soil contamination could further affect groundwater quality. These standards establish a limitation on the total concentration of principal organic contaminants (POCs) and unspecified organic contaminants (UOCs) of less than 100 ug/l. An MCL of 5 ug/l was established for all POCs, and 50 ug/l for UOCs. The MCLs for the organic compounds found in the groundwater at the Link site are provided in Table 2-1.

2.3.1.4 NYSDEC Groundwater Quality Standards and Guidance Values (6 NYCRR 703.5, TOGS 1.1.1)

These groundwater standards include all NYSDEC groundwater standards and NYSDOH MCLs. They are applicable to Class GA waters; groundwater in the study area is classified as Class GA, as defined in 6 NYCRR 701.1. Standards for the contaminants of concern are provided in Table 2-1.

2.3.1.5 USEPA HEASTS

The USEPA has developed Health Effects Assessment Summary Tables (HEASTs). These values describe maximum allowable concentrations of contaminants in soil based on direct ingestion. These values are provided in Table 2-1.

2.3.1.6 NYSDEC Determination of Soil Cleanup Objectives and Cleanup Levels (TAGM HWR-92-4046)

This TAGM provides a basis and procedure by which soil cleanup levels can be determined. The cleanup levels for soils containing volatile organic compounds include health-based criteria taken from EPA's Health Effects Assessment Summary Table (HEAST) numbers, laboratory analytical contract required method detection limits, and groundwater protection criteria, which are calculated based on contaminant solubility, the groundwater or drinking water standard for that contaminant, total organic carbon contained in the soil, and the water/soil partitioning theory. Soil cleanup objectives for heavy metals were developed from comparisons of eastern United States background concentrations, and laboratory analytical contract required method detection limits. Cleanup objectives are expressed as a specific concentration, site background, or both. These values are provided in Table 2-1.

2.3.1.7 EPA Health Advisories and NAS SNARLS

The EPA has established guidance for contaminants that are unregulated but can potentially cause effects through the use of health advisories and suggested no adverse response levels (SNARLS). The levels were developed based on a child weighing 10 kg, with chemical exposure periods of one day, ten days, several months, and several years. The basis for adults was established based on a person 70 kg, and exposure of over 70 years. The National Academy of Sciences (NAS) developed SNARLS based on a 70 kg man exposed for periods of one day, seven days, and several months. NAS also developed acceptable daily intake (ADI) levels for one milligram of chemical per kilogram of body weight basis. These guidance values are presented in Table 2-1.

2.3.2 Action-specific ARARs

Action-specific ARARs are regulatory requirements or limitations based on implementation of the remedial action technologies selected for a site. Action-specific ARARs include those ARARs which will be triggered if specific process options are chosen from soil and groundwater remedial technologies potentially applicable to the site.

2.3.2.1 RCRA Requirements (40 CFR 264.94)

RCRA requirements may be applicable if any remedial alternative involving off-site treatment and disposal is implemented. Materials removed from the Link site and treated or disposed of may be sent to a RCRA-permitted facility. Any land-disposal activities will be subject to RCRA land disposal restrictions programs.

2.3.2.2 Groundwater and Surface Water Classifications and Discharge Standards (6 NYCRR 701 - 703)

This action-specific ARAR would be triggered if groundwater extraction and treatment were performed at the site. Management of treated groundwater might include discharge to groundwater or to surface water. These regulations provide a means of classifying groundwater and surface waters, and provide standards for certain contaminants. The Chenango River is classified as a Class B fresh surface water, as defined in 6 NYCRR 701. These regulations do not establish standards for specific volatile organic compounds in Class B waters, but do establish standards for inorganic compounds and total volatile organic compound concentration effluent limitations. Groundwater effluent standards are indicative of allowable concentrations in groundwater which has the potential for use as a potable water source (Class GA waters); hence, effluent standards are the same as groundwater ambient water quality standards.

2.3.2.3 NYSDEC Air Quality Regulations (6 NYCRR 212)

This action-specific ARAR would be triggered if treatment of groundwater for volatile organic compounds allowed for air emissions of these compounds. Compliance with the standards for those compounds found in the groundwater would be required; additional controls may be required to be in compliance if this process option is implemented.

2.3.2.4 Local POTW Discharge Standards

This action-specific ARAR would be triggered if management of extracted and treated groundwater was via discharge to sewer. Treatment of groundwater would require compliance with the Johnson City Joint Sewage Board regulations.

2.3.2.5 NYSDEC Surface Water Quality Criteria (TOGs 1.1.1)

Guidance values for certain specific volatile organic compounds such as trichloroethene are contained here for compounds where no standards exist. These water quality criteria would be considered if disposal of treated and extracted groundwater was via discharge to surface water, and no standard is established in 6 NYCRR 703.

2.4 General Response Actions

Two media at the site were shown to be affected by volatile organic compounds and heavy metals. General response actions for groundwater might include no action, continued monitoring, containment, in-situ treatment, or collection, treatment, and discharge actions. General response actions for soil might include no action, containment, insitu treatment, excavation, treatment, and disposal.

2.5 Identification of Remedial Technology Types and Process Options

Remedial technology types and process options which are applicable to the general response actions for soil and groundwater are identified in this section. The remedial technologies evaluated for the Link site must be effective in the removal of volatile organic compounds and inorganic contaminants. Remedial alternatives are briefly evaluated in this section for implementability, and for their ability to meet ARARs and/or to provide overall protection of human health and the environment within reasonable time. Those which may not be effective in meeting remedial action objectives, and/or prove difficult to implement based on site conditions, and/or rely on unproven technologies may be eliminated from further consideration. A summary of the remedial technologies identified and briefly evaluated is presented in Table 2-2. Those alternatives still determined to be applicable are further evaluated in the preliminary and detailed analysis of alternatives, using the following criteria:

- Compliance with standards criteria and guidelines
- Overall protection of human health and the environment
- Short-term effectiveness
- Long term effectiveness and performance
- Reduction in toxicity, mobility and volume
- Implementability
- Cost

2.5.1 Identification of Groundwater Remedial Technologies

The upper water table aquifer underlying the site aquifer of the site was found to contain elevated levels of volatile organic compounds and dissolved inorganic contaminants. Potential remedial technologies and process options are presented below.

Table 2-2

Identification of Remedial Technologies - CAE-Link Hillcrest Facility

ALTERNATIVE	PROCESS	COMMENTS	RETAIN OR ELIMINATE
GROUNDWATER REMEDIATION TECHNOLOGIES			
CONTAINMENT	SLURRY WALLS/SHEET PILING	NOT FEASIBLE DUE TO LARGE AREAL EXTENT OF PLUME	ELIMINATE
GROUNDWATER EXTRACTION, TREATMENT, DISCHARGE	PUMP, TREAT, DISCHARGE GROUNDWATER ON- OR OFF-SITE	TECHNOLOGY POTENTIALLY APPLICABLE	RETAIN
GROUNDWATER EXTRACTION, DISCHARGE TO SURFACE WATER OR POTW	PUMP AND DISCHARGE	NO ADVANTAGE TO NATURAL CONDITIONS/POTW ACCEPTANCE PRECLUDED	ELIMINATE
BIOLOGICAL TREATMENT	CONTROLLED ENVIRONMENT TO ENHANCE THE GROWTH OF MICROORGANISMS	NOT EFFECTIVE IN THE TREATMENT OF INORGANICS END PRODUCT OF SLUDGE	ELIMINATE
CHEMICAL OXIDATION-REDUCTION REACTION	ADDITION OF A STRONG OXIDIZING OR REDUCING CHEMICALTO RENDER CONTAMINANTS NON-HAZARDOUS	CONTAMIINANTS COULD BE TRANSFORMED TO MORE TOXIC SUBSTANCES STORAGE OF HAZADROUS OXIDIZING/REDUCING CHEMICALS	ELIMINATE
CHEMICAL PRECIPITATION	ADDITION OF CHEMICALS TO REACT WITH INORGANICS AND FORM PRECIPITATE	POTENTIALLY APPLICABLE	RETAIN
ULTRAVIOLET OXIDATION	CHEMICAL OXIDATION PROCESS UTILIZING UV LIGHT AS A CATALYST	POTENTIALLY APPLICABLE	RETAIN
COAGULATION & FLOCCULATION	COMBINATION OF CHEMICAL ADDITION AND MECHANICAL MIXING	NOT EFFECTIVE IN THE TREATMENT OF VOLATILE ORGANICS	ELIMINATE
REVERSE OSMOSIS	CONTAMINANT SEGREGATION VIA PRESSURIZATION & PASSING THE STREAM THROUGH A MEMBRANE	EXTENSIVE PRETREATMENT REQUIRED	ELIMINATE
SEDIMENTATION	REMOVAL OF PARTICULATE MATTER BY GRAVITY	NOT COMPLETELY EFFECTIVE IN THE REMOVAL OF DISSOLVED CONTAMINANTS	ELIMINATE
ION EXCHANGE	REMOVAL OF CONTAMINANTS BY PASSING GROUNDWATER THROUGH A CHEMICAL ADSORPTIVE RESIN	DIFFERENT CONTAMINANTS REQUIRE DIFFERENT RESINS PRETREATMENT OF THE GROUNDWATER REQUIRED	ELIMINATE
CARBON ADSORPTION	CONTAMINANT ADSORPTION VIA ACTIVATED CARBON	POTENTIALLY APPLICABLE	RETAIN
AIR STRIPPING	TRANSFER OF CONTAMINANTS FROM LIQUID PHASE TO AIR PHASE BY COUNTERCURRENT AIR FLOW	POTENTIALLY APPLICABLE	RETAIN
IN-SITU BIOLOGICAL TREATMENT	DECOMPOSITION OF ORGANIC CONTAMINANTS VIA THE USE OF MICROORGANISMS	AREAL EXTENT OF PLUME IS TOO LARGE / CONCENTRATION OF VOLATILES TOO LOW	ELIMINATE
IN-SITU CHEMICAL TREATMENT	INJECTION OF CHEMICALS TO DEGRADE, IMMOBILIZE OR FLUSH OUT THE CONTAMINANTS	AREAL EXTENT OF PLUME IS LARGE	ELIMINATE
IN-SITU PHYSICAL TREATMENT	IMMOBILIZATION OR DETOXIFICATION OF THE CONTAMINANT BY THERMAL DECOMPOSITION OR VAPORIZATION/DISTILLATION	TECHNOLOGY NOT PROVEN / NOT EFFECTIVE IN THE TREATMENT OF INORGANICS	ELIMINATE
NO ACTION	CONTINUED MONITORING	POTENTIALLY APPLICABLE	RETAIN
SOIL REMEDIAL TECHNOLOGIES			
DISPOSAL	EXCAVATION OF CONTAMINATED SOILS AND TRANSFER TO A RCRA PERMITTED LANDFILL	POTENTIALLY APPLICABLE	RETAIN
BIOLOGICAL TREATMENT	USE OF MICROBIAL ACTION TO BREAKDOWN THE CONTAMINANTS	NOT EFFECTIVE IN THE TREATMENT OF LOW LEVEL ORGANICS AND INORGANICS	ELIMINATE
MOBILIZATION	FLUSHING OF THE CONTAMINATED SOIL VIA THE USE OF FLUSHING AGENTS	POTENTIALLY APPLICABLE	RETAIN
IMMOBILIZATION	MODIFICATION OF CONTAMINANT TO A LESS MOBILE FORM VIA CHEMICAL ADDITION	NOT A PROVEN TECHNOLOGY	ELIMINATE
DETOXIFICATION	ALTERATION OF THE CONTAMINANTS TO A LESS TOXIC FORM	NOT A PROVEN TECHNOLOGY	ELIMINATE
IN-SITU STABILIZATION/ SOLIDIFICATION	CHEMICALLY OR PHYSICALLY STABILIZING THE CONTAMINANTS INTO A SOLID MATRIX FORM	POTENTIALLY APPLICABLE	RETAIN
INCINERATION	EXCAVATION / INCINERATION ON- OR OFF-SITE	NOT EFFECTIVE IN THE TREATMENT OF INORGANICS / DISPOSAL OF RESULTANT ASH	ELIMINATE
CONTAINMENT	ISOLATION VIA THE USE OF AN IMPERMEABLE CAPPING SYSTEM	AREA IS CURRENTLY CAPPED	ELIMINATE
NO ACTION	GROUNDWATER MONITORING TO ASSESS GROUNDWATER IMPACTS	POTENTIALLY APPLICABLE	RETAIN

2.5.1.1 Containment

Containment of the contaminated groundwater would require either the construction of impermeable slurry walls or sheet piling.

- Slurry Walls - Containment of the contaminant plume via the use of slurry walls would require the installation of a network trenches to surround the contaminant plume. The trenches would be then backfilled with an impermeable slurry in order to prevent further migration of the plume. Based on the areal extent of the volatile organic plume, this option is deemed not feasible.

- Sheet Piling - As with the slurry walls, this method would require surrounding the contaminant plume with impermeable sheet piling to prevent further migration of the contaminant plume. Based on the areal extent of the volatile organic plume, this option would not be feasible.

2.5.1.2 Collection

This option would require the construction of recovery wells sufficient to create a hydraulic boundary to intercept the groundwater plume. The water collected could be treated on-site, or discharged directly to the river or to the Publicly Owned Treatment Works (POTW) without treatment.

- Pump and Treat - Through the use of recovery wells, contaminated groundwater would be collected and treated on-site. Treated groundwater would be recharged back to groundwater, or discharged to surface water, or to the POTW. Pump and treat technology with various discharge options is a technically viable option and will be retained for further analysis. Treatment technologies are discussed in the following sections.

- Pump and Discharge to River - Discharging the extracted groundwater directly to the Chenango River without treatment would dilute levels of volatile organic contaminants. This method does not provide any benefits over allowing the groundwater plume to naturally discharge to the river. Therefore, this treatment technology shall not be considered for further evaluation.

- Pump and Discharge to POTW - A series recovery wells would be constructed in order to capture the contaminant plume. The groundwater would then be discharged to the POTW where it would be treated with domestic and industrial wastewater. Approval from the POTW would be required prior to implementation. Discharge of groundwater to the POTW is not permitted by the POTW if an alternative active treatment process is viable. This treatment alternative will not be retained for further analysis.

2.5.1.3 Biological Treatment

Biological treatment, consisting of activated sludge systems, trickling filters, and rotating biological contractors, attempts to create a controlled environment which maximizes the growth of microorganisms required for the breakdown of organic material and nutrients. Biological treatment processes produce a sludge which might require additional treatment for inorganic contaminants.

- Activated Sludge Systems - Activated sludge systems rely on microorganisms which oxidize the volatile organics to carbon dioxide and water in the presence of oxygen. This process would require the addition of oxygen and a relatively high and steady influent of organics, a portion of which is synthesized into new cells. This option is not feasible due to the historically low levels of volatile organics in the groundwater at the facility, and the inability of this process to treat inorganics.

- Trickling Filters - This process involves the growth of biological system on a media through which the contaminated water is passed, resulting in the oxidation of the organic material in the water stream. Trickling filters are sensitive to seasonal variations, and are susceptible to clogging due to build-up and subsequent sloughing off of excessive biological material. Similar to the activated sludge systems, trickling filers will not treat inorganics, and also require a relatively high and steady influent of organics for effective long-term treatment. This option is removed from further considerations.

- Rotating Biological Contactors - Rotating Biological Contactors (RBCs) are conceptually similar to trickling filters. Microorganisms attach to media which is rotated through the groundwater discharge stream. As with the other biological treatment alternatives, limitations include a steady source of organic material required and the inability to remove inorganic contaminants. This process is eliminated from further consideration.

2.5.1.4 Chemical Treatment

Chemical treatment processes include oxidation-reduction reactions, chemical precipitation and Ultraviolet (UV) Oxidation.

- Chemical Oxidation-Reduction Reactions - This process is effective in reducing the toxicity or solubility of a contaminant. The oxidation process is useful in the treatment of dilute organic solutions via the addition of a strong oxidizing chemical (ozone, hydrogen peroxide, potassium permanganate, etc.). Chemical reduction is commonly used in the treatment of liquids containing hexavalent chromium, mercury and lead. Chemical additions required for the reduction reaction to occur include sulfur dioxide, sulfite salts, or ferrous sulfate. An adjustment in the pH is generally also required to bring the reaction to completion. Limiting factors include the necessity of hazardous chemicals to perform the reduction process, and the possibility of toxic by-products if the oxidation reaction is not brought to completion. This process is eliminated from further consideration because of these limiting factors.

- Chemical precipitation/Coagulation & Flocculation- Chemical precipitation/Coagulation & Flocculation is primarily used in the treatment of solutions containing dissolved metals. Chemicals are added to the water stream to react with dissolved contaminants to form a precipitate, which is easily settled out of the liquid. This process combines the chemical process by which a suspended particles' charge is satisfied (coagulation) with the mechanical process of mixing. Mixing increases the interaction between particles, producing an easier to settle floc (flocculation). Common reagents introduced to promote settling include lime, sulfide, and calcium or sodium carbonate. Volatile organics would not be effectively treated using this process. However, this treatment technology is widely used and effective for metals removal. Chemical precipitation will be retained for further analysis.

- Ultraviolet Oxidation - UV oxidation is a chemical oxidation process, utilizing ultraviolet light as a catalyst, which provides for the reaction of dissolved volatile organic compounds to produce carbon dioxide and water. Non-hydrocarbon dissolved contaminants, including naturally occurring metals and minerals, will also be subject to the oxidation reaction. Common sources of oxygen utilized include hydrogen peroxide, air, chlorine, ozone and permanganate. The effectiveness of UV oxidation is dependent upon organic and inorganic contaminant loading, pH, and the ability of the groundwater to transmit light. This alternative is feasible and therefore retained for further consideration.

2.5.1.5 Physical Treatment

Physical treatment techniques include reverse osmosis, sedimentation, ion exchange, filtration, carbon absorption and air stripping.

- Reverse Osmosis - A contaminated stream is pressurized and subsequently fed through a membrane from which the water and the contaminant are segregated. Membranes utilized in the reverse osmosis process are characterized either as natural or synthetic. Synthetic membranes are generally used during desalination processes. Natural membranes can be utilized in the removal of dissolved organics and inorganics. Reverse osmosis requires pretreatment to prevent solids loading across the membrane, temperature variations, or the coating of the membrane. The residual contaminant flow and spent membranes require disposal. Due to the extensive pretreatment processes required to ensure proper operation, and the wastes associated with operation, this alternative is removed from further consideration.

- Sedimentation - Sedimentation is the removal of particulate matter through the use of gravity. Groundwater is transferred to a rectangular basin or tank; in which gravitational settling is allowed to occur via sufficient detention time. This process can be enhanced through the addition of chemical coagulants to settle out the suspended solids. Sedimentation is effective in the removal of inorganic material, but not effective in the removal of organic contaminants. In addition, sedimentation typically requires long retention time for effective settling, thus requiring large retention basins. Since available space for construction of retention basins is limited, use of sedimentation basins would not be feasible for this site. This process will be eliminated from further consideration.

- Ion Exchange - Ion exchange is the process by which a substitution of ions occurs between the waste stream and an independent membrane (resin). Resins are generally "charged" with H^+or OH^- ions and can be divided into four groups. Cation exchange resins containing strong acids are generally used in the treatment of heavy metals; cation exchange resins containing weak acids are generally used in the treatment of simple and complex organic bases. Strong base anion resins are utilized in the removal of weak mineral acids; strong mineral acids are best removed with weak base anion resins. The process is reversed during regeneration of the resin, with discharge of the wasted ions and replenishment of original ions transferred to the resin from a solution. The discharged solution requires disposal. Ion exchange units must not be loaded with waste streams containing suspended solids, and may be sensitive to temperature and pH, depending on the type of resin required. Ion exchange technology is not selective in the contaminants being removed, and therefore, removes all ions in solution. As a result, large ion exchange columns are typically required to achieve the desired removal. The contaminants within the groundwater would require a combination of resins. Use of this treatment technology is not feasible due to space considerations and the amount of material requiring management after treatment.

- Filtration - Filtration is the process by which suspended matter is removed from water. It is accomplished by passing a water stream through a porous media of appropriate size. Filtration is utilized in pretreatment systems for a variety of treatment alternatives, but is not effective in the removal of dissolved organic and inorganic contaminants.

- Carbon Adsorption - Carbon adsorption treatment is accomplished by passing the affected groundwater through a vessel containing activated carbon. Consideration of temperature and contact time is required for complete treatment. The carbon used in this process is available in two forms, granular activated carbon (GAC) and powdered activated carbon (PAC). The adsorption of the organic material to the carbon particles is a three stage process. The first stage is the movement of the organic material through the water to the solid-liquid interface by advection and diffusion. The second stage is the movement of the organic material within the carbon system to adsorption sites located on the carbon particles. The actual chemical adsorption between the carbon particle and the organic material is minimal. The third stage, physical attraction, completes the adsorption process. Breakthrough of contaminants occurs when the carbon adsorption sites are at full capacity. When this occurs, the carbon must be sent off-site for regeneration. This technology has been proven effective in many groundwater remediation projects, and is therefore retained for further consideration.

- Air Stripping- Air stripping involves the intimate contact between the contaminated groundwater and air, resulting in a transfer of volatile organic compounds contained within the groundwater from the liquid phase to the air phase. This process would require the construction of a tower filled with an inert plastic media designed to maximize the volume of liquid in contact with air. Additional air treatment may be required at the point of air discharge. This method has been proven effective in the remediation of volatile organic contaminated groundwater and is therefore retained for further analysis.

2.5.1.6 In-Situ Treatment

In-situ treatment is the process by which contaminants are remediated at their present location. In-situ treatment techniques include biological, chemical and physical treatment.

- Biological Treatment - Biological treatment requires the development of microorganisms capable of decomposing specific organic contaminants. Generally, this process requires the addition of oxygen and nutrients. This process is most effective in the treatment of groundwater consisting of moderate to high levels of organic compounds. The groundwater at the Link facility contains low levels of organic compounds and levels of dissolved inorganic contaminants that are not susceptible to bioremediation; therefore, this remedial technology would not be effective.

- Chemical Treatment - In-situ chemical treatment of the contaminants would require the injection of chemicals to degrade, immobilize, or flush out the contaminants. Based on the areal extent of the plume, this alternative is deemed not feasible.

- Physical Treatment - In-situ physical treatments attempt to immobilize or detoxify the contaminants. Methods currently utilized include heating for thermal decomposition or vaporization/distillation of organics. In-situ physical treatment processes would not be effective in the treatment of inorganic contaminants and are not a proven alternative; therefore, this option is removed from further evaluation.

2.5.1.7 No Action

The no action alternative would be coupled with the implementation of a groundwater monitoring program to monitor contaminant levels over time. The baseline risk assessment demonstrated that no risks to public health or the environment are posed by the contaminants in the groundwater. Additionally, the level of contamination is naturally attenuating over time. This alternative is feasible and therefore retained for further evaluation.

2.5.2 Identification of Soil Remedial Technologies

Soils associated with the source area of groundwater contamination, the leaching pools located along the eastern border of the site collectively known as Outfall 004, were found to contain elevated levels of some heavy metals and volatile organic compounds. Potential remedial technologies and process options are presented below.

2.5.2.1 Excavation and Disposal

This would require excavation of the contaminated soil and transfer to a RCRA-permitted landfill. Prior to acceptance of the excavated material at an off-site landfill, analytical testing would be required to confirm that the material is acceptable for disposal at a hazardous waste landfill, or that the waste can be treated to meet Federal Land Ban regulations currently in effect. This option is feasible and therefore retained for further evaluation.

2.5.2.2 Biological Treatment

This remedial technology relies on microbial action to break down the contaminants within the soil into nonhazardous substances. This treatment technology can be applied in-situ or ex-situ. Bioremediation primarily applies to organic and petroleum based contaminants, which are biodegradable. The process is relatively slow and could take several years for complete remediation. Bioremediation is most effective in the treatment of soils containing moderate to high levels of volatile organic compounds, and would not be effective in the treatment of the inorganic contaminants found within the soil. Therefore, this remedial technology is removed from further discussion.

2.5.2.3 Chemical Treatment

Chemical treatment refers to three broad categories where chemicals are employed to reduce organic or inorganic contaminants: mobilization, immobilization, or detoxification. Chemical treatment can be applied in-situ or to excavated soils.

- Mobilization is the flushing of the contaminated soil via the use of flushing agents (surfactants, dilute acids, bases and water) in order to extract the contaminants. In this process an aqueous solution is injected, contaminants are mobilized into solution, and the resulting liquid is pumped out for treatment by incineration or other wastewater treatment methods. The inorganic contaminants within the soil may not be easily transformed into a mobile state. This treatment technology is potentially applicable and will be retained for further evaluation.

- Immobilization - Includes the process of precipitation (for dissolved metals), chelation (for metals) and polymerization (for organics) to modify the chemical contaminant to a less mobile form. Immobilization is still relatively unproven as a viable treatment alternative and is therefore removed from further consideration.

- Detoxification - Detoxification attempts to alter the contaminants to a less toxic form through the processes of oxidation, reduction, neutralization, and hydrolysis. This method is also relatively unproven as a viable treatment alternative and is removed from further consideration.

- Stabilization/Solidification - These processes chemically or physically lock the contaminants into a solidified matrix, which minimizes or eliminates the potential for contaminant leaching and chemical interaction. Stabilization/solidification processes commonly used include silicate, organic polymer, thermoplastics, cement, or molten glass as fixation agents. These processes are effectively used for inorganic, volatile organic, PCB, and radioactive wastes. This treatment technology is viable and will be retained for further evaluation.

2.5.2.4 Incineration

This process would produce end products such as CO_2,, H_2O vapor, SO_2, NO_x, HCl gases, and ash. Issues concerning air emissions and disposal of potentially hazardous ashes would need to be addressed. Common incineration techniques include rotary kiln, fluidized bed, and multiple hearth. Incineration would result in an ash that is high in inorganic contamination requiring further management; therefore, incineration is eliminated from further evaluation.

2.5.2.5 Containment

This would require the use of capping as a source control action. Capping is a process used to isolate the contaminants, control water and wind erosion, and prevent contaminant contact with rainwater via leaching through the source area. Much of the area is already effectively capped with paved surfaces. However, the extent of capping could be improved and therefore this alternative is retained for further consideration in conjunction with other remedial measures.

2.5.2.6 No Action

Under the no action alternative, no soil cleanup actions would be undertaken at the site. Discharge to the industrial wastewater leaching pools ceased several years ago. The no action alternative does not pose risks to the public or current employees, since contaminated soil is located about 10 feet below grade, and inaccessible to the public. Groundwater monitoring might be required to evaluate any additional effects these remaining contaminants might have on groundwater quality. This alternative is feasible and therefore retained for further evaluation.

3.0 Development and Screening of Alternatives

The primary purpose of this section is to develop an appropriate range of site management options that will be analyzed more fully in the detailed analysis phase of the FS. The alternatives addressed in the preliminary screening will include those process options of the technology types discussed in Section 2.5 which have been chosen to represent media-specific general response actions. These options will be combined as appropriate on a media-specific basis. The alternatives that survive this screening will be subjected to the detailed analysis in Section 4.

3.1 Development and Screening of Groundwater Remediation Alternatives

Table 3-1 presents the potential remedial alternative and process options retained from the initial screening of technologies for groundwater. The alternatives have been assembled based on their ability to meet the remedial action objectives, i.e., protection of human health and the environment. Process options within each of the alternatives have been retained based on the ease with which the options can be compared with respect to effectiveness, implementability, and in the detailed analysis, cost.

3.1.1 Alternative GW-1: No Action with Monitoring

Under the no action alternative, no groundwater remedial action would be undertaken at the site. Groundwater affected by volatile organic and inorganic compounds would be allowed to remain on-site and off-site with eventual discharge to the Chenango River, downgradient of the site. Periodic sampling of selected monitoring wells which adequately define the plume would be performed to assess contaminant levels and migration.

Effectiveness - This alternative poses no significant short or long-term risks to the community or environment. The concentrations of contaminants in the groundwater were determined during the baseline risk assessment to pose no risk to public health or the environment, since no increased risk can be attributed to the discharge of affected groundwater to the Chenango River, the key receptor area identified in the RI. Groundwater monitoring would be effective in documenting changes in groundwater quality.

Implementability - This alternative would require periodic sampling and laboratory analysis of groundwater from selected on-site and off-site monitoring wells. This alternative is very easily implemented.

Recommendation - This alternative will be retained for detailed analysis, as no action with continued monitoring is potentially applicable to the Link site, and as required under the NCP.

Table 3-1

Groundwater Remedial Technologies & Process Options

Preliminary Analysis of Alternatives

CAE-Link

Hillcrest Facility

Alternative	General Response Action	Remedial Technology	Process Options	Retain or Eliminate
GW-1: No Action w/Monitoring	No Action	Monitoring	Monitoring well sampling & analysis	Retain
GW-2: Extraction and Treatment	Groundwater Collection	Extraction	Extraction wells	Retain
	Groundwater Treatment	Physical / Chemical Treatment	Precipitation for Metals	Retain
			VOC Option A: Air stripping	Retain
			VOC Option B: UV-oxidation	Retain
			VOC Option C: Carbon adsorption	Retain
	Groundwater Discharge	Off-site Discharge	Option A: POTW (Johnson City)	Eliminate
			Option B: Surface Water (Phelps Creek)	Retain
		On-site Discharge	Infiltration galleries	Retain

3.1.2 Alternative GW-2: Groundwater Extraction and Treatment

Under this alternative, groundwater would be collected via extraction wells and treated to remove volatile organic compounds and metals to levels in compliance with NYSDEC standards. The treated water would then be discharged on or off-site. Periodic monitoring of groundwater as described in the "No Action" alternative would be conducted in order to observe groundwater cleanup progress and to ensure capture of the contaminant plume. Additional monitoring of influent and effluent groundwater with respect to the treatment system will also be conducted to monitor treatment system efficiency and compliance. The following paragraphs briefly describe the process options associated with this alternative.

3.1.2.1 Groundwater Collection

Effectiveness - It is anticipated that the use of groundwater extraction wells will be effective in recovering contaminated groundwater for treatment. Numerous pumping wells would be required to recover the contaminants in the groundwater due to large areal extent of the plume, a small saturated thickness, and low hydraulic conductivity of the shallow unconfined aquifer. Extraction wells installed near the facility in the vicinity of the highest concentration of contaminants would prevent further migration of contaminants from this area, thus accelerating aquifer rehabilitation. Additional extraction wells would be sited at the downgradient edge of the plume, immediately upgradient of the Chenango River. Since there are other confirmed sources of groundwater contamination present between the CAE-Link facility and the river, CAE-Link would be mitigating groundwater contamination caused by other responsible parties. Multiple extraction wells with overlapping cones of influence would be necessary to create a hydraulic boundary between the Chenango River (the only completed exposure pathway or receptor of contaminated groundwater) and the plume, due to the width of the plume at this location. Pump tests would be conducted during the remedial design phase to better determine aquifer characteristics, and suitable locations and pumping rates for each extraction well.

Implementability - This technology uses conventional well installation techniques. Contractors and materials are readily available. From this standpoint, this technology is easily implemented. However, the installation of extraction wells at the downgradient edge of the plume would require permission from private landowners, or from the town to perform the work in the right-of-way. A centrally located pump station would also be required for the transfer of groundwater back to the facility. Construction of piping beneath public streets would be necessary from the extraction wells near the Chenango River to the pump station, and then back to the facility for treatment. Extensive coordination with the town may be required for construction in the right of way. Short term exposure risks during construction are unlikely, since affected groundwater averages 22 feet below the surface. However, construction of the extraction system may have a short-term effect on the community life-style associated with street closures and/or re-routing of traffic. The time required for necessary approvals and construction would most likely be greater than two years.

Recommendation - This process option is the most feasible for groundwater collection for this site. This collection technology is potentially applicable, and will be retained for detailed analysis.

3.1.2.2 Groundwater Treatment

Process options for groundwater treatment for volatile organic compounds include granular activated carbon ("GAC") adsorption, UV-oxidation, and air stripping. Groundwater treatment by "air stripping" is generally implemented by pumping untreated groundwater to the top of a packed-column, which contains a specified height and cross-sectional area of inert "packing" material along with water distribution and collection systems. The column receives ambient air under pressure in an upward vertical direction from the bottom of the column as the water flows downward; hence the term "counter-current packed column air stripping". Counter-current packed towers have been utilized in the chemical process industry for decades as a standard unit operation to affect mass transfer, both in adsorption (e.g., air pollution control) and desorption (e.g., groundwater treatment via stripping). The adsorption process is typified by the mass transfer of material from the air phase to the liquid phase, where desorption involves the mass transfer of material from the liquid phase to the air phase. For that reason, the physical chemistry and mass kinetics are well understood and documented. The packed tower promotes intimate contact between a gas phase and a liquid phase so as to enhance the establishment of equilibrium between phases. Air stripping removes the volatile compounds from the untreated groundwater by transferring them to the air phase.

Activated carbon is an excellent adsorbent due to the large degree of surface area contained within the carbon particle that is accessible for the adsorption process. Adsorption is a natural process in which molecules of a liquid or gas are attracted to and then held at the surface of a solid. In addition to the "outer" surface area on the carbon particle, "inner" cavities allow for significant surface area per mass of particle. Contaminants in the untreated water adsorb onto the GAC. The adsorptive capacity of the carbon varies with the nature and concentration of the contaminants. As the contaminant loading on the carbon reaches the adsorptive capacity of the carbon near the top of the filter, the interface between the saturated and the "clean" carbon moves downward through the carbon bed inside the pressure vessel. When the carbon in the filter vessel is fully loaded with contaminants (i.e., at its adsorptive capacity), no further removal will take place and contaminants will begin to be found in the filter effluent. Effluent monitoring and estimates of the adsorptive capacity of the carbon enable the carbon in the filter to be replaced prior to occurrence of contaminant breakthrough. The GAC removed from the pressure vessel, after adsorptive capacities have been reached, can be regenerated by heating at high temperatures. On-site carbon regeneration facilities only prove economical for a facility having a very high rate of consumption. Off-site carbon regeneration is usually preferred. The frequency with which the carbon must be regenerated or replaced depends on several factors, including the nature and concentration of the contaminants to be removed, the total flow through the pressure vessel, and the total amount of carbon contained within the pressure vessel.

UV-oxidation utilizes a combination of ultraviolet ("UV") light and a chemical oxidant, such as ozone or hydrogen peroxide, to break down volatile organic compounds by photochemical oxidation. A typical UV-ozone/hydrogen peroxide system consists of a hydrogen peroxide feed system or an ozone generator in conjunction with an oxygen or air source, and a UV-oxidation reactor. The reactor provides controlled, simultaneous UV-oxidant contact. The ultimate end products of UV-oxidation treatment are trace salts, carbon dioxide, and water or non toxic intermediates. Unlike air stripping with vapor phase carbon or GAC, no toxics are introduced to the atmosphere or are adsorbed onto media which require disposal or regeneration. UV lamps lose efficiency and must be properly maintained to prevent the release of toxic intermediate products into the atmosphere resultant from incomplete oxidation.

Chemical precipitation is a physio-chemical process by which a dissolved inorganic contaminant is transformed into an insoluble solid, facilitating its subsequent removal from the liquid phase by sedimentation or filtration. The process usually involves pH adjustment in order to shift the chemical equilibrium that no longer favors solubility, addition of a chemical flocculent, and flocculation, in which precipitate particles agglomerate into larger particles. This process would produce an aqueous effluent which might require further treatment (filtration), and a sludge containing the removed inorganic compounds. The sludge is typically dewatered, stabilized, and landfilled.

Effectiveness - GAC adsorption, UV-oxidation, and air stripping are effective and proven methods by which to remove volatile organic compounds from groundwater. By-products from these process options might include management of carbon potentially used for vapor phase emission controls in conjunction with air stripping, or management of carbon if GAC adsorption is used.

Precipitation has been proven effective for groundwater contaminated with heavy metals. By-products from the precipitation process would include sludge requiring dewatering and stabilization prior to off-site disposal.

All treatment methods described here should be effective in producing an aqueous effluent of suitable quality for discharge to surface water, groundwater, or a local treatment plant.

Implementability - All treatment process options described here require the purchase and construction of commonly available equipment. There are little to no inherent difficulties in the site-specific design of these treatment units. A program to monitor the units is easily accomplished.

Recommendation - All process options described here are potentially applicable for the site, and will be retained for detailed analysis.

3.1.2.3 Groundwater Discharge

Discharge options for the treated groundwater include off-site or on-site discharge. Off-site options include discharge to surface water (Phelp's Creek) or the local municipal treatment plant. Discharge on-site would be via underground infiltration beds.

Discharge to Phelp's Creek

Effectiveness - For this option, treated water would be piped to Phelp's Creek. The treatment objective for this discharge would be surface water quality criteria. The feasibility of SPDES permit modification and the ability of Phelp's Creek to assimilate the additional flow would require additional investigation.

Implementability - This option would require a modification to the facility's existing SPDES permit. The permit would specify allowable flows and contaminant concentrations. Construction of piping would be easily accomplished.

Recommendation - This option is retained for further consideration in the detailed analysis.

Discharge to Municipal Treatment Plant

Effectiveness - For this option, the treated water would be piped to the Johnson City municipal treatment plant. The discharge limits for the treated effluent are expected to be more relaxed than for other disposal options.

Implementability - This option is easy implemented from an engineering standpoint. However, initial discussions with treatment plant personnel indicate that the plant would not accept the discharge, unless it can be demonstrated that there are no other viable discharge options available to the facility for disposal of the treated groundwater. The quantity of water discharged would be quite high, affecting the limited capacity of the POTW.

Recommendation - This option will not be retained for detailed analysis, since other options for the disposal of treated groundwater are available, precluding acceptance by the Johnson City municipal treatment plant.

Underground Infiltration Trenches

Effectiveness - This option would include the construction of leaching beds for the distribution of treated groundwater discharge. This option is most effective in higher permeability soils; the lower permeability soils at the facility would require the construction of a larger, more extensive leaching system.

Implementability - This option requires further evaluation of the permeability of site soils and system design. Installation of the system would use conventional construction techniques, and is therefore easily implemented.

Recommendation - This option is retained for further consideration in the detailed analysis.

3.2 Development and Screening of Soil Remediation Alternatives

The remedial action alternatives for soil address the source area (Outfall 004) of inorganic and volatile organic contamination that has affected groundwater, located at the eastern perimeter of the site. The former Outfall 004 system is composed of twelve leaching pools constructed of conrete block and fieldstone (Pool A is constructed of precast concrete rings). They are approximately 10 feet in diameter, and approximately 10 to 12 feet deep. The drywells formerly received wastewater discharges from the facility's metal finishing operations. Contaminant concentrations are expected to be highest in the sludges located at the bottom of several of the inactive drywells.

Remedial action alternatives for soils include no action and source control remedial measures, which can be implemented as in-situ and ex-situ technologies. These alternatives have been assembled based on their ability to meet the remedial action objective, i.e., overall protection of human health and the environment. The potential remedial alternative and process options for soils associated with Outfall 004 provided in Table 3-2 and described below in the preliminary evaluation have been retained from the initial screening of technologies based on the ease with which the options can be compared with respect to effectiveness, implementability, and in the detailed analysis, cost.

3.2.1 Alternative S-1: No Action

Under the no action alternative, no soil cleanup actions would be undertaken at the site. Discharge to the industrial wastewater leaching pools was terminated several years ago, eliminating further contaminant loading to the leaching pools. Groundwater monitoring required by all of the groundwater remediation alternatives would be sufficient to evaluate any additional effects these remaining contaminants might have on groundwater quality.

Table 3-2
Soil Remedial Technologies & Process Options
Preliminary Analysis of Alternatives
CAE-Link
Hillcrest Facility

Alternative	General Response Action	Remedial Technology	Process Options	Retain or Eliminate
S-1: No Action with Groundwater Monitoring	No Action	Groundwater Monitoring	Monitoring well sampling & analysis	Retain
S-2: Excavation & Off-site Disposal	Excavation/Treatment/ Disposal	Excavation/Pretreatment/ Landfill	Excavation/Disposal Facility- & Concentration-Dependent Pretreatment/ Landfill	Retain
S-3: Excavation & On-site Disposal	Excavation/Treatment/ Disposal	Excavation/Pretreatment/ Landfill	Excavation/soil washing/On-site Landfilling	Eliminate
S-4: In-Situ Stabilization/Chemical Fixation	In-Situ Treatment	Stabilization/Fixation	Chemical Mixing/Chemical Injection/Soil Mixing	Retain

Effectiveness - The no action alternative does not pose any imminent short- or long-term risks to the public or environment. Contaminated soil is located about 10 feet below grade. These contaminated soils are not accessible to site workers, or to the public. Any risk to site workers, or the community from contact with contaminated soils is minimal since there are no known completed exposure pathways. Since this alternative would not involve any remedial action, no efforts are needed to maintain the remedy. However, the no action alternative would not mitigate the potential for contaminant leaching from the sludges to the groundwater, or the potential for future exposure if the sludges or contaminated soils become exposed during any future site construction activities.

Implementability - The no action alternative is readily implemented since no remedial action technologies will be employed. Periodic groundwater monitoring will be performed to assess groundwater quality, and to identify any further effects on groundwater resulting from the soil contamination.

Recommendation - This option is retained for further consideration in the detailed analysis.

3.2.2 Alternative S-2: Soil Excavation and Off-Site Disposal

This remedial action alternative consists of removal of sludges from the bottom of the drywells, and excavating contaminated soils that are present at concentrations which exceed quality standards. Under this remedial approach, the sludges in the bottom of the leaching pools and contaminated soils surrounding the pools will be removed. Sludge removal can be accomplished using a high powered vacuum tanker truck. Soils from beneath and immediately adjacent to the leaching pools which contain contaminants above applicable soil standards for this site will be removed. Soils from the majority of these pools, with the exception of leaching pools E, N and J, primarily contain cadmium, chromium, and copper above standards. Leaching pools E, N, and J also contain elevated levels of 1,1,1-trichloroethane, acetone, and 1,1-dichloroethane in the sludges.

Since the objective of the soil remediation program is to remediate to levels which are protective of human health and groundwater, soil excavation will proceed to a maximum depth of the groundwater table.

Following soil removal, the excavation will be backfilled with clean fill, and the area will be paved. Soils which are below the soil cleanup objectives would remain at the site. It is anticipated that since the top four feet of soils from grade level to the top of the leaching pools will not have been affected with metals or volatile organic contaminants, these soils will remain on-site.

Excavated soils and sludges will be disposed of or treated at a RCRA permitted Treatment, Storage, and Disposal (TSD) facility. Some stabilization of the waste sludges and soils would be required prior to any land disposal.

Confirmatory soil sampling of the soils at the bottoms and sidewalls of the excavations will be conducted during soil excavation to help delineate the extent of soil removal. Testing can be conducted on-site by a mobile laboratory or by the use of field instrumentation such as X-ray fluorescence, or at an off-site analytical laboratory. In addition, controls would be taken to minimize dust migration and to prevent runoff of the stockpiled soils during precipitation events. Any soils temporarily stockpiled on site would be secured between plastic to minimize the potential for dust and runoff releases.

Effectiveness - Excavation and removal of soils contaminated above quality standards is an effective means by which impacts to groundwater can be minimized, and by which the rate of aquifer restoration can be accelerated. Excavation and removal of these soils would have no other benefit from the standpoint of protection of human health, since these contaminants pose no risk to the public via inhalation, ingestion, or direct contact. Potential exposure to contaminants will temporarily exist for workers and the community during soil excavation activities. However, these risks can be effectively minimized through administrative and engineering controls taken during field activities. Continued monitoring of the groundwater would be performed to help assess the effectiveness of the soil remediation.

Implementability - This remedial alternative would take approximately 3 to 6 months to complete. This time frame is necessary to secure approvals from the disposal facilities, and to arrange for contractor services for excavation, transport and disposal. Actual field time required to complete the excavation activities would be approximately 3 to 6 weeks. Pump-out of sludges can be performed using standard construction equipment and practices, and is therefore easily implemented. However, because of the loose soils encountered in the unsaturated zone, excavation down to the depth of the groundwater table may require sheeting and shoring in order to avoid the collapse of the sidewalls of the excavation. Further, the proximity of the drywells to the building will significantly increase the complexity of this operation.

Recommendation - This alternative will be retained for detailed analysis.

3.2.3 Alternative S-3: Soil Excavation and On-Site Treatment/Placement

With this alternative, soils contaminated at levels above standards would be excavated and treated on-site. Confirmatory soil sampling of the soils at the bottoms and sidewalls of the excavations will be conducted during soil excavation to help delineate the extent of soil removal. Testing can be conducted on-site by a mobile laboratory or by the use of field instrumentation such as X-ray fluorescence, or at an off-site analytical laboratory. In addition, controls would be taken to minimize dust migration and to prevent runoff of the stockpiled soils during precipitation events. Any soils temporarily stockpiled on site would be secured between plastic to minimize the potential for dust and runoff releases. The treatment process would include soil washing by contaminant specific solutions. The treated soils would be tested, and if appropriate, used as backfill.

Effectiveness - The soil washing process would potentially be effective on the volatile organic and inorganic contamination present at the site. The effectiveness of this technology would require evaluation via treatability studies on site-soils. Several different wash solutions may be required to treat organics and inorganics. Residual levels of wash solutions or contaminants in the treated soils may prohibit the on-site placement of this soil, thus requiring off-site disposal. Treatment of the spent wash solutions would also be required. This could be accomplished on or off-site, depending on the volume of material generated.

Implementability - Implementation of this alternative would require design and construction of the soil washing system, excavation of soils, and on-site placement or disposal off-site of treated soils, depending on the cleanup level achieved. These aspects are readily implemented. A treatability testing program would also require implementation in order to determine the type and usage of reagents, removal efficiencies, and the volume of wastewater generated. Treatment of potentially large volumes of spent wash and rinse solutions would be required, which would involve consideration of additional treatment or disposal options for this separate waste stream.

Recommendation - This alternative will not be retained for detailed analysis because of its uncertain effectiveness to meet treatment levels for site soils, and the requirement for disposal or treatment of the spent soil washing solutions.

3.2.4 Alternative S-4: In-Situ Stabilization/Chemical Fixation

Under this alternative, soils will be stabilized in place by chemical fixation/stabilization techniques. The objective of the stabilization process is to reduce the overall leachability of the contaminants such that contaminated soils can be left in place and not pose any threat to the public or the environment. Utilizing the soil stabilization process, chemicals are used to fixate the contaminants within the soils, thereby reducing the overall solubility, toxicity and/or mobility of the contaminants. Metals are immobilized into insoluble compounds within the soil matrix, and organic contaminants are immobilized, and then, chemically altered into innocuous complexes. The effectiveness of the treatment process can be evaluated using the USEPA TCLP, Synthetic Leaching Procedure (SLP) or other extraction procedure. Leachability test methods would be used to an indication of the potential concentration of contaminants leaching from the soils to the underlying groundwater. Following in-situ stabilization, the ground surface would be paved to redirect rainwater infiltration away from the treated areas.

Effectiveness - In-situ stabilization provides for long term solution to site contaminants. The sludges, which contains the higher concentrations of contaminants would be removed for off-site disposal at a RCRA TSD facility for treatment or disposal. Contaminated soils left in place would be chemically treated (stabilized and fixated) in place. The stabilization and fixation process produce less soluble and less mobile compounds, allowing contaminants to be left in place without posing any significant threats to human health or the environment. Aquifer rehabilitation under natural processes can be achieved more effectively by eliminating the source of any ongoing contribution of contaminants to the groundwater.

Implementability - Implementation of this remedial alternative will entail pumping out the drywell sludge which contains the highest concentration of site contaminants. The sludge would be disposed of off-site at a RCRA TSD facility. In addition, the concrete block drywells would be excavated to allow for effective in-place soil mixing. Removal of the concrete blocks would be difficult based on experience from past excavation activities conducted at this facility. The sidewalls of the excavation would readily collapse and therfore, shoring of the excavation may be required. Particular care will be required to protect building footers and foundation due to the nature of the soil and the proximity of the drywells to the building. Although the number of vendors currently available to implement this treatment alternative is somewhat limited, the number of vendors are growing as this technology continues to develop, and become more popular. Specialty equipment and chemistry is required for implementation of this remedial technology.

Recommendation - This remedial alternative meets the remedial action objective for soils, i.e. overall protection to human health and the environment. It will be retained for detailed analysis.

4.0 Detailed Analysis of Alternatives

This section presents the detailed qualitative and quantitative analysis of remedial alternatives which were developed and evaluated in the previous section.

4.1 Evaluation Criteria

Under NYS Superfund guidance (NYSDEC TAGM No. HWR-90-4030), each remedial alternative must be evaluated using the seven criteria listed below:

- Short-term effectiveness.
- Long-term effectiveness.
- Reduction of toxicity, mobility, and volume of contaminants.
- Implementability.
- Compliance with New York State Standards, Criteria, and Guidelines (SCGs).
- Overall protection of human health and the environment.
- Cost.

These evaluation criteria are consistent with those outlined in the NCP, and presented in the USEPA Superfund guidance documents. Under the NYS Superfund guidance, each criteria must be evaluated qualitatively, and then rated quantitatively. A scoring system, developed by NYSDEC and presented in the TAGM, is used to evaluate the remedial alternatives, relative to each other , and provide a basis for selecting the recommended remedial action for the site.

The seven evaluation criteria for remedial action selection address the following concerns:

- Short-Term Effectiveness - The effectiveness of alternatives in protecting human health and the environment during implementation, construction, and remedial action is evaluated using this criterion. Short-term effectiveness is assessed by protection of the community, protection of workers, environmental impacts, and the time frame until protection is achieved.
- Long-Term Effectiveness and Permanence - This criterion evaluates the long-term protection of human health and the environment, the potential risk remaining after completion of the remedial action, and the permanence of the remedial alternative. It is measured by the magnitude of risk remaining from untreated waste or treatment residuals, by the adequacy of the controls in achieving clean-up criteria, and by the reliability of the controls against possible failure.
- Reduction of Toxicity, Mobility, and Volume of Contaminants - This criterion evaluates the anticipated performance of treatment alternatives. There is a statutory preference for selecting remedial actions with treatment technologies that permanently and significantly reduce toxicity,

mobility, or volume of the hazardous wastes as their principal element. Specific factors include: (1) the amount of hazardous materials that will be destroyed or treated; (2) the degree of expected reduction in toxicity, mobility or volume; (3) the degree to which the treatment will be irreversible; and (4) the type and quantity of treatment residuals that will remain following treatment.

- Implementability - This assessment evaluates the technical and administrative feasibility, and the availability of services and materials in implementing the remedial alternative. Factors used to assess technical feasibility include construction and operational considerations, reliability of technology, ease of implementing the remedial action, and monitoring considerations.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs) - This criterion describes how the alternative complies with ARARs, and appropriate New York State SCGs, or if a waiver is required and how it is justified. The remedial action alternatives will be evaluated relative to their ability to comply with the chemical and action-specific ARARs previously identified.

- Overall Protection of Human Health and the Environment - This assessment draws on the results of the above evaluations to describe whether, and how, each alternative provides protection of human health and the environment.

- Cost - Order of magnitude cost estimates (-30% to +50%) inclusive of capital and Operation & Maintenance (O&M) costs are developed to help evaluate the overall cost-effectiveness of the remedial action alternatives. Capital costs include direct (e.g., construction) and indirect (e.g., non-construction and overhead) costs. O&M costs are post construction costs incurred to ensure effective operation, and can also include monitoring costs associated with the implementation of the remedial action. All costs are developed (using 1993 dollars) to the same level of detail in order to provide for an even basis for comparison. Present worth calculations are used to compare the cost-effectiveness of these alternatives. Present worth values were calculated based on the estimated life span, or 30 years for each remedial action, using a 5% interest rate.

4.2 Analysis of Groundwater Remedial Alternatives

4.2.1 Alternative GW-1: No Action with Monitoring

The no action alternative for groundwater does not provide for active clean-up of the groundwater at the site; remedial measures will not be implemented. Assuming no additional introduction of contaminants to the groundwater, existing contaminants in the groundwater would naturally degrade, or will be naturally flushed out.

Based on the baseline risk assessment conducted for this site, there are no human receptors for the groundwater exposure route. According to public records and available information, all homes in the affected area of the groundwater plume are currently connected to a public water supply for drinking, showering and cooking purposes. The public supply wells draw water from a deeper aquifer, which is not being affected by the groundwater plume in the shallow aquifer. As groundwater from the CAE Link site discharges to the Chenango River, the potential for human exposure would be through ingestion of surface water during recreation activities (i.e., swimming or wading), at locations downstream of the point of groundwater discharge to the river. The baseline risk assessment concluded that based on estimated exposure concentrations for this exposure pathway, there is no increased risk to the public resulting from the discharge of affected groundwater into the Chenango River. Because there is no significant risk to the public associated with the groundwater contaminant plume, the no action alternative is consistent with the remedial action objectives for this site.

Groundwater monitoring will be conducted to evaluate gradual changes in contaminant concentrations over time. This monitoring program would also help provide early warning to detect any changes in contaminant concentrations moving towards the Town of Fenton public water supply wells. Selected monitoring wells installed and sampled as part of the RI would be initially sampled on a semi-annual basis. If sampling results from four consecutive sampling periods indicate that the levels of contaminants in a well are below ARARs, then the frequency of sampling would be modified or eliminated.

- Short-Term Effectiveness - The no action alternative for groundwater would not pose any short-term risks to the public or environment. The groundwater contaminant plume will continue to discharge to the Chenango River. As determined from the baseline risk assessment, there are no significant impacts to the public via the groundwater or surface water migration pathways. Since no remedial actions are taken under this alternative, there will be no short-term effects to the community, to workers, or to the environment associated with implementation of any remedial actions. Activities associated with continued groundwater monitoring also would not pose any health threats to the samplers. The concentrations of contaminants in the groundwater is low, and therefore, would not present any health threats via the inhalation, or direct contact routes.

- Long-Term Effectiveness - Since the no action alternative for groundwater would not involve any remedial action, no efforts would be needed to maintain this remedy. Assuming no additional contributions of contaminants enter the groundwater, the contaminant plume would eventually achieve remedial objectives relative to ARARs through natural attenuation processes (contaminant degradation and dispersion). The groundwater sampling program would help document the gradual decreases in contaminant concentrations over time, as well as provide early warnings of any increases in contaminant concentrations that may be of concern.

The magnitude of risk remaining associated with the no action alternative does not exceed the reference value of 1.0E-06 (one in a million) for excess lifetime cancer risk for carcinogens, and does not exceed the reference value (1.0E+00) for the hazard index for non-carcinogens. These reference values are often used by the USEPA as guidance in determining acceptable risk levels. Risk characterization for this site therefore indicates that there are no increased risks due to either non-carcinogens or carcinogens found at this site, in the groundwater. The long-term effectiveness of this remedial alternative meets the remedial action objective for this site of being protective of human health and the environment.

- Reduction of Toxicity, Mobility, and Volume of Contaminants - Under the no action alternative, contaminant destruction would only occur through passive, natural degradation processes. As such, the volume, toxicity and mobility of the contaminants would be relatively unaffected initially. However, over time, and with the elimination of any continuing contaminant source, the groundwater plume will exhibit a gradual decrease in contaminant concentrations as a result of natural degradation and plume dispersion.

- Implementability - The no action alternative for groundwater is readily implemented since no remedial actions would be undertaken. Groundwater monitoring would be conducted to track changes in contaminant concentrations.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs) - Under the no action alternative, the concentrations of VOCs (trichloroethylene and 1,1,1-trichloroethane) will continue to exceed the New York State Groundwater Quality Standard for Class GA Groundwaters, and the New York State Department of Health Drinking Water Standards (MCLs). Chromium (based on unfiltered groundwater data) also exceeds the groundwater quality standard, however, only in the on-site wells. The chromium appears to be bound to the silts, and are significantly less mobile than volatile organic constituents. Contaminant concentrations of both VOCs and chromium will decrease, provided that no additional contamination is released to the groundwater.

- Overall Protection of Human Health and the Environment - The no action alternative is protective of human health and the environment. There are no significant short-term or long-term risks to the public or the environment associated with this alternative, since there are no known receptors for the groundwater exposure pathway, and exposure via the surface water route are within acceptable regulatory guidelines. The no action alternative provides sufficient protection to the public and the environment, and is consistent with the remedial action objectives.

- Cost - The present worth order of magnitude cost estimates for the no action alternative includes only O&M costs for continued groundwater monitoring. The cost reflects semi-annual monitoring (assuming 30 years total). The groundwater monitoring program includes sampling approximately 10 wells for volatile organic compounds, chromium and cadmium. There are no capital costs associated with this alternative. The present worth O&M costs associated with groundwater monitoring is on the order of $290,000. as presented in Table 4-1.

4.2.2 Alternative GW-2: Groundwater Extraction and Treatment

This alternative includes aquifer restoration through contaminant capture of the identified plume. Interception of contaminated groundwater would be accomplished using recovery wells. Groundwater extracted from the recovery wells would discharge to a centralized treatment system to be located at the CAE Link facility. Treatment technologies for volatile organics removal include packed tower air stripping, granular activated carbon (GAC) and UV Oxidation, and pH adjustment/chemical precipitation for metals removal. Treated groundwater will either be recharged to the ground via leaching fields, or to Phelps Creek as a surface water discharge. In addition to groundwater treatment, a groundwater monitoring program would be implemented to monitor changes in groundwater quality, which will help assess the effectiveness of the remediation system and to monitor capture of the plume.

The major components of this remedial alternative are summarized below:

- Groundwater extraction using ten (10) shallow wells.
- Treatment of groundwater using the following treatment technologies:
  - Option A - Metals pretreatment using pH adjustment and precipitation, and VOCs removal using air stripping.
  - Option B - Metals pretreatment using pH adjustment and precipitation, and VOCs removal using GAC.
  - Option C - Metals pretreatment using pH adjustment and precipitation, and VOCs removal using UV Oxidation.
- Discharge to groundwater using leaching fields, or discharge to Phelps Creek.
- Groundwater monitoring to evaluate the effectiveness of aquifer rehabilitation.

TABLE 4-1
Order of Magnitude Operating Cost Estimates
Feasibility Study Report
No Action Groundwater Remedial Alternative
CAE Link Facility
Binghamton, New York

Groundwater Monitoring

		Annual
Sampling & Field Expenses		$4,000
Laboratoy Services		7,000
Reporting		3,000
	Subtotal:	$14,000
Administration (10%)		1,400
Contingency (25%)		3,500
		$18,900
Present Worth*		$290,000

* Present Worth Assuming 30 Years of Operation at 5%.

These cost estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.

4.2.2.1 Description

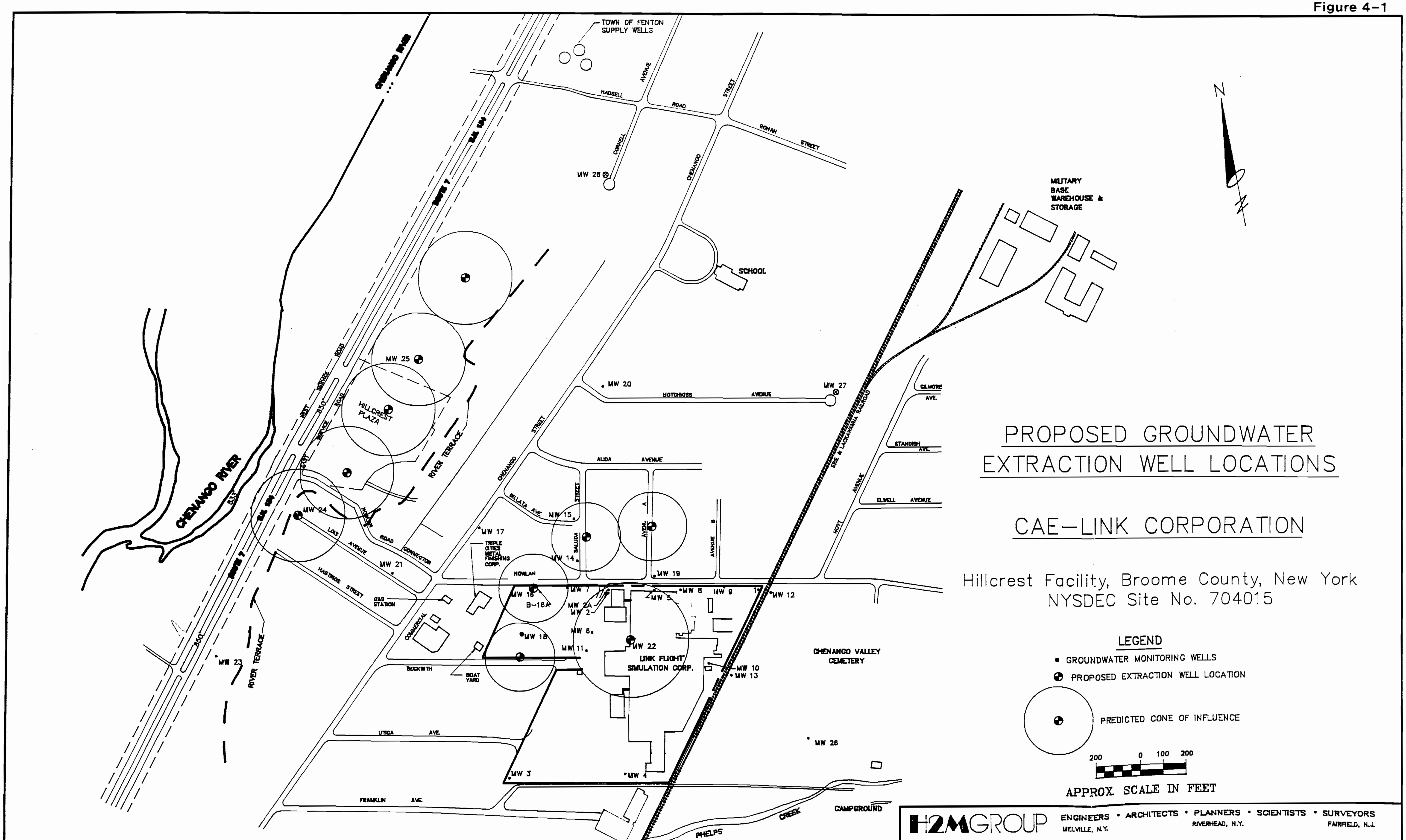
Groundwater Extraction

In general, groundwater recovery wells will be installed near the source area to prevent further migration of contaminants from the source area, thus accelerating aquifer restoration further downgradient of the site. Recovery wells will also be installed along the downgradient edge of the plume, immediately upgradient of the Chenango River, to capture the plume for treatment before groundwater discharges to the river. A conceptual description of the groundwater recovery system is provided in the following paragraphs.

The placement and pumping rate of the extraction wells is based upon the application of the Theis nonequilibrium well function equation, using site-specific and conservative estimates of hydraulic conductivity and saturated thickness of the water table aquifer. Application of the Theis equation is a conservative approach by which the theoretical response of the aquifer to pumping can be estimated. Hydraulic conductivities ranging from 1 foot per day to up to 6.7 feet per day were used in the calculations. Saturated thicknesses ranging from 15 feet to 38 feet were used to determine aquifer transmissivity at each location. The most recent dissolved contaminant concentration isopleth maps prepared during the addendum to the RI indicate that a groundwater extraction system exerting a cone of influence approximately 400 feet in length would be required to capture the plume in the vicinity immediately west of the facility, where the highest concentrations of trichloroethylene were found in the groundwater. This can theoretically be accomplished by installing five extraction wells as shown in Figure 4-1. The placement of these wells and a total extraction rate of 10 gallons per minute were estimated from results of Theis equation analysis. It is estimated that a cone of influence approximately 1,600 feet in length would be required to capture groundwater at the downgradient edge of the plume, which contains trichloroethylene at a mean concentration of 40 ppb. An analysis using the Theis equation indicates that this may be accomplished via five extraction wells with a total pumping rate of approximately 18 gallons per minute. The locations of the wells to be placed along the downgradient edge of the plume are also provided in Figure 4-1. Low extraction rates of less than two gallons per minute and limited areas of influence can be expected from most of the extraction wells due to low transmissivity and hydraulic conductivity of the shallow unconfined aquifer. Pump tests would ultimately be conducted at each potential extraction well location to more fully characterize the optimal extraction rate and corresponding effect on the water table gradient.

The extraction wells would be installed to the top of the silt unit. Based on the borehole logs developed during the RI, the extraction wells would be installed to depths ranging from approximately twenty-five to forty feet below grade. The well casing and screen should be a minimum of six inches in order to accommodate the extraction pump, piping and controls. Installation of extraction wells off-site at

Figure 4-1



PROPOSED GROUNDWATER EXTRACTION WELL LOCATIONS
CAE-LINK CORPORATION
Hillcrest Facility, Broome County, New York
NYSDEC Site No. 704015
LEGEND
GROUNDWATER MONITORING WELLS
PROPOSED EXTRACTION WELL LOCATION
PREDICTED CONE OF INFLUENCE
200 0 100 200
APPROX. SCALE IN FEET
H2MGROUP
ENGINEERS · ARCHITECTS · PLANNERS · SCIENTISTS · SURVEYORS
MELVILLE, N.Y.
RIVERHEAD, N.Y.
FAIRFIELD, N.J.
TOWN OF FENTON SUPPLY WELLS
MILITARY BASE WAREHOUSE & STORAGE
SCHOOL
CHENANGO RIVER
ROUTE 7
RIVER TERRACE
HILLCREST PLAZA
HADSELL ROAD
RONAN STREET
CHENANGO STREET
HOTCHKISS AVENUE
ALIDA AVENUE
BULLATA AVE
NOWLAN
LOIS AVENUE
HASTINGS STREET
NOWLAN ROAD CONNECTOR
GAS STATION
COMMERCIAL
BECKWITH
BOAT YARD
UTICA AVE.
FRANKLIN AVE.
TRIPLE CITIES METAL FINISHING CORP.
LINK FLIGHT SIMULATION CORP.
ERIE & LACKAWANNA RAILROAD
GILMORE AVE.
STANDISH AVE.
ELWELL AVENUE
HOYT AVENUE
CHENANGO VALLEY CEMETERY
CAMPGROUND
PHELPS CREEK
MW 28
MW 20
MW 27
MW 25
MW 24
MW 21
MW 17
MW 15
MW 14
MW 19
MW 16
B-16A
MW 7
MW 2A
MW 2
MW 5
MW 8
MW 9
MW 12
MW 6
MW 18
MW 11
MW 22
MW 10
MW 13
MW 23
MW 3
MW 4
MW 26

the downgradient edge of the plume would require permission from private landowners, or from the town to perform the work in the right-of-way. A centrally located pump station would also be required for the transfer of groundwater back to the facility. Construction of piping beneath public streets would be necessary from the extraction wells near the Chenango River to the pump station, and then back to the facility for treatment.

Groundwater Treatment

Contaminants detected in the groundwater plume include trichloroethylene and 1,1,1-trichloroethane at concentrations ranging from trace levels to in excess of NYS Class GA Groundwater Quality Standards. Based on contaminant distribution within the plume, the highest concentrations were observed on-site near the source (on the order of 800 ug/l total VOCs), and more dilute concentrations (5 ug/L) off-site, along the downgradient edge of the plume. Based on the proposed pumping scenario, the average concentration of VOCs in the extracted groundwater is expected to be on the order to 100 to 150 ug/L for treatment.

Groundwater near the source area (Outfall 004) also contains metals including chromium and cadmium. Because the groundwater data is from unfiltered samples, it is likely that some of the metals detected in the groundwater samples may be attributed to the turbidity of the water samples. During the RI, a limited number of groundwater samples were analyzed for dissolved metals and for total metals. Samples for dissolved metals were filtered prior to preservation and analysis. The filtered samples contained significantly lower concentrations of metals, suggesting that the metals in groundwater are predominantly in the precipitated state (i.e., adhered to the silts). Therefore, filtration of the groundwater, as a treatment option, may be sufficient to reduce the concentrations of metals to below acceptable NYS groundwater quality standards. In the absence of sufficient analytical data on filtered groundwater quality, the remedial alternative for groundwater treatment will include metals removal as a pretreatment step. Additional testing would need to be conducted during remedial design to quantify the concentrations of dissolved metals in groundwater, and to confirm the actual need for metals treatment.

PH Adjustment/Chemical Precipitation

Pretreatment will consist of metals removal to address inorganic contaminants, including chromium and cadmium, which were present above the NYS groundwater quality standards. Because hexavalent chromium was detected in the groundwater, metals treatment may require two stages. The initial stage would consists of reduction of hexavalent chromium to the trivalent state using sodium metabisulfite at a low pH, and then adjusting the pH of the water upwards to precipitate out any dissolved metals.

The fundamental process for metals removal using this technology is the process of precipitation, by which dissolved metals are transferred into the solid phase which then can be settled or filtered out of solution. This process is typically driven by pH changes. The solubility of a given compound is a function of the pH of the solute. At neutral pH ranging between 5.0 and 7.0, most metals are fairly soluble. Therefore, a highly basic compound such as lime ($Ca(OH)_2$) or sodium hydroxide (NaOH) is added such that the metal ions react with the hydroxyl radical to form metal hydroxide compounds which are relatively insoluble in water solution at higher pH ranges. Associated with each metal hydroxide compound is a pH range in which the metal hydroxide exhibits minimum solubility. Based on the metals of interest for the CAE Link site, a pH range on the order of 9 provides for least soluble concentrations of chromium and cadmium hydroxides. Pilot testing would be required to determine the optimal pH for metals removal.

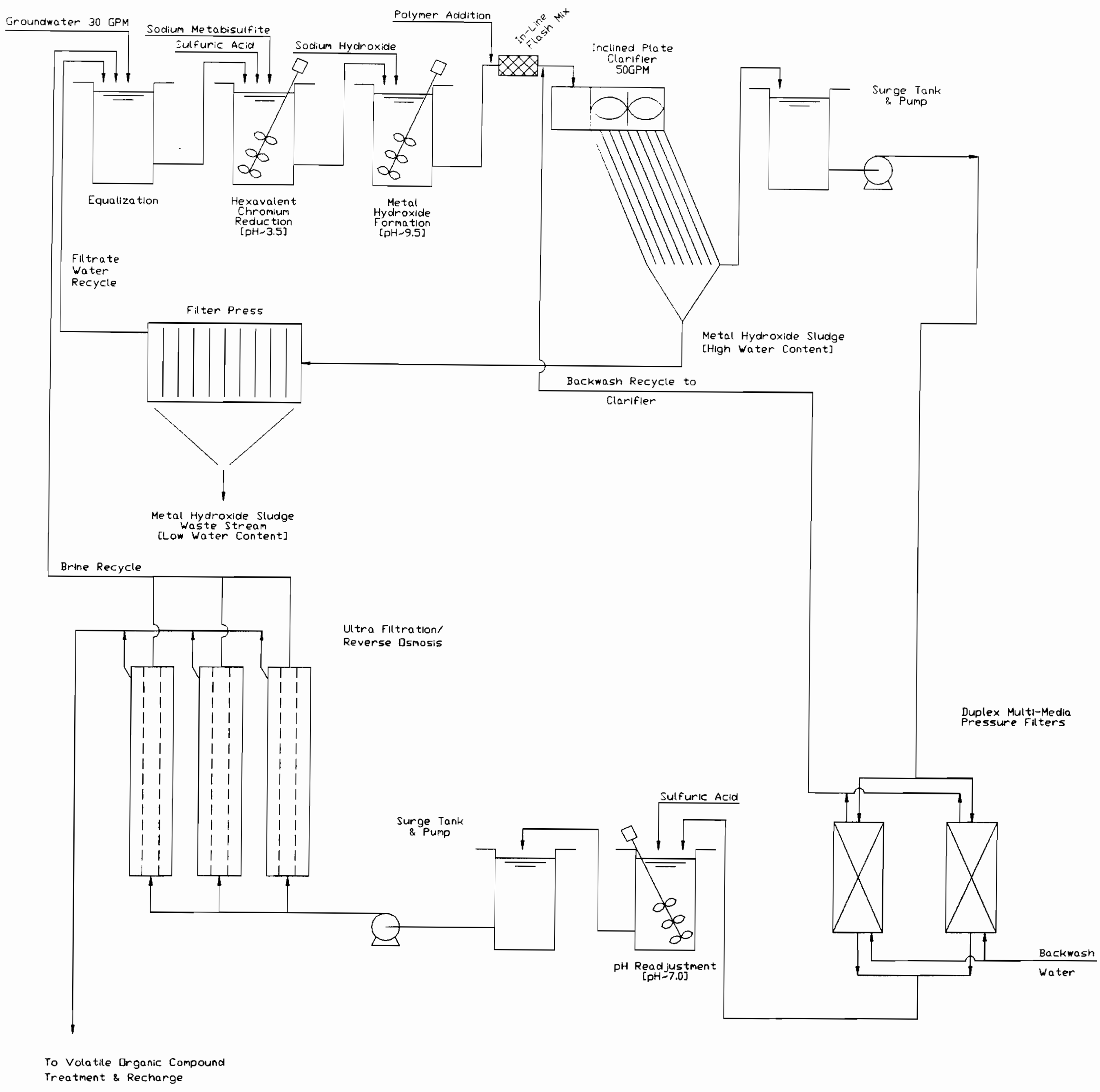
Process equipment for the metals removal treatment system would consist of an equalization tank, several rapid mix tanks, a clarifier, a multi-media sand filter, and a high pressure vacuum filter. Two rapid mix tanks in series would be used. In the first tank, sulfuric acid will be added to lower the pH of the water, and provide for chemical reduction of hexavalent chromium to trivalent chromium using sodium metabisulfite. Effluent from the first mixing tank is fed to a second rapid mix tank where hydrated lime or sodium hydroxide is added to form metal hydroxides. The pH of the solution will be maintained at approximately a pH of 9. Wastewater from the mixing tank is fed to the clarifier where coagulation and flocculation occurs. Ferric chloride may be added as a flocculation aid. The solids settle out and are separated in the clarifier unit. The liquid then passes through a multi-media filter to remove the majority of the suspended coagulated particles. The pH of the treated water is readjusted back to a neutral pH (between 6.0 and 8.0). In order to achieve water quality which meets NYS Groundwater Discharge Standards, a high pressure ultrafiltration unit would be used for final removal of suspended particles. The effluent from the ultrafiltration unit is then discharged to a second equalization tank for VOCs removal utilizing either air stripping, GAC, or UV oxidation.

The volume of sludge removed from the clarifier can be significantly reduced using a filter press. Sludge from the clarifier and the filter press cake would be tested, and disposed of off-site depending upon on the characteristics of the wastes. A flow schematic of the metals removal process is shown in Figure 4 -2.

<u>Air Stripping</u>

Groundwater treatment by "air stripping" is generally implemented by pumping untreated groundwater to the top of a packed-column tower containing inert "packing" material. The column

Figure 4-2



DISSOLVED METALS PRETREATMENT SYSTEM SCHEMATIC

GROUNDWATER REMEDIATION

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receives ambient air under pressure in an upward vertical direction from the bottom of the column as the contaminated groundwater water flows downward through the tower.

The basis of air stripping lies in the two-part theory. This theory describes what occurs at the interface between aqueous and gaseous phases. At this interface, an equilibrium exists between liquid concentration and the gaseous concentration. This equilibrium is represented with a proportionality constant appearing on the liquid side. The relationship between liquid and gas phase equilibrium is as follows:

$$\tilde{y}_A = \frac{\tilde{x}_A H_A}{p}$$

Where $\tilde{y}_A$ is the mole fraction of component A in the gas phase, M/L^3;

$\tilde{x}_A$ is the mole fraction of component A in the liquid phase, M/L^3;

p is the total pressure, and ;

H_A is the Henry's Proportionality Constant.

From the above equation, it can be seen that the greater the magnitude of the Henry's law constant, the higher $\tilde{y}_A$ becomes, and therefore, the equilibrium mole fraction of component A increases in the gas phase. For any given compound in water, a higher Henry's law constant will mean that the compound would be more easily removed from water by stripping. Values of Henry's constant are available for selected compounds in literature. Henry's constants for trichloroethylene and 1,1,1-trichloroethane are provided in the table below.

Henry's Law Constants and Liquid Film Resistance
for Selected Volatile Organic Compounds

Compound	Henry' s Constant	Resistance of Mass Transfer to Gas Phase Due to Liquid Film
Trichloroethylene	0.042	97.7%
1,1,1-Trichloroethane	0.15	93.8%

In addition, the liquid phase resistance is the limiting factor in the transfer of volatile organic compounds from the liquid phase to the gas phase. The percent liquid film resistance is a function of the Henry's Constant for each particular compound. For low solubility contaminants (i.e., where Henry's Constant is greater than 0.1), the liquid film resistance will control the stripping rate.

The removal efficiency of a particular size air stripping tower for a given contaminant is dependent upon the overall transfer coefficient, usually denoted as "K_L x a", where "K_L" is the overall liquid film coefficient, and "a" is the specific surface of the packing media, expressed as wetted surface area per tower volume. The overall transfer coefficient can be determined empirically through the results of pilot studies.

Packing media such as 2-inch Tripacks are suitable for use with low air to water ratios, and is well proven with the types of contaminants at this site. For purposes of design, air to water ratios of 75:1 to 45:1 are typical with Tripacks.

The design of an air stripping tower is based upon selection of reasonable overall transfer coefficients, liquid loading rates and packing height matched to the design conditions. Conventional practice in sizing the packing height for a tower of known cross section is based upon determining the height of a theoretical transfer unit (HTU) and the number of theoretical transfer units (NTU) required to achieve the desired removal. Also, for a stripping tower with a specified cross-sectional area and packing height, the extent of mass transfer (or removal efficiency) can be estimated.

The derivation of the mass balance equations can be found in the literature and the results are as given below:

Z = Required Packing Height = (HTU) x (NTU)

$$HTU = \frac{Q / A}{K_L a}$$

Where, Q	=	Flow
A	=	Cross sectional area
K_La	=	Overall transfer coefficient

A surge tank is used to allow accumulation of water and provide a steady feed rated to the tower of 30 gallons per minute. A tower 23 inches in diameter (1.917 feet) is chosen as a standard commercial size available for this application at a reasonable hydraulic loading rate (10.5 gpm/ft^2).

Q	=	30 gpm	=	240.6 [cubic feet/hour]
A	=	Pi x (1.917/2)^2	=	2.87 [square feet]
K_La	=	45 [1/hour] based on previous experience		
HTU	=	$\frac{240.6/2.87}{45}$	=	1.86 feet

From literature, the value of NTU can be calculated as

$$NTU = \frac{1}{(1-A)} \log_e[(A+(1-A) C_o/C_e]$$

where, A = Absorption Factor = $\frac{Q}{HG}$

and, G is the gas flow rate

For system analysis and design, the steady state equation for the liquid film is utilized. From this equation, the tower packing height can be calculated:

$$Z = HTU \times NTU = HTU \times \frac{1}{1-A} \log_e[A+(1-A) C_o/C_e]$$

and the removal efficiency of a given packed tower is given by:

$$\frac{\%R}{100} = 1 - C_e/C_o = 1 - \frac{1-A}{e^{K_L aZ(1-A)/\overline{Q}} - A} = \frac{(1-e^B)}{(A-e^B)}$$

$$B = K_L aZ(1-A)/\overline{Q}$$

$$\overline{Q} = Q/A$$

Utilizing these equations, the results presented in the following table identify the height of packing required to treat the influent to the desired effluent concentrations:

Treated Effluent Concentrations Estimated Based on Highest Influent Design Levels

Compound	Influent Concentration [ug/L]	Effluent Concentration [ug/L]	Height of Packing Required [Feet]
Trichloroethylene	125	5	9.9
1,1,1-Trichloroethane	10	5	1.35

From the above results, a packing height of 10 feet will be sufficient to reduce the concentrations to meet groundwater or surface water discharge standards. Mass transfer of multiple contaminants may reduce the theoretical removal efficiencies. Therefore, a contingency factor would be applied to the calculated height of packing. Experiment and experience have demonstrated that utilizing the fifty percent safety factor on the influent concentrations produces. A fifty percent safety factor would be incorporated into the remedial design of the air stripping system. A flow schematic of an air stripping system is shown in Figure 4-3.

An evaluation of an air stripping installation must also include consideration of the rate of contaminants discharged to the atmosphere. Conservative estimates of the emission rate potential can be calculated from the design influent flows, assuming complete mass transfer to the gas phase. The design influent of 30 gpm at a total VOC loading rate of between 100 µg/L and 150 µg/L (and utilizing an average influent concentration of 125 µg/L) results in the following emission rate:

VOC emissions = 30 gpm x 3.785 l/gal x 0.125 mg/l x 10^{-6} kg/mg x 2.205 lb/kg x 60 min/hr = 0.002 pounds per hour

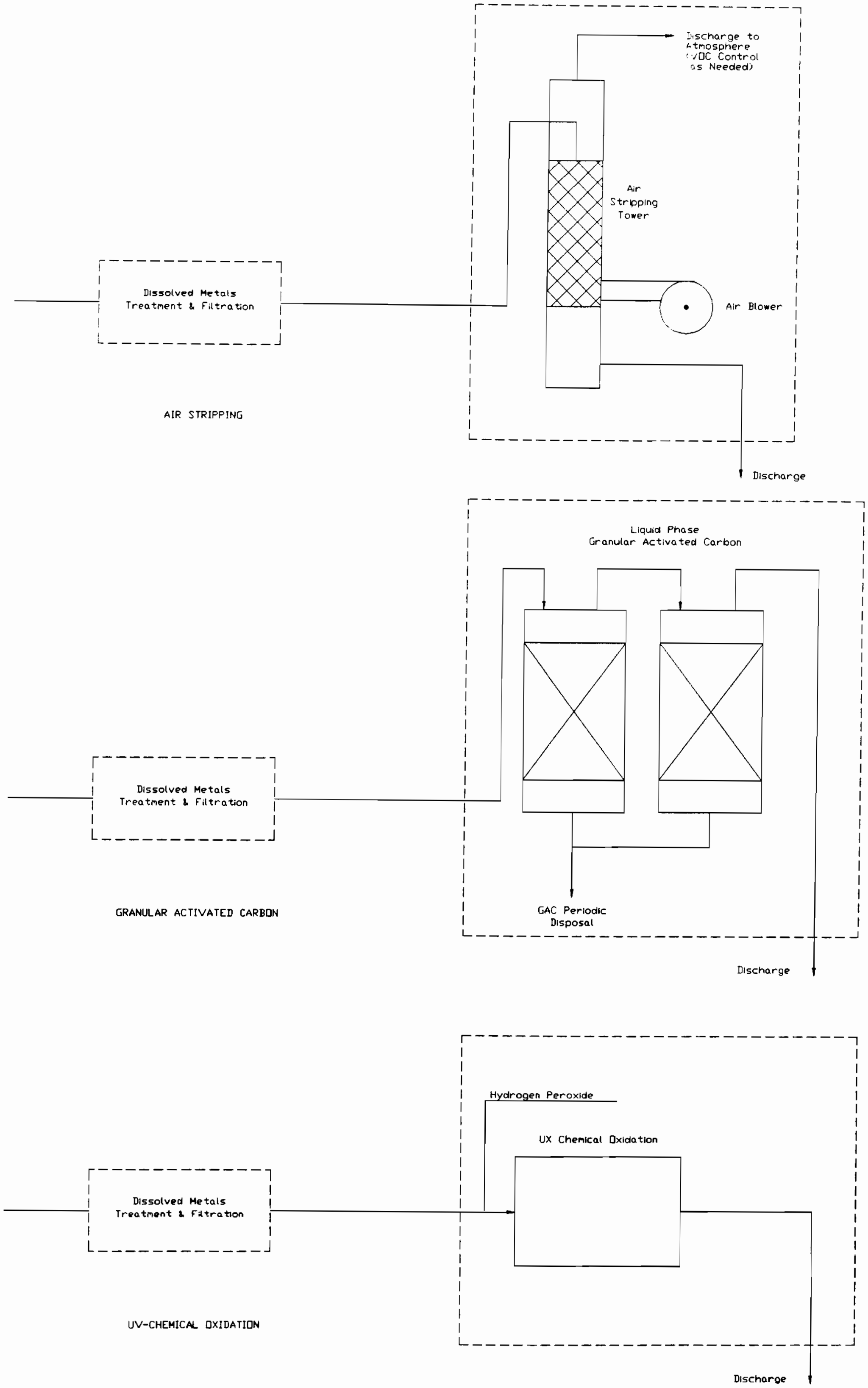
In similar manner, the conservative estimates of the emission rate potentials for each of the contaminants expected to be present in the untreated groundwater are given in the following table:

Estimated Emission Rate of Volatile Organic Compounds from Air Stripping Operation

Compound	Influent Concentration [ug/L]	Maximum Emission Rate Potential [lbs/hr]	Maximum Emission Rate Potential [lbs/day]
Trichloroethylene	1250	0.0019	0.045
1,1,1-Trichloroethane	10	0.0001	0.018

The sum total of emission rate potential is estimated at 0.002 pounds of volatile organic compounds per hour and 0.048 pounds per day. The NYSDEC requires vapor phase carbon adsorption for total volatile organic emission (TVO) of greater than 10 lbs/hr for a Class B environmental area. Under the state air regulations, 6 NYCRR Part 212 defines a Class B environmental air emission rating as that which "Includes processes, exhaust and ventilation systems where the discharge of a contaminant or contaminants result, or would reasonably be expected to result, in only moderate and essentially localized effects; or where the multiplicity of sources of the contaminant or contaminants in any given area is such as to require an overall reduction of the atmospheric burden of that contaminant or contaminants". This environmental rating is applicable for this site. Therefore, vent gas treatment would not be required.

Figure 4-3



VOLATILE ORGANIC COMPOUND TREATMENT ALTERNATIVES

GROUNDWATER REMEDIATION

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Granular Activated Carbon (GAC) Treatment System Description

Activated carbon is an effective removal technique for dissolved volatile organic substances. The carbon adsorbs the contaminants out of the aqueous phase. Adsorption is a natural process in which molecules of a liquid or gas are attracted to and then held at the surface of a solid. Granular activated carbon (GAC) is an excellent adsorbent due to the large degree of surface area contained within the carbon particle that is accessible for the adsorption process.

The adsorption process consists of three steps:

- diffusion of the contaminants through the fluid (gas or liquid phase) to the carbon particle;
- diffusion of the contaminant through the "inner" cavities to the adsorption site; and,
- adsorption of the contaminant to the carbon particle.

Contaminants in the raw water adsorb onto the GAC. The adsorptive capacity of the carbon varies with the nature and concentration of the contaminants. As the contaminant loading on the carbon reaches the adsorptive capacity of the carbon near the top of the filter, the interface between the saturated and the "clean" carbon moves downward through the carbon bed inside the pressure vessel. When the carbon in the filter vessel is fully loaded with contaminants (i.e., at its adsorptive capacity), no further removal will take place and contaminants will begin to be found in the effluent. Effluent monitoring and estimates of the adsorptive capacity of the carbon enable the carbon in the filter to be replaced prior to occurrence of contaminant breakthrough. The GAC can be regenerated by heating at high temperatures. On-site carbon regeneration facilities only prove economical for a facility having a very high rate of consumption. Therefore, off-site carbon regeneration is usually preferred.

The adsorptive capacity of activated carbon for organic contaminants can be estimated from an adsorption isotherm, which relates the concentration of a contaminant laden wastewater to that which is adsorbed by the GAC. Carbon adsorption isotherms are available from studies conducted by vendors for the groundwater contaminants at this site.

The Freundlich equation can be used to estimate the amount of carbon need for a specific application.

$$\frac{C_o - C_f}{M} = K(C_f)^{1/n}$$

where, C_o is the contaminant concentration of the influent,
C_f is the contaminant concentration of the effluent,
M is the total weight of carbon; and,
K and $1/n$ are empirical constants unique to the contaminant and carbon.

The ultimate capacity of the carbon can be estimated by defining carbon as reaching saturation when the contaminant influent concentration equals the effluent concentration. Choosing the point on the isotherm where $C_f = C_o$ will yield a value of carbon adsorption capacity $C_o - C_f / M$ at that contaminant concentration.

In a similar manner, obtaining the empirical constants allows for a calculated estimate of adsorptive capacity (i.e., $K(C_f)^{1/n}$). For the case of a design discharge value of 5.0 µg/l trichloroethylene and applying the empirical equation yields:

x/M = (28.0) x (0.005 mg/L)$^{[0.62]}$
= 1.05 mg trichloroethylene per gram of carbon
or 0.95 g carbon per mg trichloroethylene

Further, to determine the estimated rate of carbon consumption, carbon consumption is calculated per year of operation:

(0.95 g/mg) x (1 lb/453.59 g) x (0.125 mg/L) x (3.785 l/gallon) x (30 gallons/min)
x (525,600 min/yr) =15,600 lbs carbon consumed per year for trichloroethylene

The following tables present the estimated carbon consumption rates for the various contaminants to be treated at their respective design concentrations.

Compound	Influent Concentration Co [ug/L]	K	1/n
Trichloroethylene	125	28.0	0.62
1,1,1-Trichloroethane	50	2.48	0.34

resulting in :

Compound	Mg contaminant per gram of Carbon	Pounds Carbon consumed per gallon of water	Pounds Carbon Consumed per Year
Trichloroethylene	1.05	9.9E-4	15,600
1,1,1-Trichloroethane	2.44	3.4E-5	540

Changes in the contaminant concentration found at each well will alter the consumption rate of activated carbon. The isotherms presented along with the empirical constants can be utilized to estimate the adsorptive capacity of the carbon at predicted future contaminant levels and subsequently for design concentrations. The impact of increasing contaminant levels on carbon consumption would greatly increase carbon costs per gallon of water treated.

A flow schematic of a Granular Activated Carbon adsorption system is shown in Figure 4-3.

UV Oxidation

An alternate method of organic contaminant destruction is by means of chemical oxidation. Oxygen and energy are provided to break down the hydrocarbon contaminants into carbon dioxide and water.

The chemical oxidation process, utilizing ultraviolet (UV) light as a catalyst, provides for the reaction of dissolved volatile organic compounds to produce into carbon dioxide and water.

An example of the chemical oxidation reaction for trichloroethylene is shown:

$$\mathbf{4}\, C_2Cl_3H + \mathbf{9}O_2 \rightarrow \mathbf{8}\, CO_2 + \mathbf{2}\, H_2O + \mathbf{12}\, Cl^-$$

In the oxidation reaction, trichloroethylene (C_2Cl_3H), in the presence of oxygen (O_2) undergoes complete oxidation to form carbon dioxide (CO_2) and water (H_2O) plus dissolved chlorine ions (Cl^-). The trichloroethylene compound loses its hydrogens and gains oxygen to form carbon dioxide. Hydrogen peroxide is commonly utilized as a source of oxygen for the reaction, as an alternate to air, chlorine, ozone, and permanganate.

Theoretically, all dissolved materials will be oxidized in the presence of an oxidizing agent, assuming sufficient time is provided. Common limiting steps include the presence of other dissolved materials which are preferentially oxidized. Non-hydrocarbon dissolved contaminants, including naturally occurring metals and minerals, will also be subject to the oxidation reaction. Poor visual water quality, which would impede the transmission of the UV radiation, would also impede the oxidation reaction. Pretreatment for metals removal will help to optimize UV oxidation system performance.

Three steps are necessary to properly size an oxidation reaction unit, namely: determination of the optimum energy density necessary to complete the reaction within a reasonable time frame; evaluation of the hydraulic loading rate to prevent an accumulation of heat within the reactor; and, analysis of the dissolved content of the feed stream for reaction interferences.

Given the proprietary nature of the units currently being marketed, the design process typically involves treatability and pilot testing. For this application, it is anticipated that at system start-up, a 30 kW UV lamp system would be required for complete oxidation. The longer residence time and higher lamp intensity is required for oxidation of 1,1,1-trichloroethane, which is more difficult to oxidize than trichloroethylene. With ongoing treatment, the lamp intensity may be reduced downwards to 10 KW.

A flow schematic of a UV Oxidation system is shown in Figure 4-3.

Treated Water Discharge

The treated water can be discharged to groundwater or to surface water. In order to discharge to groundwater, a leaching field would need to be constructed at the CAE Link property. Based on an estimated recharge rate of 0.80 gallons per day per square feet (for sandy loam), the leaching system would be approximately 54,000 square feet in size in order to accommodate the 30 gpm recharge rate. Discharge of treated groundwater to the river can be accomplished through the facility's existing SPDES outfall. A modification would have to be made to the facility's SPDES permit to include the additional discharge volume. Additional information and investigation would be required to confirm that Phelps Creek is capable of handling the additional hydraulic loading.

4.2.2.2 Assessment

- Short-Term Effectiveness - Groundwater extraction wells would be installed on site and off site of the CAE Link facility to capture contaminants near the source, as well as in the adjacent community to capture the downgradient edge of the plume. Underground piping and a pump station would be installed to carry extracted groundwater from the extraction wells to the on-site centralized treatment system. Drilling activities and piping trench excavation would not pose any health threats to workers or to the community, as the contaminant concentrations in groundwater are relatively low. All piping installed will be above the groundwater table, therefore, workers would not come into contact with potentially affected soils. Air monitoring should be conducted during drilling and excavation activities, as a precautionary measure.

However, construction activities associated with this remedial alternative would result in disruption to the community. The installation of recovery wells and collection piping network on off-site properties would require permission from the Town of Fenton, or private residences for access in locating the wells and piping. Road closings would also be necessary during construction activities for installation of underground piping.

All three treatment options (air stripping, GAC and UV oxidation) can be operated relatively safely. Chemical usage is required for metals removal, and for UV Oxidation. Concerns associated with chemical storage (i.e., secondary spill containment, ventilation, etc.) must be addressed during system design. In addition, high voltage electrical is required for the operation of the UV oxidation equipment. Safety measures must be incorporated into the UV oxidation system design.

Operation of the air stripper will generate a vapor phase discharge. However, it is not expected that vapor phase controls would be required. VOC emission rates will be relatively low from the air stripper and should not impact air quality in the surrounding community.

- Long-Term Effectiveness - At present (i.e, pre-remediation conditions) the magnitude of risk to the public based on ingestion of surface waters from the Chenango River is less than $1x10^{-6}$ (less than one chance in a million of getting cancer based on contaminants in the groundwater). A $1x10^{-6}$ excess lifetime cancer risk level is considered to be within acceptable guidelines by the USEPA. With the implementation of a groundwater remediation program, the risk level will be further reduced.

Groundwater extraction and treatment offers long range protection to public health against contaminated groundwater consumption. The extraction system will be designed to collect the more contaminated groundwater (near the source area), as well as at the diluted groundwater at the furthest downgradient portion of the plume. Extraction wells at the edged of the plume will also help prevent contaminated groundwater from discharging to the Chenango River, reducing the potential risk to the public, below the one in one million risk level noted above.

The groundwater will be treated to effluent concentrations of less than 0.005 mg/l for individual VOCs, and less than 0.05 mg/l for chromium, and 0.01 mg/l for cadmium. Sampling will be performed at the treatment system (influent, effluent, and intermediate locations) to monitor system performance. A long term groundwater monitoring program will also be performed over the life of the groundwater remediation program (30 years).

This remedial alternative provides for additional protection to the public beyond what is already considered acceptable, as well as protection to the environment through aquifer rehabilitation.

- Reduction of Toxicity, Mobility, and Volume of Contaminants - Capture of contaminated groundwater would reduce the overall mobility of contaminants in the environment. With active aquifer rehabilitation (i.e., treatment), the concentrations of contaminants in the groundwater will decrease.

All three treatment technology alternatives (Options A, B and C) are considered permanent solutions since contaminants will be removed from the groundwater media. Metals treatment technology will remove dilute concentrations of metals in the groundwater, and concentrate the metals in a sludge, thus reducing the overall volume of contaminated media. The sludge may be considered a hazardous waste if the metals concentrations exceed the RCRA threshold for TCLP. If hazardous, the sludge would need to be disposed of at a RCRA permitted facility. Stabilization of the sludge prior to landfilling would help to limit the mobility of the contaminants. Use of GAC will also generate a waste stream. Spent activated carbon would require off-site disposal or regeneration as a hazardous waste.

Use of UV oxidation will not generate a waste stream, with the exception of residuals resulting from the periodic cleaning of the UV lamps. The waste is generated from the oxidation of dissolved metals or minerals which coats onto the surface of the UV lamp. No other waste is generated from the operation of the UV oxidation treatment process, or from use of an air stripper since gas vent controls would not be required.

This alternative will provide long-term protection to the public and the environment through aquifer rehabilitation, and is consistent with the remedial action objectives.

- Implementability - This alternative involves the construction of groundwater extraction wells, underground piping, and construction of a leaching field on the CAE Link property. Installation of the groundwater collection system would utilize conventional well drilling and construction methods. Contractors and materials are readily available. Extensive lengths of underground piping (12,000 linear feet) including a pump station would be necessary to transfer extracted groundwater from the recovery wells form off-site locations back to the centralized treatment system to be located at the CAE Link property. If a leaching system is constructed for site recharge, the leaching field would be approximately 54,000 square feet in size to accommodate the 30 gpm (43,200 gallons per day) discharge. Locating a leaching system of this size at the CAE Link facility would be difficult, and may require relocating site utilities or other underground structures to allow for construction of the leaching field.

Similarly, process equipment for the various treatment technologies evaluated are also readily available and easily installed. Metals removal using pH adjustment/chemical coagulation is widely used in industrial wastewater treatment. Air stripping, GAC, and UV oxidation are all effective in reducing VOCs in water. UV oxidation is a newer technology, with a limited number of vendors who manufacture this type of equipment. The UV Oxidation equipment requires significantly higher electrical demand.

Operation of the treatment technologies vary in terms of the level of maintenance required. The metals removal process requires more frequent monitoring and readjustment to ensure proper pH and chemical dosing. Much of the monitoring can be incorporated into electronic controls systems to ensure optimum operation. Use of GAC would also require frequent testing of the effluent stream to monitor for carbon breakthrough and replacement. UV Oxidation also requires a highest level of maintenance due to the sensitivity of the treatment equipment to changes in water quality. Programmable Logic Controls can be incorporated into the UV Oxidation system design. The air stripper requires least maintenance, with the exception of routine equipment inspection and replacement.

Treatment residuals such as dewatered sludge from the metals removal process would required off-site disposal at an approve facility. Depending upon the characteristics of the waste sludge, the material may be considered a hazardous waste. The air stripping and UV Oxidation treatment processes generally do not generate a waste stream, whereas, GAC produces spent activated carbon. The activated carbon, after reaching its adsorptive capacity, would need to be regenerated. On-site carbon regeneration is not cost effective for this site. Therefore, off-site carbon regeneration would be conducted. This requires handling and transporting of the spent carbon, as a hazardous waste.

- <u>Compliance with New York State Standards, Criteria, and Guidelines (SCGs)</u> - This remedial action alternative would achieve ARARs for groundwater. The treatment options evaluated are all capable of reducing metals and VOC concentrations to meet groundwater or surface water discharge standards. Groundwater remediation for the purpose of aquifer rehabilitation is consistent with federal and NYS groundwater protection strategies.

In order to discharge the treated wastewater to the ground or to Phelps Creek, a NYS State Pollutant Discharge Elimination System (SPDES) permit must be obtained, or a modification to the facility's existing SPDES permit must be granted. Groundwater and surface discharge limits under the SPDES permit will be established based on 6 NYCRR Part 700. At a minimum, monthly monitoring and reporting will be required of the treated effluent being discharged to groundwater or to surface water.

This remedial action alternative, regardless of which treatment option is used would be effective in reducing the concentrations of VOCs and metals in the groundwater to meet NYS groundwater and surface water discharge standards.

- Overall Protection of Human Health and the Environment - This alternative provides an additional level of protection to human health and the environment thorough aquifer rehabilitation. The only route of potential exposure for contaminated groundwater is through surface water contact from the Chenango River. The excess lifetime cancer risk posed to the public from potentially affected surface water was found to be less than $1x10^{-6}$, indicating that a person has less than one chance in a million of getting cancer based on exposure to contaminants from this site. According to the USEPA, an exposure risk of one in one million is considered to be an acceptable risk level. With the implementation of groundwater remediation, the residual level of risk will only provide for additional protection beyond what is already considered acceptable by the USEPA.

- Cost - Order of magnitude cost estimates for Option A (metals pretreatment and air stripping), Option B (metals pretreatment and GAC), and Option C (metals pretreatment and UV Oxidation) are presented in Table 4-2. The present worth (assuming 30 years of operation, at 5%) for these three options range from $5.8M to $7.0M. A time frame of 30 years is used per CERCLA guidance for long term remediation. However, actual time for operation is estimated to be closer to ten (10) years based on hydrodynamics. These costs includes capital costs associated with the installation of the groundwater collection system, treatment equipment, and leaching field installation. Annual O&M costs include maintenance and upkeep of the treatment system, and groundwater monitoring, which reflects semi-annual sampling.

4.3 Analysis of Soil Remedial Alternatives

The soil remedial action alternatives address the contaminant source area (Outfall 004) located at the eastern perimeter of the site. Outfall 004 is comprised of twelve (12) leaching pools (drywells) which are constructed of precast concrete rings, approximately 6 feet in diameter, with each drywell approximately 10 feet deep. The drywells, which are presently inactive, formerly received wastewater discharges from the facility's metal finishing operations.

Remedial action alternatives for soils include no action, and source control measures which can be implemented as in-situ and ex-situ technologies. The detailed evaluation of remedial action alternatives for soils is presented below.

TABLE 4-2
Summary of Order of Magnitude Capital and Operating Cost Estimates
Feasibility Study Report
Groundwater Remediation System
CAE Link Facility
Binghamton, New York

I. Groundwater Extraction System

Capital Cost	$700,000
Operating Cost *	1,245,000
	$1,945,000

II. Dissolved Metals Pretreatment System

Capital Cost	$300,000
Operating Cost *	2,822,000
	$3,122,000

III. Dissolved Volatile Organic Compound Treatment System

	Air Stripping	GAC	UV Oxidation
Capital Cost	$39,000	$80,000	$80,000
Operating Cost *	104,000	1,307,000	872,000
	$143,000	$1,387,000	$952,000

IV. Discharge

Capital Cost	$148,000
Operating Cost *	154,000
	$302,000

V. Groundwater Monitoring

Capital Cost	- -
Operating Cost **	$290,000
	$290,000

* Present Worth Assuming 30 Years of Operation at 5%.
** Present Worth Reflecting Semi-Annual Monitoring.

These cost estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.

4.3.1 Alternative S-1: No Action

4.3.1.1 Description

The no action alternative for soil would not include any soil cleanup actions. Since all discharges to the industrial wastewater leaching pools have terminated several years ago, no additional contaminant loading is occurring to these drywells. With the exception of some rainwater which may runoff into the drywells during a heavy rain event, no additional wastewater is being discharged to these pools. The site is a restricted access facility, with fencing and 24-hour security.

The no action alternative for soil would not actively remediate soil contamination. Any site cleanup would occur through natural degredation and attenuation processes. A long-term groundwater sampling program will be performed to monitor groundwater quality and identify any future impacts to groundwater from leaching of contaminants from the soil.

4.3.1.2 Assessment

- Short-Term Effectiveness - Since the sludges and contaminated soil within the drywells are located about 10 feet deep, the contaminated materials are not accessible to site workers, or to the public. Any risk to facility personnel, workers, or the community from direct contact with contaminated soils is minimal since there are no known completed exposure pathways. These drywells no longer receive active wastewater discharges, therefore, no additional contaminant loading is being introduced to the source areas.

- Long-Term Effectiveness - Since this alternative would not involve any remedial action, no efforts are needed to maintain this remedy. Contaminants in the sludge and soil may potentially degrade, or leach from the soil to within acceptable levels. However, this process would require a long time frame for VOCs. This would not be achievable for metals.

The magnitude of risk to the public associated with the no action alternative, under current site conditions, is not significant since there are no completed routes of exposure for contact with contaminated materials. However, if future site activities are conducted near the source area and the sludge and contaminated soil become exposed, they could present a threat to site workers or the public. The no action alternative does not provide any protection against future exposure scenarios.

Leaving the sludges and contaminated soil in place may result in further adverse impact to the groundwater if contaminants continue to leach from the soils. The no action alternative would not mitigate the potential for future contaminant leaching from the sludge or contaminated soils to the groundwater.

- Reduction of Toxicity, Mobility, and Volume of Contaminants - There are no treatment processes associated with this remedial alternative to reduce or alter the toxicity, mobility, or volume of contaminants in the soils. In time, the contaminant concentrations in the soils would decrease with chemical and biological degredation, and contaminant leaching. However, any significant decrease in metal concentrations would be expected to take an extremely long time since metals do not migrate readily, particularly in the soil column. As such, the degree of contaminant toxicity and mobility in the soil would remain at the present levels. The overall volume of contaminated soils can potentially increase due to contaminant dispersion if contaminants in the sludge continue to leach.

- Implementability - The no action alternative is readily implemented since no remedial action technologies will be employed. Groundwater monitoring will be performed to assess groundwater quality, and to monitor future impacts to groundwater resulting from leaching of contaminants to the groundwater.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs) -The no action alternative does not comply with ARARs. The concentrations of metals, specifically cadmium in the sludge and in some of the underlying soils exceed the health based soil levels (USEPA HEAST soil concentrations). Concentrations above the HEAST levels represent unacceptable exposure risks to the public (based on direct contact or ingestion). In addition, the concentration of VOCs in the sludge and soils of several of the drywells exceed the NYSDEC recommended soil cleanup objectives (identified in the NYSDEC TAGM No. HWR-92-4046) for 1,1,1-trichloroethane, acetone, and 1,1-dichloroethane. All of these volatile compounds are within the NYSDEC maximum recommended concentration of 10 mg/kg for total VOCs. The NYSDEC recommended soil cleanup objectives are intended to be protective of human health and of groundwater.

- Overall Protection of Human Health and the Environment - There are, at present, no imminent risk to the public via the direct contact exposure pathway. The sludges and soils in the drywells are inaccessible to facility employees, and to the public at its present state (i.e., the site is secured, and the contaminated materials are 10 feet below grade). However, disturbance of the soils in the future can result in some increased risk to site workers, or to the public. Since the drywell sludges contain elevated levels of metals and volatile organic compounds above the USEPA health based soil cleanup levels (USEPA HEAST levels), the excess lifetime cancer risk to human health would be above acceptable EPA guidelines.

By leaving the sludges and contaminated soils in place without any active treatment, the potential exists for continued leaching of contaminants from the sludges. Risks posed by the leaching of contaminants from sludges and soils into the groundwater would not be addressed. This alternative is not consistent with aquifer protection strategies. The no action alternative does not meet the remedial action objective relative to protection of human health and the environment.

- Cost -There are no capital costs associated with the implementation of this remedial alternative. O&M costs include continued monitoring of the groundwater to identify and assess potential future affects to groundwater quality from contaminants remaining in the soils. The present worth order of magnitude cost for annual monitoring, assuming a 30 year duration, is $290,000. This cost reflects semi-annual groundwater monitoring from approximately 10 wells. Analysis would be for volatile organic compounds, and for cadmium and chromium.

4.3.2 Alternative S-2: Soil Excavation and Off-Site Disposal

4.3.2.1 Description

One method of a source control remedial action consists of removal of sludges from the bottom of the drywells, and excavating soils which are present at concentrations which exceed NYS ARARs (USEPA HEAST levels of metals, and 10 mg/kg for total VOCs). The twelve drywells which comprise the Outfall 004 wastewater disposal network (A, B, C, D, E, H, I, J, K, L, M, and N) are confirmed sources of groundwater contamination. These drywells previously received metal bearing wastewaters from the facility's former industrial operations. Soils from these drywells are impacted with metals, primarily cadmium, and chromium. Elevated levels of volatile organic compounds (1,1,1-trichloroethane, acetone, and 1,1-dichloroethane) are also present in some of these pools. Concentrations are highest in the sludges.

Under this remedial approach, the sludges and contaminated soils underlying the sludges would be removed for off-site disposal. Sludge removal can be accomplished using a high powered vacuum tanker truck. Based on preliminary estimates of sludge volumes, a total of approximately 40 cubic yards (60 tons) of sludge is present in the bottoms of leaching pools E, H, I, J, K, L, M, and M.

Impacted soils from leaching pools which contain contaminant concentrations above applicable soil ARARs will be removed. In estimating the volume of contaminated soil for removal at each leaching pool, soil contamination was assumed to extend directly from the bottom of the drywells (at a depth of 10 feet below grade) down to a maximum depth of 18 feet below grade (the average depth of groundwater). In excavating the drywells, it is assumed that the soils within a 4 foot radius outward from the edge of the concrete block drywells would also be removed. Data from borings taken through the center of the leaching pools were evaluated to determine the depths to which soil remediation would be conducted. Based on the RI soil data, and applying NYS ARARs (i.e., the USEPA HEAST health based soil guidance values for metals, and the NYSDEC recommended soil cleanup objective of 10 mg/kg for total VOCs), eleven of the twelve drywells (A, B, C, D, E, H, J, K, L, M, and N) would require remediation. In each drywell, soil remediation would extend to the surface of the groundwater table (18 feet below grade). The total volume of soils from these eleven drywells is estimated to be 1,400 cubic yards (or 1,800 tons).

Excavated soils and sludges will be disposed of at a RCRA permitted Treatment, Storage, and Disposal (TSD) facility. Some chemical and physical stabilization of the sludges and excavated soils may be required prior to land disposal.

Confirmatory samples of the remaining soil at the bottom and sidewalls of the excavations would be conducted to help confirm the extent of soil removal. Testing can be conducted utilizing an on-site mobile laboratory, or off-site analytical laboratory.

4.3.2.2 Assessment

- Short-Term Effectiveness - The potential can exist for exposure to site workers and to the community from soil excavation activities. However, these risks can be effectively minimized through administrative and engineering controls taken during field activities. During excavation, dust erosion and control measures would be taken to minimize the release of airborne particulate matters to the atmosphere. On-site air monitoring would be conducted within the work zones, and downwind of the work areas to assess potential exposure to the community. Excavated soils would be secured between plastic to minimize the potential for producing airborne matters and runoff releases. Gloves and other personal protective clothing and equipment (i.e., coveralls, boots, hard-hats, safety glasses, etc.) should be worn to minimize any risk from inhalation, ingestion, or direct contact.

This remedial alternative would take approximately 3 to 6 months to complete. This time frame is necessary to secure approvals from the disposal facilities, and to arrange for contractor services for excavation, transport and disposal. Actual field time required to complete the excavation activities is approximately 3 to 6 weeks.

- Long-Term Effectiveness - The risk to public health, at present, directly attributable to contaminated soil from the source area (Outfall 004) is minimal since these soils are not accessible for direct contact and does not pose an airborne threat (e.g., from volatilization). Soil gas data taken around the community did not identify any airborne contaminant levels which poses a health risk to the community. However, if future construction activities are conducted at the site to disturb the buried waste, exposing the sludges and contaminated soils pose a potential health threat to the public.

Excavation of the contaminated sludge and soils (i.e., source area) off-site provides for long term protection to the public and to the environment through aquifer protection strategies. Removal of sludges and contaminated soils prevents the continued leaching of contaminants from the source area to the groundwater. Soil excavation and off-site disposal is a permanent remedy for the CAE Link facility. No further maintenance for the soils would be required.

With the removal of contaminated soils from the site, the risk to the public health, and to groundwater and the environment following remediation would be minimal.

- Reduction of Toxicity, Mobility, and Volume of Contaminants - By excavating and removing contaminated soils from the site, threats posed to groundwater is minimized. If the excavated sludges and soils are disposed of at a RCRA permitted landfill, all or a portion of the wastes would likely require treatment/stabilization to meet land ban requirements. Treatment performed prior to landfilling would be effective in reducing the mobility of the contaminants in the soils, but may not reduce the toxicity of the contaminants. With treatment/stabilization for land disposal, the overall waste volume would also increase. The landfilling disposal option provides for the relocation of contaminated materials from the site to another controlled site.

If the wastes is disposed of via incineration, the volatile organic compounds will be destroyed. Both the toxicity, mobility and volume of VOCs in soils would be eliminated. An ash would be generated which contain metals. The volume of metal contaminated waste would be significantly reduced.

- Implementability - Removal of 40 cubic yards of sludges and excavation of 1,400 cubic yards of soils is technically feasible, and implementable. Sludges can be removed from the leaching pools using a vacuum pumper truck. Since all soils to be removed are located above the groundwater table (approximately 18 feet below grade), excavation of the leaching pools and adjacent soils can be performed using standard construction equipment and practices. However, based on experience during past excavation activities conducted at the site, extensive sidewall collapse during excavation can be expected. This is attributed to the loose, sandy soils encountered in the unsaturated zone. Also, because some of the drywells are located close to existing buildings, removal of the soils from some of these drywells may compromise the structural integrity of the adjacent structures. In order to control the size of the excavation and to protect the stability of adjacent structures, sheeting and shoring during excavation would be required. Some logistical consideration must also be given to waste staging since the available space behind the main plant where the source area drywells are located is limited.

Waste stream approvals must be obtained from the RCRA TSD facility prior to shipment off-site. Time frames for approvals typically range between 4 to 12 weeks, depending upon the level of treatability testing required by the disposal facility. The volumes of and characteristics of the wastes encountered at this site should not preclude acceptance of this waste by TSD facilities.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs) - This remedial alternative complies with the soil ARARs identified for this site (NYS To be Considered Criteria using USEPA HEAST levels for metals, and NYSDEC soil cleanup level of 10 mg/kg for total VOCs). Soil removal would be performed to concentrations below these levels. Excavation would extend down along the soil column to the maximum depth of the groundwater table surface .

Groundwater quality data from the RI supports the observation that metals present at the source area (in the drywells of Outfall 004) are not very mobile. Comparison of the water quality data between on-site and off-site wells support that metals have generally not migrated away from the source area, or off-site. Metals generally are not very mobile, and tend to migrate at a significantly slower rate than volatile organic compounds. Metals are less likely to leach and migrate, but presents more of a health concern via the ingestion exposure pathway. Therefore, in assessing inorganics in soils, health-based ARARs (USEPA HEAST soil guidance values) are used for metals in soils. Volatile organic compounds, however, exhibit a higher potential to leach from soils and migrate readily with groundwater flow. Therefore, leach based soil cleanup goals would be employed for VOCs. The NYSDEC recommended soil cleanup objective (of 10 mg/kg for total VOCs) is intended to be protective of human health and groundwater, and therefore is appropriate for VOCs in soil.

- Overall Protection of Human Health and the Environment - This remedial action provides for protection to groundwater and the environment. By eliminating the source of any ongoing contamination entering the groundwater, aquifer rehabilitation under natural processes can be achieved more efficiently.

With excavation and off-site removal of the contaminated soils, particularly the sludges, the potential for future exposure to site workers, and to the community is mitigated. The magnitude of risk remaining to the public after soil remediation would be consistent with levels acceptable to the USEPA. Also, in remediating soils to the NYSDEC recommended soil cleanup objective (10 mg/kg for total VOCs), the future risks posed by leaching of contaminants from sludges and soil into the groundwater would be minimized. Therefore, this remedial alternative meets the remedial action objective and provides for long term protection to human health and the environment.

- Cost - The soil remediation costs consist of pumping out the sludge and excavating the surrounding soils. This cost estimate include labor, equipment, post excavation sampling, and transportation and disposal. The total present worth cost for the excavation and off-site disposal alternative is on the order of $2M. Costs associated with soil excavation and disposal are summarized in Table 4-3.

4.3.3 Alternative S-4: In-Situ Stabilization/Chemical Fixation

4.3.3.1 Description

Under this alternative, contaminated soils would be stabilized in place by stabilization/chemical fixation techniques. The objective of the stabilization/fixation process is to reduce the overall leachability of the contaminants such that impacted soils can be left in place and not pose any threats to the public or the environment. Utilizing the soil stabilization process, chemicals are injected into the soil column to fixate the contaminants within the soils, thereby reducing the overall solubility, toxicity and/or mobility of the contaminants. Metals are immobilized into insoluble compounds within the soil matrix, and organic contaminants are immobilized, and then, chemically altered into innocuous complexes.

Chemicals used in the stabilization/chemical fixation process typically include Portland cement, cement kiln dust, lime, bentonite, various types of clays, sodium silicate (water glass), slag, gypsum, etc. Proprietary treatment products are also available which serve to increase the number of active pore sites/surface area for chemical bonding reactions to take place.

In-situ waste treatment of subsurface soils would be accomplished utilizing an auger mixing system mounted on a crane, backhoe or drilling rig. Cement slurries, and proprietary mixes or dry reagents used to stabilize and fixate the soils are injected through the mixing blades and evenly blended into the soil column to produce a homogeneous mixture of soil and reagent. Reactions occur between the contaminants, reagents, and organic matters in the soil, which produces a chemically and physically stabilized soil mixture. Treatability testing must be conducted to develop the most effective reagent mixture, chemical feed rate, and in-situ mixing method for this site application.

In order to implement the most effective and efficient strategy for in-situ remediation, sludges contained in the drywells (approximately 40 cubic yards) would be removed for off-site disposal. The soils within the center of the drywells, from a depth of 10 feet below grade (the bottom of the drywell) down to an average depth of 18 feet below grade (the depth to groundwater) will be treated in-situ by

TABLE 4-3
Order of Magnitude Capital Cost Estimates
Soil Remediation Alternatives
Feasibility Study Report
CAE Link Facility
Binghamton, New York

I. Sludge Removal	Alternative S-2: Sludge Removal, Excavation and Off-Site Disposal	Alternative S-4: Sludge Removal, In-Situ Stabilization/Chemical Fixation
Labor	$9,000	$9,000
Equipment	7,000	7,000
Analytical Services	8,000	8,000
Transportation & Disposal	23,000	23,000
Subtotals:	$47,000	$47,000
Engineering (20%)	9,000	9,000
Administration (10%)	5,000	5,000
Contingency (25%)	12,000	12,000
	$73,000	$73,000

II. Soil Remediation	Excavation	In-Situ Stabilization
Labor	$30,000	- -
Equipment	27,000	- -
Sheeting & Shoring (Labor & Materials)	500,000	
Analytical Services	13,000	- -
Post-Excavation Sampling	3,000	- -
Monitoring & Documentation	13,000	- -
Transportation & Disposal	630,000	- -
Backfilling	33,000	- -
Paving & Restoration	8,000	- -
Mobilization/Demobilization	- -	$50,000
In-Situ Stabilization	- -	50,000
Treatability Study	- -	25,000
Subtotals:	$1,257,000	$125,000
Engineering (20%)	251,000	25,000
Administration (10%)	126,000	12,000
Contingency (25%)	314,000	31,000
	$1,948,000	$193,000
Total Estimated Cost:	$2,021,000	$266,000

These cost estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, comptetitive bidding and market conditions.

stabilization and chemical fixation. These soils have been confirmed, based on the RI soil boring data, to exceed the soil ARARs for this site (i.e., exceeds the USEPA HEAST levels for metals, and NYSDEC recommended soil concentration of 10 mg/kg for total VOCs). The total estimated volume of soils from directly beneath the 11 drywells requiring remediation is on the order of 350 cubic yards (estimated based on an average 10 feet diameter drywell, and 8 foot soil column for in-situ remediation). The concrete blocks from the drywell structures will not be removed because removal of the rings will result in collapse of the drywell.

The effectiveness of the treatment process can be evaluated using the USEPA TCLP, Synthetic Leaching Procedure (SLP) or other extraction procedures. Leachability test data would be used as an indication of the leaching potential of the treated soils. Following in-situ stabilization, the ground surface would be paved to redirect rainwater infiltration away from the treated areas.

4.3.3.2 Assessment

- Short-Term Effectiveness - With the exception of the removal of a small amount of sludge (approximately 40 cubic yards), all other contaminated material would remain in the ground for treatment. Sludge removal would be conducted by pumping the sludge directly from drywells into a high vacuum tanker truck. Therefore, site workers would not need to come into contact with the contaminated materials. Furthermore, since soils would not be excavated and stockpiled on site, the community would not be subjected to potential exposure from airborne dusts or volatile organics resulting from soil excavation activities.

Volatile organics can be emitted during the in-situ soil mixing process, however, with the addition of wet slurry, the probability and amount of VOC emissions is greatly reduced. The levels of VOCs in the residual soils is not expected to generate significant VOC emissions, and therefore would not be of concern. Monitoring would be performed during the remediation process to measure VOC levels in the atmosphere. The potential for short term exposure to site workers, and to the community, attributable to the implementation of this remedial alternative is minimal.

- Long-Term Effectiveness - In-situ stabilization provides for long term solution to site contaminants. The sludges, which contain the higher concentrations of contaminants would be removed for off-site disposal at a RCRA TSD facility for treatment or disposal. Contaminated soils left in place would be chemically treated in place. With in-situ stabilization, the contaminated soils are transformed into a hard, solid mass, which can not be easily excavated or removed. The stabilization and fixation processes also produce a less soluble, less mobile, and less toxic contaminant compound. With use of chemical fixation to immobilize the contaminants in soils, no further maintenance of the soils would be required. Overtime, as the soil mixture continues to cure and crystallize, contaminant leachability should continue to decrease. This soil remedial action technology provides for overall protection to public health, and to the environment through aquifer protection.

- Reduction of Toxicity, Mobility, and Volume of Contaminants - This remedial approach provides for a permanent reduction in contaminant mobility, and some reduction in chemical toxicity, however, does not result in a volume reduction. The chemical fixation/stabilization process involves reactions between the contaminants in the soils with chemical reagents which are mixed into the soil column to form complexes which are less soluble, and some which are less toxic than in the untreated state. If hexavalent chromium is confirmed to be present in the soils, a two stage fixation process would be conducted; hexavalent chromium would first be reduced to the trivalent state, followed by chemical fixation. The reactions which occurred form permanent transitions, and therefore, this treatment process permanently reduces the solubility and toxicity of the contaminants.

- Implementability - This treatment technology is relatively new, however, has gained considerable favor over recent years as an alternative to soil excavation and off-site disposal. This technology is recognized by the USEPA under its Superfund Innovative Technology and Evaluation (SITE) program. Because this technology is still relatively new, and requires specialty equipment and chemical, there are a limited number of vendors, at present offering these services. The number of vendors are growing as this technology continues to develop, and becomes more widely used.

In-situ stabilization/chemical fixation can be implemented using an auger soil mixing system. The slurries and chemical reagents used would be injected and mixed with the contaminated soil using the auger blades. Chemical mixing and injection systems would be used to supply the chemical feed to the soils. In-situ soil mixing can be readily accomplished down to 18 feet below grade (the average depth of the groundwater table). If necessary, this treatment technology is capable of treating soils at much greater depths. The void space provided by the center of the drywells will facilitate soil mixing and allow for soil expansion. Treatability and pilot testing must be performed to identify the most effective chemical reagent mixtures for the contaminants at this site.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs) - This alternative complies with the soil ARARs identified for this site (NYS To be Considered Criteria). Remediation would be performed on soils with metals concentrations above USEPA health based soil cleanup criteria (HEAST soil cleanup guidance values), or soils with volatile organics above the NYSDEC recommended soil cleanup level of 10 mg/kg for total VOCs.

Subsurface soils which remain, and which are above the ARARs would be chemically fixated in place to reduce the likelihood of the soils to leach contaminants to the groundwater. Testing of the treated soils using analytical procedures such as the USEPA TCLP, or Synthetic Leachability Procedure would be conducted to assess the leachability of the soils following remediation. The chemically stabilized soils would be capable of achieving leachability concentrations less than the NYS groundwater quality standards.

- Overall Protection of Human Health and the Environment - This remedial action provides for protection to groundwater and the environment. By eliminating the source of any ongoing contaminant contribution to the groundwater, aquifer rehabilitation under natural processes can be achieved more effectively. With the removal of the sludges and chemical fixation of contaminated soils, the potential for future exposure to site workers, to the community, and to the groundwater aquifer is mitigated. This remedial alternative meets the remedial action objective for soils, and provides for overall protection to human health and to the environment.

- Cost - The present worth cost for in-situ stabilization is on the order of $266,000. Costs for in-situ stabilization/chemical fixation are summarized in Table 4-3.

5.0 Comparisons of Remedial Action Alternatives

The feasibility study for the CAE Link site has been performed in accordance with NYSDEC and USEPA Superfund guidances. This section presents a summary of the positive and negative aspects of each alternative, a comparison among alternatives, and recommendations for remedial action selection for each media evaluated. A summary of the remedial alternatives evaluation for groundwater and soil is presented in Table 5-1 and Table 5-2, respectively.

5.1 Recommendation for Groundwater Remedial Action

Remedial action alternatives for groundwater included no action, and a groundwater pump and treat alternative. Within the groundwater pump and treat scenario, several technically feasible treatment technologies and two disposal options were evaluated. A comparison of the groundwater remedial actions evaluated, and recommendations for selection is discussed below.

Active treatment of groundwater would be more effective in reducing the toxicity, and mobility of the contaminants in the groundwater media than the no action alternative. In evaluating the long term and short term effectiveness, and implementability of the VOC treatment technologies, all three treatment methods (air stripping, GAC and UV Oxidation) can readily achieve the desired wastewater effluent concentrations. UV Oxidation, which is considered an innovative technology, is capable of chemical destruction, whereas air stripping and GAC removes the VOC contaminants from the aqueous stream to another media. Other factors such as water chemistry (i.e., presence of dissolved iron, minerals, etc.) affects the performance and efficiency of the UV Oxidation treatment, and can provide limitations in terms of treatment capability or require increased maintenance. Use of air stripping for VOC removal is preferred over UV Oxidation or GAC when evaluating potential long and short-term effects. An air stripper does not utilize any chemical feeds (as does UV Oxidation), and does not generate a potentially hazardous waste requiring handling and disposal (as would use of GAC). An air discharge will be emitted from the air stripper. However, based on the calculated VOC loading to the atmosphere, the concentrations emitted would be relatively low and would not produce any adverse affects to the surrounding air quality. Therefore, although all three technologies are capable of achieving the desired effluent limits and same relative removal efficiencies, use of an air stripper is the preferred treatment method of the three analyzed because this technology poses the least risk to workers and the community relative to chemical safety concerns, requires least maintenance for long term operation, and is a reliable and proven VOC treatment technology.

Both the no action and the various groundwater pump and treat alternatives are consistent with the remedial action objective for this site since they all provide protection to human health and the environment. There are no significant differences to short term or long term effectiveness between these

Table 5-1
Evaluation of Groundwater Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative GW-1 - No Action With Monitoring	Alternative GW-2: Groundwater Pump and Treat		
		Option A - Metals Pretreatment and Air Stripping	Option B - Metals Pretreatment and GAC	Option C - Metals Pretreatment and UV Oxidation
Short Term Effectiveness				
Protection of Workers	Workers would be adequately protected during well sampling.	Construction activities would be disruptive to the community. Health risks to workers and residents are minimal.	Construction activities would be disruptive to the community. Health risks to workers and residents are minimal.	Construction activities would be disruptive to the community. Health risks to workers and residents are minimal.
Environmental Impact	Groundwater continues to discharge to Chenango River. Risk of exposure from ingestion of surface water is within EPA risk guidelines.	Would prevent further spreading of the contaminant plume; also capture plume from discharging to the Chenango River.	Prevents further spreading of the contaminant plume; also capture plume from discharging to the Chenango River.	Prevents further spreading of the contaminant plume; also capture plume from discharging to the Chenango River.
Long-Term Effectiveness				
Adequacy and Reliability of Controls	The magnitude of risk to the public from exposure of site contaminants is within EPA risk guidelines. This alternative is protective of human health and the environment; therefore meets the remedial action objective.	Provides for an added level of protection to public health over and above that which is already considered acceptable according the EPA risk guidelines.	Provides for an added level of protection to public health over and above that which is already considered acceptable according the EPA risk guidelines.	Provides for an added level of protection to public health over and above that which is already considered acceptable according the EPA risk guidelines.
Reduction of Toxicity, Mobility, and Volume				
Treatment Process Used and Materials Treated	Not Applicable	Metals removal using pH Adjustment/Chemical Precipitation, and VOCs removal using air stripping.	Metals removal using pH Adjustment/Chemical Precipitation, and VOCs removal using GAC.	Metals removal using pH Adjustment/Chemical Precipitation, and VOCs removal using UV Oxidation.
Amount of Hazardous Materials Destroyed or Treated	None	Groundwater extraction rate estimated at 30 gallons per minute (from 10 recovery wells).	Estimated groundwater pumping rate of 30 gpm.	Estimated groundwater pumping rate of 30 gpm.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None	Expect 90% to 95% for metals removal; greater than 99% removal for VOCs.	Expected 90% to 95% for metals removal; greater than 99% removal for VOCs.	Expected 90% to 95% for metals removal; greater than 99% removal for VOCs.

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Table 5-1 (Cont'd)
Evaluation of Groundwater Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative GW-1 - No Action With Monitoring	Alternative GW-2: Groundwater Pump and Treat Option A - Metals Pretreatment and Air Stripping	Option B - Metals Pretreatment and GAC	Option C - Metals Pretreatment and UV Oxidation
Degree of Irreversibility	Not Applicable	Contaminant removal process is irreversible.	Irreversible.	Irreversible.
Type and Quantity of Residuals Remaining	Not Applicable	Less than NYS groundwater quality standards, or surface water criteria for metals, and for VOCs.	Less than NYS groundwater quality standards, or surface water criteria for metals, and for VOCs.	Less than NYS groundwater quality standards, or surface water criteria for metals, and for VOCs.
Implementability Ability to Construct and Operate	Not Applicable	Readily installed, and low O&M required.	Readily installed. Requires periodic replacement of carbon bed.	Readily installed; high electrical demand; sensitive to water quality (iron, minerals, turbidity, etc.)
Ease of Site Preparation	Not Applicable	Readily installed.		
East of Undertaking Additional Remedial Actions	Not Applicable	Can add additional process units onto treatment train.	Can add additional process units onto treatment train.	Can add additional process units onto treatment train.
Ability to Monitor Effectiveness	Groundwater monitoring would be conducted to detect changes in groundwater quality; can be readily implemented.	Sampling of influent, effluent to monitor system performance.	Frequent sampling of wastewater effluent is needed to monitor for carbon breakthrough.	Sampling to determine System performance can be monitored using Programmable Logic Control.
Ability to Obtain Approval From Other Agencies	Not Applicable	Must obtain SPDES permit for discharge of treated water.	Must obtain SPDES permit.	Must obtain SPDES permit.
Availability of Materials	Not Applicable	Readily available.	Readily available.	UV Oxidation is an innovative technology; number of vendors may be limited.
Compliance with NYS Standards, Criteria, and Guidelines Chemical Specific ARARs	VOCs in on-site and off-site locations, and chromium in on-site locations will continue to exceed NYS Groundwater Quality Standards	Groundwater treatment would achieve ARARs (treated groundwater would meet NYS Groundwater Quality Standards, or Surface Water Criteria..	Groundwater treatment would achieve ARARS (treated groundwater would meet NYS Groundwater Quality Standards, or Surface Water Criteria..	Groundwater treatment would achieve ARARS (treated groundwater would meet NYS Groundwater Quality Standards, or Surface Water Criteria..
Action-Specific ARARs	Not Applicable	Would meet action-specific ARARs.	Would meet action-specific ARARs.	Would meet action-specific ARARs.

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Table 5-1 (Cont'd)
Evaluation of Groundwater Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative GW-1 - No Action With Monitoring	Alternative GW-2: Groundwater Pump and Treat Option A - Metals Pretreatment and Air Stripping	Option B - Metals Pretreatment and GAC	Option C - Metals Pretreatment and UV Oxidation
Location-Specific ARARs	Not Applicable	Not Applicable.	Not Applicable.	Not Applicable.
Compliance with other criteria, waivers laws, and guidance	Does not comply with ARARs, however, does meet remedial action objectives. The magnitude of risk, without any remedial action is within EPA guidelines; therefore, ARARs for groundwater should be waived.	Would meet NYS SCGs/ARARs; complies with NYS and EPA Superfund guidance.	Meets NYS and EPA Superfund guidance.	Meets NYS and EPA Superfund guidance.
Overall Protection of Human Health and the Environment				
Protectiveness	There are no known receptors for the groundwater exposure pathway; exposure via surface water ingestion is within EPA risk guidelines. This alternative is protective of human health and the environment.	Protective of human health since this remedial alternative provides for an added level of risk protection beyond a level already considered by the EPA as protective. Prevents further discharge of contaminates to the Chenango River.	Protective of human health since this remedial alternative provides for an added level of risk protection beyond a level already considered by the EPA as protective. Prevents further discharge of contaminates to the Chenango River.	Protective of human health since this remedial alternative provides for an added level of risk protection beyond a level already considered by the EPA as protective. Prevents further discharge of contaminates to the Chenango River.
Cost				
Capital Cost	$0	$887,000	$1,328,000	$1,357,000
Annual O&M Costs (30 years)	$290,000	$4,881,000	$6,084,000	$5,649,000
Present Worth	$290,000	$5,768,000	$7,412,000	$7,006,000

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Table 5-2
Evaluation of Soil Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative S-1: No Action	Alternative S-2: Excavation and Off-site Disposal	Alternative S-4: In-Situ Stabilization/Chemical Fixation
Short Term Effectiveness			
Protection of Workers and the Community	Workers would be protected during sampling.	Administrative and engineering controls would be taken to minimize the potential for release of airborne dusts and particles. Air monitoring would be conducted. Personnel protective equipment will be worn to protect site workers.	Administrative and engineering controls would be taken during drilling and soil mixing activities. Air monitoring would be conducted. Personnel protective equipment by site workers.
Environmental Impact	Not Applicable.	Removal of sludges and contaminants would eliminate future leaching of contaminants to the groundwater.	Sludges would be removed. Chemical fixation of the soils beneath the drywells would minimize contaminant leaching to the groundwater.
Long-Term Effectiveness			
Adequacy and Reliability of Controls	There is no risk to public health from ingestion/contact with the contaminated soil since the site is secured, and the waste is buried. If the waste becomes exposed, potential would exist for health risk to facility employees or to the public.	Removal of sludge and soil is effective in eliminating potential future risk to the public, and potential leaching of contaminants to the groundwater. No long term maintenance or site management is required for this alternative.	Chemical fixation minimizes the potential for any on-going contaminant leaching to the groundwater. Soil leachability will continue to decrease over time following treatment. Long term site management is not required.
Reduction of Toxicity, Mobility, and Volume			
Treatment Process Used and Materials Treated	Not Applicable.	Not Applicable.	In-Situ stabilization/chemical fixation of soils under the drywells.
Amount of Hazardous Materials Destroyed or Treated	None	None (with the exception of off-site stabilization/treatment at TSD facility prior to land disposal).	Approximately 350 cubic yards of soils under the drywells will be chemically fixated in place.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None	None (only off-site treatment prior to disposal).	Reduction of contaminant solubility, mobility, and leachability. Hexavalent chromium, if present will be converted to the trivalent state, then treated.

H2M GROUP

Table 5-2 (Cont'd)
Evaluation of Soil Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative S-1: No Action	Alternative S-2: Excavation and Off-site Disposal	Alternative S-4: In-Situ Stabilization/Chemical Fixation
Degree of Irreversibility	Not Applicable	Not Applicable.	Irreversible.
Type and Quantity of Residuals Remaining	Not Applicable	Contaminated sludges and soils would be removed for off-site disposal at a RCRA permitted facility.	An estimated 350 cubic yards of soil under the drywells would be chemically treated in place. Soil would contain contaminants (metals), however, contaminants would not leach to the groundwater.
Implementability			
Ability to Construct and Operate	Not Applicable.	Sheeting and Shoring would be required to control the size of the excavation, and to protect the structural stability of nearby buildings.	Will require specialty equipment (augers and chemical injection system).
Ease of Site Preparation	Not Applicable.	Readily implemented.	Site would be paved following chemical fixation.
Ease of Undertaking Additional Remedial Actions	Not Applicable.	Can increase the area of excavation, however, would not be able to excavate beneath existing building.	Can increase the soil volume or depth for in-situ treatment.
Ability to Monitor Effectiveness	Groundwater monitoring would be conducted to detect changes in groundwater quality; can be readily implemented.	Post excavation sampling would be conducted.	Analytical testing using USEPA TCLP, Synthetic Leaching Procedure or equivalent test methods to assess leachability of the treated soils.
Ability to Obtain Approval From Other Agencies	Not Applicable.	Not Applicable.	Not Applicable.
Availability of Materials	Not Applicable.	Not Applicable.	Since this is considered an innovative technology, the number of vendors available may be limited.
Compliance with NYS Standards, Criteria, and Guidelines			
Chemical Specific ARARs	Not Applicable.	Not Applicable.	Not Applicable.
Action-Specific ARARs	Not Applicable.	Not Applicable.	Not Applicable.
Location-Specific ARARs	Not Applicable.	Not Applicable.	Not Applicable.

Table 5-2 (Cont'd)
Evaluation of Soil Remedial Action Alternatives
Feasibility Study
CAE Link Facility
Binghamton, New York

Criteria	Alternative S-1: No Action	Alternative S-2: Excavation and Off-site Disposal	Alternative S-4: In-Situ Stabilization/Chemical Fixation
Compliance with other criteria, waivers laws, and guidance	Does not meet NYS SCGs (USEPA HEAST concentrations for metals, and NYSDEC recommended soil cleanup objective of 10 mg/kg for total VOCs).	Would meet NYS SCGs (USEPA HEAST concentrations for metals, and NYSDEC recommended soil cleanup objective of 10 mg/kg for total VOCs).	Would meet NYS SCGs; leachability of fixated soils would be within NYS groundwater discharge limits.
Overall Protection of Human Health and the Environment			
Protectiveness	Contaminants, if exposed and becomes accessible, could pose a health threat to the public (via ingestion). Contaminants would continue to leach to the groundwater.	Eliminates the source of any ongoing contamination entering the groundwater; allows for natural aquifer rehabilitation. Also eliminates potential for future exposure to workers and the community if the contaminated material became exposed and accessible.	Eliminates the source of any on-going contaminant leaching to the groundwater. Aquifer rehabilitation can occur. Protective of human health and the environment.
Cost			
Capital Cost	$0	$2,021,000	$266,000
Annual O&M Costs (30 years)	$290,000	$0	$0
Present Worth	$290,000	$2,021,000	$266,000

remedial alternatives because the initial risk to the public, even without any groundwater remedial actions, is already minimal. It was determined from the RI that the groundwater plume is discharging to the Chenango River. There are no human receptors for this groundwater contamination as all homes in the affected area of the groundwater plume are connected to a public water supply. The baseline risk assessment, which was performed using conservative assumptions on pre-remedial conditions, estimated that the magnitude of cumulative risk to the public from ingestion of impacted surface waters from the Chenango River is within the $1x10^{-6}$ excess lifetime cancer risk. A one in a million ($1x10^{-6}$) excess lifetime risk level is the benchmark used by regulatory agencies, including the USEPA, in evaluating acceptable contaminant exposure risks. Therefore, even without any remedial actions taken (i.e., no action), it has already been demonstrated through the baseline risk assessment that the site exposure risk to the public is below levels which warrant concern. With implementation of a groundwater remediation program, the risk level will only be reduced beyond what is already considered to be an acceptable risk level by the USEPA.

The treatment technologies evaluated under the pump and treat remedial alternative are capable of reducing metals and VOC concentrations to meet groundwater quality or surface water discharge standards. Groundwater remediation for the purpose of aquifer rehabilitation is consistent with federal and NYS groundwater protection strategies. Therefore, active groundwater remediation would achieve NYS ARARs for groundwater. Under the no action alternative, the concentrations of VOCs (trichloroethylene, 1,1,1-trichloroethane) and of chromium (in some of the on-site wells) will continue to exceed the New York State Groundwater Quality Standard for Class GA Groundwaters. With remedial measures taken at the source area and no additional contaminant entering the groundwater, the contaminant plume will naturally degrade and/or disperse to within acceptable levels. The no action alternative would not meet groundwater quality ARARs in the immediate future.

The no action alternative can be justified even if the groundwater ARARs are not being met at this time because this remedy is sufficiently protective of public health.. With the exception of possible ingestion of surface water from the Chenango River during recreational activities, there are no groundwater exposure pathways. As such, there are no increased risk to the public associated with the contaminated groundwater from the site. The magnitude of risk to the public for contaminant exposure (via surface water ingestion) is less than the EPA risk guidance of $1x10^{-6}$, considered by regulatory agencies as being protective of human health. The no action alternative will attain an equivalent standard (i.e, acceptable degree of protection to human health), as would be achieved using alternate remedial methods (i.e., groundwater pump and treat alternatives). The no action alternative is consistent with the remedial action objective for this site.

The present worth capital and O&M cost to implement active groundwater treatment using various groundwater pump and treat alternatives will range between $5.8 M (using the air stripper), to $7.0 M (using GAC). The no action alternative, which does not include an active treatment process, only groundwater monitoring over a 30 year period, is estimated at $290,000.

In evaluating cost benefits between the no action alternative ($290,000) and the active groundwater remediation alternatives ($5.8 M to $7.0 M), there is an added cost of $5.5 M to $6.7 M associated with the implementation of a groundwater pump and treat alternative. This cost of $5.5 M to $6.7 M would only provide an incremental higher level of protection to the public, beyond a risk level which is already considered sufficiently protective of human health by the USEPA. Based on the cost for groundwater treatment, and taking into consideration that the no action remedial alternative is sufficiently protective of human health and the environment and therefore meets the remedial action objective for this site, no action is recommended for the groundwater media.

5.2 Recommended Soil Remedial Alternative

The detailed evaluation of remedial alternatives for the soil media included no action, excavation and off-site disposal, and in-situ stabilization/chemical fixation. Remedial alternatives for excavation and disposal, and for in-situ stabilization are source control measures intended to minimize or eliminate further impact to groundwater.

The no action alternative would not address continued leaching of contaminants from the source area (the Outfall 004 leaching pools), or removal of sludges from the bottom of the drywells. There would be no reduction in contaminant mobility, toxicity or volume under this remedial alternative. Contaminants in the sludges and contaminated subsurface soils would continue to leach from the source areas to the groundwater. As a result, this alternative would impede cleanup of the groundwater plume. Because the sludges contain elevated levels of metals, the sludges may be a RCRA hazardous waste. The concentrations of metals in the sludges, and in some of the subsurface soils in the drywells exist at levels above the USEPA health based soil cleanup objectives (USEPA HEAST soil levels). The concentrations of volatile organics exceed the NYSDEC recommended soil cleanup levels (NYSDEC TAGM No. HWR-92-4046). The no action remedial alternative does not comply with ARARs, or provide a sufficient level of protection to human health. However, recent history has shown that natural remediation is taking place and can be expected to continue over time.

Remedial alternatives utilizing soil excavation, and in-situ stabilization both provide long term solutions for source area control. Under both remedies, the sludges (an estimated 40 cubic yards), would be pumped out and disposed of off-site at a RCRA TSD facility. The remaining soils which are above soil ARARs would be either excavated for off-site disposal, or stabilized/chemically fixated in place, depending upon the remedial alternative selected.

The excavation and off-site disposal option would encompass removal of approximately 1,400 cubic yards or 1,800 tons) of contaminated subsurface soils for off-site disposal at a TSD facility. Since all soil to be removed is located above the groundwater table, excavation can be performed to some degree. The proximity of the building precludes total removal. However, because the unsaturated soils at the site are comprised of loose sandy soils, sidewall collapse can be expected during excavation of the drywells. Sheeting and shoring would be necessary to control the size of the excavation, and to provide structural stability to adjacent buildings or other structures in the immediate vicinity of the open excavations. Use of sheeting and shoring would extend the field time required for excavation activities, and significantly increase the overall cost of the remedial project. Off-site disposal would not reduce the volume or toxicity of the contaminants, however, may reduce the overall mobility of the waste if stabilization/treatment is performed at the TSD facility prior to disposal. Landfilling off-site only provides for the relocation of contaminated materials from the CAE Link site to controlled site. By eliminating the source of any ongoing contamination entering the groundwater, aquifer rehabilitation under natural processes can be achieved more efficiently. This remedial alternative provides for long term protection to the public and to the environment through aquifer protection. Removal of sludges and contaminated soils is a permanent remedy for the CAE Link facility. No further maintenance for the soils would be required. This remedy complies with the soil ARARs identified for this site, and is protective of groundwater and the environment.

In-situ stabilization/chemical fixation also provides for a long term, permanent solution to source area control. Contaminated soils under the drywells would be chemically treated (stabilized and fixated) in place. The stabilization/fixation process transforms the soil into a hard, solid mass and produces contaminants which are less soluble, mobile, and toxic. By minimizing future impacts to groundwater contamination, aquifer rehabilitation under natural processes can be achieved more effectively. This remedial alternative meets the NYS ARARs and the remedial action objective for soils, and provides overall protection to human health and the environment. According to NYSDEC Superfund Guidance and the NCP, for remedial action selection, preference should be given to remedies which are registered under the EPA Superfund Innovative Technology and Evaluation (SITE) program. In-situ stabilization/chemical fixation is a relatively new technology, and is considered an innovative technology recognized by the USEPA under its SITES program. Special in place mixing equipment and chemical feeds are required, therefore, the present number of vendors capable of providing these services may be limited. The number of vendors are growing as this technology continues to develop, and is implemented at more sites. This technology has gained considerable favor over recent years as an alternative to soil excavation and off-site disposal.

Therefore, based on CAE Link's proactive approach regarding soil remediation technologies, and since the in-situ stabilization/chemical fixation meets all the criteria under the NYS Superfund guidance, the sludge removal and in-situ treatment remedial action alternative is recommended for the soil media associated with the source area. In summary, the remedial action for the soil media will encompass:

- Removal of sludges from the drywells.
- Fixation of soils under the drywells.

APPENDIX A

NYSDEC REMEDIAL ALTERNATIVE EVALUATION SCORING SHEETS

Alternative GW-1: Groundwater - No Action With Monitoring

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 29
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes		0
		No	X	(4)
	° Can the short-term risk be easily controlled?	Yes		1
		No		0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes		0
		No		2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes		0
		No	X	(4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes		3
		No		0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)
		> 2yr.		0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	X	(1)
		> 2yr.		0
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment*			3
	° Off-site treatment*			1
	° On-site or off-site land disposal			0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes		3
		No	X	(0)
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None		3
		≤ 25%		2
		25-50%		1
		≥ 50%	X	(0)
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes		0
		No	X	(2)
	iii) Is the treated residual toxic?	Yes		0
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No		1
Subtotal (maximum = 5)				
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	X	(1)
		> 5yr.		0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	X	(1)
		Somewhat to not confident		0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum		2
		Moderate		1
		Extensive	X	(0)
Subtotal (maximum = 4)				
TOTAL (maximum = 25)				

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		X	(3)
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		X	(2)
	ii) Somewhat likely		___	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)
	ii) Required coordination is normal.		___	1
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes No	___ ___	1 0 NA
	ii) Will more than one vendor be available to provide a competitive bid?	Yes No	___ ___	1 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes No	____ ____	1 0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 30
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	X	(0) 4
	° Can the short-term risk be easily controlled?	Yes No	X	(1) 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	X	(0) 2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	 X	0 (4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No		3 0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 X	1 (0)
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 X	1 (0)
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal			(3) 1 0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	X	(3) 0
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None		3
		≤ 25%	X	(2)
		25-50%		1
		≥ 50%		0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 8.)**	Yes		0
		No	X	(2)
	iii) **Is the treated residual toxic?**	Yes		0
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No		1
Subtotal (maximum = 5)				
8. Adequacy and reliabilit... of c...	**... and maintenance required ...iod of:**	**< 5yr.**		**1**
		> 5yr.	X	(0)
	...nmental controls required **of the remedy to handle problems? (If answer is "iv")**	Yes	X	(0)
		No		1
	...confidence that controls ...ely handle potential	**Moderate to very confident**	X	(1)
		Somewhat to not confident		0
	...gree of long-term ...equired **(compare with ...ial alternatives)**	**Minimum**		2
		Moderate		1
		Extensive	X	(0)
Subtota...				
TOTAL (n...				

Alternative GW-2: Groundwater Extraction, Treatment and Discharge

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	X	(2)
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	___	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	X	(1)
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	X	(2)
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)			
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	___	1
	iii) Extensive coordination is required.	X	(0)
Subtotal (maximum = 2)			
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes X No ___	(1) 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes X No ___	(1) 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Alternative S-1: Soil - No Action

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 24
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes		0
		No	X	(4)
	° Can the short-term risk be easily controlled?	Yes		1
		No		0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes		0
		No		2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes		0
		No	X	(4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes		3
		No		0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)
		> 2yr.		0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	X	(1)
		> 2yr.		0
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment*		NA	3
	° Off-site treatment*			1
	° On-site or off-site land disposal			0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/treatment or solidification/chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes		3
		No	X	(0)
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None		3
		≤ 25%		2
		25-50%		1
		≥ 50%	X	(0)
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes		0
		No	X	(2)
	iii) Is the treated residual toxic?	Yes		0
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No		1
Subtotal (maximum = 5)				
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	X	(1)
		> 5yr.		0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident		1
		Somewhat to not confident	X	(0)
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum		2
		Moderate		1
		Extensive	X	(0)
Subtotal (maximum = 4)				
TOTAL (maximum = 25)				

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		X	(3)
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		___	3 NA
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		X	(2)
	ii) Somewhat likely		___	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		___	2
	ii) Some future remedial actions may be necessary.		X	(1)
Subtotal (maximum = 10)				
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)
	ii) Required coordination is normal.		___	1
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes No	___ ___	1 0 NA
	ii) Will more than one vendor be available to provide a competitive bid?	Yes No	___ ___	1 0 NA

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	___	1 N/A
		No	___	0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Alternative S-2: Soil Excavation and Off-Site Disposal

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 30
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	X ___	(0) 4
	° Can the short-term risk be easily controlled?	Yes No	X ___	(1) 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	___ X	0 (2)
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ X	0 (4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	X ___	(1) 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	X ___	(1) 0
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal			3 1 (0)
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	___ X	3 (0)
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None		3
		≤ 25%	X	(2)
		25-50%		1
		≥ 50%		0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes		0
		No	X	(2)
	iii) Is the treated residual toxic?	Yes		0
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No		1
Subtotal (maximum = 5)				
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	X	(1)
		> 5yr.		0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	X	(1)
		Somewhat to not confident		0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum	X	(2)
		Moderate		1
		Extensive		0
Subtotal (maximum = 4)				
TOTAL (maximum = 25)				

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		X	(1)
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		X	(2)
c. Schedule of delays due to technical problems.	i) Unlikely		___	2
	ii) Somewhat likely		X	(1)
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		___	2
	ii) Required coordination is normal.		X	(1)
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No	___	0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Alternative S-3: Soil Excavation and On-Site Treatment

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 29
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	X ___	(0) 4
	° Can the short-term risk be easily controlled?	Yes No	X ___	(1) 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	___ X	0 (2)
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ X	0 (4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	___ X	1 (0)
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ X	1 (0)
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal			(3) 1 0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	X ___	(3) 0
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None		3
		≤ 25%	X	(2)
		25-50%		1
		≥ 50%		0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 8.)**	Yes		0
		No	X	(2)
	iii) Is the treated residual toxic?	Yes		0
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No		1
Subtotal (maximum = 5)				
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.		1
		> 5yr.	X	(0)
	ii) Are environmental controls required as a part of the remedy to handle potential problems? **(If answer is no, go to "iv")**	Yes	X	(0)
		No	X	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident		1
		Somewhat to not confident	X	(0)
	iv) Relative degree of long-term monitoring required **(compare with other remedial alternatives)**	Minimum		2
		Moderate		1
		Extensive	X	(0)
Subtotal (maximum = 4)				
TOTAL (maximum = 25)				

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		X	(1)
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		X	(2)
c. Schedule of delays due to technical problems.	i) Unlikely		___	2
	ii) Somewhat likely		X	(1)
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		___	2
	ii) Required coordination is normal.		X	(1)
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No	___	0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes		1
		No	X	(0)

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score 40
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes	X	(0)
		No		4
	° Can the short-term risk be easily controlled?	Yes	X	(1)
		No		0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes		0
		No	X	(2)
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes		0
		No	X	(4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes		3
		No		0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)
		> 2yr.		0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	X	(1)
		> 2yr.		0
Subtotal (maximum = 2)				
4. On-site or off-site treatment or land disposal	° On-site treatment*			(3)
	° Off-site treatment*			1
	° On-site or off-site land disposal			0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes	X	(3)
		No		0
Subtotal (maximum = 3)				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.	X	(3)
		20-25yr.		2
		15-20yr.		1
		< 15yr.		0
Subtotal (maximum = 3)				
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None	X	(3)
		< 25%		2
		25-50%		1
		≥ 50%		0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes	X	(0)
		No		2
	iii) Is the treated residual toxic?	Yes	X	(0)
		No		1
	iv) Is the treated residual mobile?	Yes		0
		No	X	(1)
Subtotal (maximum = 5)				
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	X	(1)
		> 5yr.		0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	X	(1)
		Somewhat to not confident		0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum	X	(2)
		Moderate		1
		Extensive		0
Subtotal (maximum = 4)				
TOTAL (maximum = 25)				

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		X	(2)
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		X	(2)
	ii) Somewhat likely		___	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)
	ii) Required coordination is normal.		___	1
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No	___	0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Alternative GW-1: Groundwater - No Action With Monitoring

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND
APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score 53
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	 X	4 (0)
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	 X	3 (0)
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	 X	3 (0)

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes		20
		No	X	(0)
TOTAL (Maximum = 20)				
. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes	X	(3)
		No		0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	X	(4)
		No		0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes	X	(3)
		No		0
Subtotal (maximum = 10)				
. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	X	(5)
	ii) Health risk	≤ 1 in 100,000		2
Subtotal (maximum = 5)				
. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		X	(5)
	ii) Slightly greater than acceptable			3
	iii) Significant risk still exists			0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes		0
		No	X	(4)
	° Can the risk be easily controlled?	Yes		1
		No		0
	° Does the mitigative effort to control risk impact the community life-style?	Yes		0
		No		2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes		0
		No	X	(4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes		3
		No		0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)
		> 2yr.		0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	X	(1)
		> 2yr.		0
Subtotal (maximum = 2)				
TOTAL (maximum = 10)				

Table 3.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)			NA
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___	3
		No X	(0)
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. X	(3)
		20-25yr.___	2
		15-20yr.___	1
		< 15yr.___	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% ___	2
		25-50% ___	1
		≥ 50% X	(0)
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No X	(2)
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	X	(1)
		> 5yr.		0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	X	(1)
		Somewhat to not confident		0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum		2
		Moderate		1
		Extensive	X	(0)

Subtotal (maximum = 4)

TOTAL (maximum = 15)

Table 3.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score	
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8	
		90-99%	___	7	
		80-90%	___	6	
		60-80%	___	4	
		40-60%	___	2	NA
		20-40%	___	1	
		< 20%	___	0	
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	___	0	
		No	X	(2)	
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0	
		On-site land disposal	___	1	
		Off-site destruction or treatment	___	2	
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/Treatment	90-100%	___	2	
		60-90%	___	1	NA
		< 60%	___	0	
	ii) Method of Immobilization				
	- Reduced mobility by containment		___	0	
	- Reduced mobility by alternative treatment technologies		___	3	
Subtotal (maximum = 5)					
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		___	5	
	Irreversible for most of the hazardous waste constituents.		___	3	NA
	Irreversible for only some of the hazardous waste constituents		___	2	
	Reversible for most of the hazardous waste constituents.		___	0	
Subtotal (maximum = 5)					
TOTAL (maximum = 15)					

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		X	(3)
	ii) Somewhat difficult to construct. No uncertainties in construction.			2
	iii) Very difficult to construct and/or significant uncertainties in construction.			1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.			2
c. Schedule of delays due to technical problems.	i) Unlikely		X	(2)
	ii) Somewhat likely			1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.			1
Subtotal (maximum = 10)				
. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)
	ii) Required coordination is normal.			1
	iii) Extensive coordination is required.			0
Subtotal (maximum = 2)				
Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No		0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No		0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

Alternative GW-2: Groundwater Extraction, Treatment and Disposal

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND
APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score 63
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	X ___	(4) 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	___ ___	3 0 NA
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	___ ___	3 0 NA

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes	X	(20)
		No	___	0
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes	___	3
		No	___	0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	___	4
		No	___	0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes	___	3
		No	___	0
Subtotal (maximum = 10)				
. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	___	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5)				
. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes	X	(0)
		No		4
	° Can the risk be easily controlled?	Yes	X	(1)
		No		0
	° Does the mitigative effort to control risk impact the community life-style?	Yes	X	(0)
		No		2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes		0
		No	X	(4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes		3
		No		0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.		1
		> 2yr.	X	(0)
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.		1
		> 2yr.	X	(0)
Subtotal (maximum = 2)				
TOTAL (maximum = 10)				

Table 5.3

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		(3)
	° Off-site treatment*		1
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes X	(3)
		No ___	0
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. X	(3)
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% X	(2)
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No X	(2)
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.		1
		> 5yr.	X	(0)
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No		1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident		1
		Somewhat to not confident		0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum		2
		Moderate		1
		Extensive	X	(0)
Subtotal (maximum = 4)				
TOTAL (maximum = 15)				

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%		8
		90-99%		7
		80-90%		6
		60-80%	X	(4)
		40-60%		2
		20-40%		1
		< 20%		0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes		0
		No	X	(2)
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal		0
		On-site land disposal		1
		Off-site destruction or treatment		2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) <u>Quality of Available Wastes Immobilized After Destruction/ Treatment</u>	90-100%		2
		60-90%		1
		< 60%		0
	ii) <u>Method of Immobilization</u>			
	- Reduced mobility by containment			0
	- Reduced mobility by alternative treatment technologies			3
Subtotal (maximum = 5)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		X	(5)
	Irreversible for most of the hazardous waste constituents.			3
	Irreversible for only some of the hazardous waste constituents			2
	Reversible for most of the hazardous waste constituents.			0
Subtotal (maximum = 5)				
TOTAL (maximum = 15)				

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		X	(1)
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		___	2
	ii) Somewhat likely		X	(1)
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		___	2
	ii) Required coordination is normal.		___	1
	iii) Extensive coordination is required.		X	(0)
Subtotal (maximum = 2)				
Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No	___	0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

Alternative S-1: Soil - No Action

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score 23	
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	___ X	4 (0)	
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	___ ___	3 0	NA
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	___ ___	3 0	NA

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes		20
		No	X	(0)
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes	X	(3)
		No		0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	X	(4)
		No		0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes		3
		No	X	(0)
Subtotal (maximum = 10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000		5
	ii) Health risk	≤ 1 in 100,000	X	(2)
Subtotal (maximum = 5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		X	(5)
	ii) Slightly greater than acceptable			3
	iii) Significant risk still exists			0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score	
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes	___	0	NA
		No	___	4	
	° Can the risk be easily controlled?	Yes	___	1	
		No	___	0	
	° Does the mitigative effort to control risk impact the community life-style?	Yes	___	0	
		No	___	2	
Subtotal (maximum = 4)					
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes	___	0	
		No	X	(4)	
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes	___	3	
		No	___	0	
Subtotal (maximum = 4)					
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)	
		> 2yr.	___	0	
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	___	1	
		> 2yr.	___	0	NA
Subtotal (maximum = 2)					
TOTAL (maximum = 10)					

Table 3.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1 NA
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___	3
		No _X_	(0)
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___	3
		20-25yr. ___	2 NA
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% ___	2
		25-50% ___	1
		≥ 50% _X_	(0)
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No ___	2 NA
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	___	1
		> 5yr.	___	0 NA
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	X	(0)
		No	___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	___	1
		Somewhat to not confident	X	(0)
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum	___	2
		Moderate	___	1
		Extensive	X	(0)
Subtotal (maximum = 4)				
TOTAL (maximum = 15)				

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%		8
		90-99%		7
		80-90%		6
		60-80%		4
		40-60%		2
		20-40%		1
		< 20%	X	(0)
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	X	(0)
		No		2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal		0
		On-site land disposal	X	(1)
		Off-site destruction or treatment		2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/Treatment	90-100%		2
		60-90%		1
		< 60%		0 NA
	ii) Method of Immobilization			
	- Reduced mobility by containment			0
	- Reduced mobility by alternative treatment technologies			3
Subtotal (maximum = 5)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible			5
	Irreversible for most of the hazardous waste constituents.			3 NA
	Irreversible for only some of the hazardous waste constituents			2
	Reversible for most of the hazardous waste constituents.			0
Subtotal (maximum = 5)				
TOTAL (maximum = 15)				

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score	
1. Technical Feasibility					
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3	NA
	ii) Somewhat difficult to construct. No uncertainties in construction.		___	2	
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1	
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		___	3	NA
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2	
c. Schedule of delays due to technical problems.	i) Unlikely		___	2	
	ii) Somewhat likely		___	1	NA
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		___	2	
	ii) Some future remedial actions may be necessary.		X	(1)	
Subtotal (maximum = 10)					
. Administrative Feasibility					
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)	
	ii) Required coordination is normal.		___	1	
	iii) Extensive coordination is required.		___	0	
Subtotal (maximum = 2)					
Availability of Services and Materials					
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	___	1	NA
		No	___	0	
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	___	1	
		No	___	0	

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	____	1 NA
		No	____	0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

Alternative S-2: Soil Excavation and Off-Site Disposal

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND
APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score 54
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	X ___	(4) 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	___ ___	3 0 NA
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	___ ___	3 0 NA

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes	X	(20)
		No		0
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes		3
		No		0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes		4
		No		0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes		3
		No		0
Subtotal (maximum = 10)				
. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000		5
	ii) Health risk	≤ 1 in 100,000		2
Subtotal (maximum = 5)				
. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable			5
	ii) Slightly greater than acceptable			3
	iii) Significant risk still exists			0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes	X	0
		No	___	1
	° Can the risk be easily controlled?	Yes	X	(1)
		No	___	0
	° Does the mitigative effort to control risk impact the community life-style?	Yes	___	0
		No	X	(2)
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes	___	0
		No	X	(1)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes	___	3
		No	___	0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr.	X	(1)
		> 2yr.	___	0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr.	X	(1)
		> 2yr.	___	0
Subtotal (maximum = 2)				
TOTAL (maximum = 10)				

Table 3.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		(0)
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___	3
		No X	(0)
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. X	(3)
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% X	(2)
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No X	(2)
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5)			

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. X	(1)
		> 5yr. ____	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes X	(0)
		No ____	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident X	(1)
		Somewhat to not confident ____	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum X	(2)
		Moderate ____	1
		Extensive ____	0
Subtotal (maximum = 4)			
TOTAL (maximum = 15)			

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	___	4
		40-60%	___	2
		20-40%	___	1
		< 20%	X	(0)
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	X	(0)
		No	___	2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	X	(0)
		On-site land disposal	___	1
		Off-site destruction or treatment	___	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	___	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		___	0
	- Reduced mobility by alternative treatment technologies		___	3
Subtotal (maximum = 5)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		___	5
	Irreversible for most of the hazardous waste constituents.		___	3
	Irreversible for only some of the hazardous waste constituents		___	2
	Reversible for most of the hazardous waste constituents.		___	0
Subtotal (maximum = 5)				
TOTAL (maximum = 15)				

NA

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	X	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	X	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	X	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	X	2
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)			
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	X	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)			
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes X	1
		No ___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes X	1
		No ___	0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

Alternative S-4: In-Situ Soil Stabilization/Chemical Fixation

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score 7
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	X ___	(4) 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	___ ___	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	___ ___	3 0

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

ıalysis Factor	Basis for Evaluation During Detailed Analysis			Score
. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes		20
		No	X	(0)
TOTAL (Maximum = 20)				
. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes	X	(3)
		No		0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	X	(4)
		No		0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes	X	(3)
		No		0
Subtotal (maximum = 10)				
ɔ. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	X	(5)
	ii) Health risk	≤ 1 in 100,000		2
Subtotal (maximum = 5)				
. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		X	(5)
	ii) Slightly greater than acceptable			3
	iii) Significant risk still exists			0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ X	0 (4)
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ X	0 (4)
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	$\leq$ 2yr. $\geq$ 2yr.	X ___	(1) 0
	° Required duration of the mitigative effort to control short-term risk.	$\leq$ 2yr. > 2yr.	X ___	(1) 0
Subtotal (maximum = 2)				
TOTAL (maximum = 10)				

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		(3)
	° Off-site treatment*		1
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/treatment or solidification/chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes X	(3)
		No ___	0
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. X	(3)
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% X	(2)
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes X	(0)
		No ___	2
	iii) Is the treated residual toxic?	Yes X	(0)
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No X	(1)
Subtotal (maximum = 5)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. X	(1)
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes X	(0)
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident X	(1)
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum X	(2)
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4)			
TOTAL (maximum = 15)			

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Mark	Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%		8
		90-99%		7
		80-90%		6
		60-80%		4
		40-60%		2
		20-40%		1
		< 20%	X	(0)
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes		0
		No	X	(2)
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal		0
		On-site land disposal		1
		Off-site destruction or treatment	X	(2)
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) <u>Quality of Available Wastes Immobilized After Destruction/ Treatment</u>	90-100%	X	(2)
		60-90%		1
		< 60%		0
	ii) <u>Method of Immobilization</u>			
	- Reduced mobility by containment			0
	- Reduced mobility by alternative treatment technologies		X	(3)
Subtotal (maximum = 5)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		X	(5)
	Irreversible for most of the hazardous waste constituents.			3
	Irreversible for only some of the hazardous waste constituents			2
	Reversible for most of the hazardous waste constituents.			0
Subtotal (maximum = 5)				
TOTAL (maximum = 15)				

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

nalysis Factor	Basis for Evaluation During Detailed Analysis			Score
.. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		X	(2)
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		X	(3)
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		___	2
	ii) Somewhat likely		X	(1)
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		X	(2)
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)				
. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		X	(2)
	ii) Required coordination is normal.		___	1
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)				
Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	X	(1)
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	X	(1)
		No	___	0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	Yes	X	(1)
		No		0

Subtotal (maximum = 3)

TOTAL (maximum = 15)