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New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

BECKER ELECTRONICS SITE
TOWN OF DURHAM
GREENE COUNTY , NEW YORK
SITE I.D. NO. 4-20-007

PHASE I & II FEASIBILITY STUDY REPORT

JULY 1992

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SECTION 1

1.0 INTRODUCTION

As part of the State of New York's program to remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) entered into contract with the firm of Metcalf & Eddy of New York, Inc. (M&E) of Tarrytown, New York to undertake a Remedial Investigation and Feasibility Study (RI/FS) for the Becker Electronics site located in Greene County, New York. The registry number for this New York Class 2 Superfund Site is 420007. The RI/FS for this site is being performed with funds allocated under the New York State Superfund Program.

The Becker Electronics site is located in the Hamlet of East Durham, south of State Route 145, lot 1, Blocks 25 and 26, within the Town of Durham. The site is owned by Becker Electronics Manufacturing, Inc. and is currently an inactive facility. The Becker Electronics site is a former manufacturer of high fidelity speakers and speaker components. As part of the plant operations, 1,1,1-trichloroethane was used to remove oil from speaker magnet plates and to degrease mechanical machinery.

The facility operated this process until March 1982. Becker Electronics entered into a consent order with the NYSDEC in June 1986 that required Becker Electronics to monitor private wells affected by the contamination released from the site and install and maintain carbon filtration systems on those wells in which the water quality was determined to be unacceptable. Becker Electronics closed the plant in 1988 and declared bankruptcy. Since that time, Becker Electronics has sporadically maintained the carbon filters and collected groundwater samples from some of the impacted private wells.

The purposes of the overall RI/FS process are to perform a Remedial Investigation (RI) to determine the nature, extent, and sources of contamination at the site, risks to public health and the environment, and to perform a Feasibility Study (FS) to identify, screen and evaluate alternatives for remediating the site.

Phase I of an FS typically identifies and screens technologies for each medium of concern at the site and presents preliminary remedial alternatives. In Phase II of an FS these preliminary remedial alternatives are evaluated based on three criteria, effectiveness, implementability and order of magnitude cost. A Phase III study includes a detailed analysis of the remedial alternatives retained in the Phase II study. Phase III will recommend a cost-effective, environmentally sound and long-term remedial action.

This report is comprised of a Phase I and II study for one of the site operable units, the groundwater. It also includes discussion of and identifies remedial technologies for the other site operable units which probably require remediation. A full scale Phase I and II FS could not be performed for the other media of concern (i.e., private well water, soil, surface water, surface water sediment, debris piles and septic systems) at this time because there is insufficient information to fully characterize the waste or to delineate the extent of contamination. The Second Phase RI will provide the additional information needed to prepare a complete Phase I and II FS for the other media and a Phase III FS for all site operable units.

The remedial investigation (RI) portion of the project commenced with the Phase I RI that was conducted by M&E during November and December 1990. The document, titled "Phase I Remedial Investigation Report for the Becker Electronics Site", presents a detailed description of activities and the results of the first phase of the field investigation program of the RI portion of the project conducted as part of a multi-phased RI/FS. This program was prepared in accordance with the Federal Superfund Amendments and Reauthorization Act (SARA) and the NYSDEC Superfund Program. A draft baseline health risk and environmental assessment has also been performed as part of the Phase I RI. The results of the Phase I RI, as well as other pertinent background information on the site are presented in Section 2.0 (Background Information) of this report.

As mentioned previously, the purpose of the RI is to identify and characterize the nature and extent of contamination at the site, while the purpose of the FS is to identify and screen remedial technologies. The Phase I RI did not fully characterize all of the media at the Becker Electronics site; however, it did provide sufficient information concerning the types of contaminants and extent of contamination to allow the preparation of the first and second phases of the FS process for the site groundwater. It also provided some information on the other media of concern. This report discusses, although does not provide a full screening of the other media. Upon completion of this report, the Second Phase RI will be performed. The information gathered during the second phase of the RI along with the currently available data will be used to perform a complete Phase I and II FS for all site media including the final phase of the FS process, namely, the Detailed Analysis of Alternatives (Phase III FS).

This FS has been prepared in general conformance with the following guidance documents:

- Technical and Administrative Guidance Memorandum (TAGM) on Selection of Remedial Actions at Inactive Hazardous Waste Sites - Revised, HWR-90-4030, New York State Department of Environmental Conservation, May 15, 1990.

- Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, EPA-540/G-89/004, OSWER Directive 9355.3-01, U.S. Environmental Protection Agency, Office of Emergency and Remedial response, April 1989.

The Phase I FS, Development of Remedial Technologies and Alternatives, is intended to identify remedial action technology and alternatives that could potentially be applicable, taking into account site specific considerations. As such, this phase includes the following steps:

- Identification and characterization of areas and media requiring remediation (based on the results of the RI and Draft Baseline Risk Assessment reports).

- Development of remedial action objectives specifying the contaminants and media of concern, and exposure pathways based on available data.

- Development of general response actions for each exposure pathway.

- Identification of potentially applicable remedial action technologies, including a description of technologies and a discussion of applicability to the Becker Electronics site. In this step, technologies which cannot be implemented will be eliminated.

- Formulation of potentially applicable remedial action alternatives, comprised of the more promising technologies for each of the media of concern.

The purpose of the Second Phase FS, Preliminary Screening of Remedial Alternatives, is to narrow the list of potential alternatives that will be evaluated in detail in the next phase. This screening evaluates the alternatives based on three evaluation criteria (i.e., Effectiveness, Implementability, and Cost). The factors considered in the three evaluation criteria are discussed in the NYS TAGM on Selection of Remedial Actions at Inactive Hazardous Waste Sites and in the USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. A brief description of these factors follows:

- The effectiveness evaluation considers the capability of each remedial alternative to protect human health and the environment. Each alternative evaluated is evaluated as to the protection it would provide, and the reductions in toxicity, mobility or volume it would achieve.

- The implementability evaluation is used to measure both the technical and administrative feasibility of constructing, operating and maintaining a remedial action alternative. In addition, the availability of the technologies involved in a remedial alternative are also considered.

- The cost evaluation includes estimates of capital costs, and annual operation and maintenance (O&M) costs. These conceptual cost estimates are order-of-magnitude estimates, and have been included by direction from NYSDEC.

The basic steps of the Phase I FS process are addressed in Section 3.0 (Development of Remedial Action Objectives and Response Actions), Section 4.0 (Identification and Technical Screening of Potential Remedial Technologies) and Section 5.0 (Development of Potential Remedial Action Alternatives) of this report. Section 6.0 (Potentially Applicable Groundwater Remediation Alternatives) presents the Phase II FS for the cited medium.

Section Two

SECTION 2

2.0 BACKGROUND INFORMATION

2.1 SITE BACKGROUND

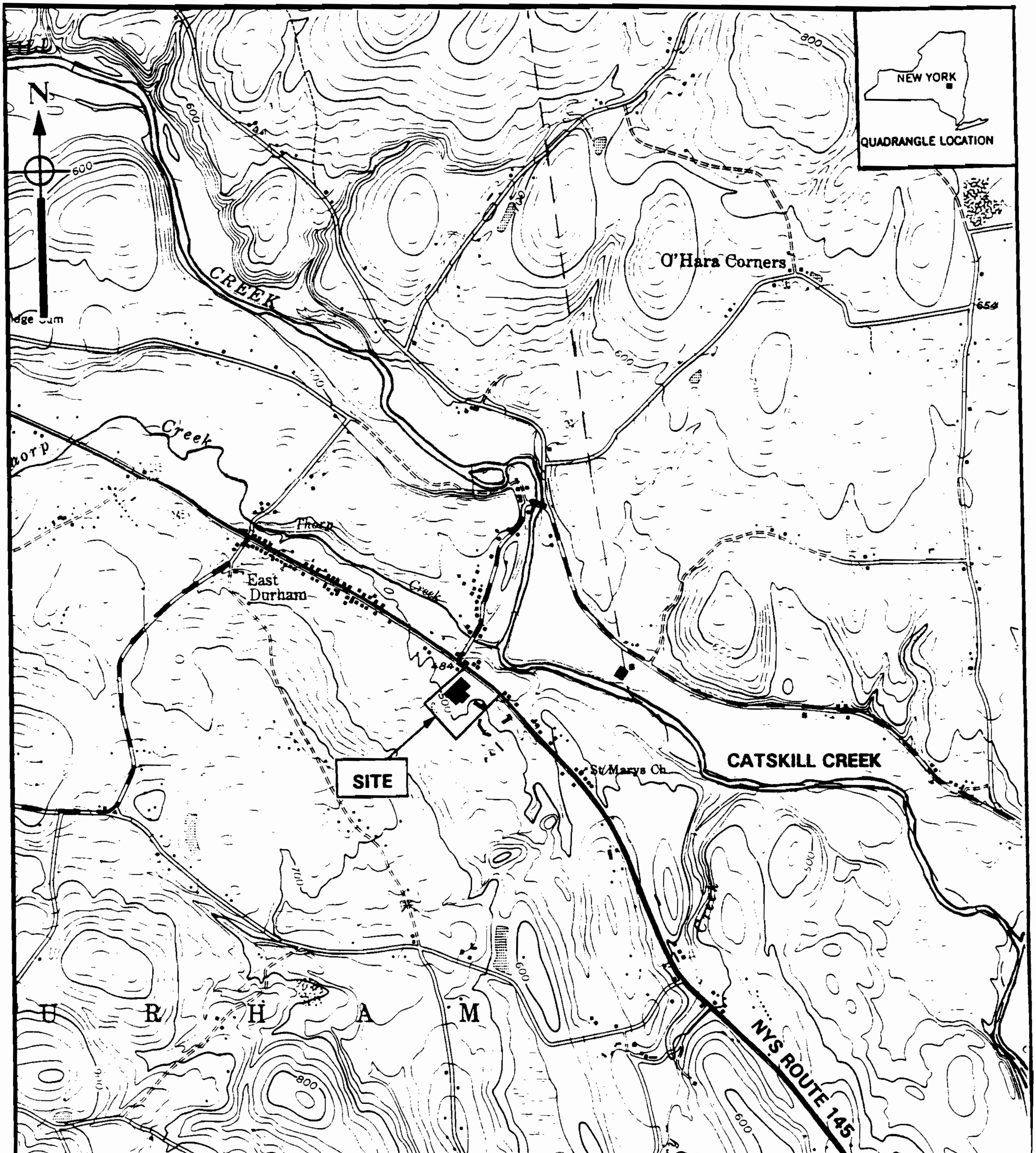
2.1.1 Site Location and Description

The Becker Electronics site is located in a rural residential area in the Hamlet of East Durham, within the Town of Durham, Greene County, New York. The Becker Electronics site is approximately 40 miles southwest of Albany, New York and 12 miles west of Catskill, New York, the county seat (Figure 2-1).

The Becker Electronics site is located south of State Route 145, lot 1, Blocks 25 and 26 in the town of Durham and is approximately 13 acres in size. The site is presently owned by Becker Electronics Manufacturing, Inc. Access to the Becker Electronics site is via State Road 145. Several access roads or vehicle trails are located within the site boundaries. Private residences and small business establishments border the site to the north and east. The Weldon House resort lies adjacent to the site on the south and a grass field and woods border the site to the north and west.

The landform within the vicinity of the Becker Electronics site may be characterized as the foothills of the Catskill Mountain, which are dissected by streams and tributaries of Catskill Creek. Elevations within a 1/2 mile radius of the site range from approximately 435 to 700 feet above mean sea level (MSL). The Becker Electronics site is located approximately 800 feet southwest of the confluence of Catskill Creeks. Thorp and Catskill Creeks are classified as C(T)-C class trout streams by the Division of Fish and Wildlife. Surface drainage at the site follows the ground surface elevations into several small tributaries that empty into Catskill Creek.

A detailed Site Plan showing the site/study area boundary is presented in Figure 2-2. The existing Becker Electronics site buildings and topography are shown on



SOURCE: USGS 7.5 Minute Series Topographic Map Freehold (1943) and Greenville (1945), NY Quadrangles Photorevised 1980

1000 0 1000 2000 3000

SCALE IN FEET

1" = 2000 FEET
CONTOUR INTERVAL = 20 FEET

FIGURE 2-1
SITE LOCATION

Becker Electronics Site
East Durham, New York

Metcalf & Eddy of New York, Inc.

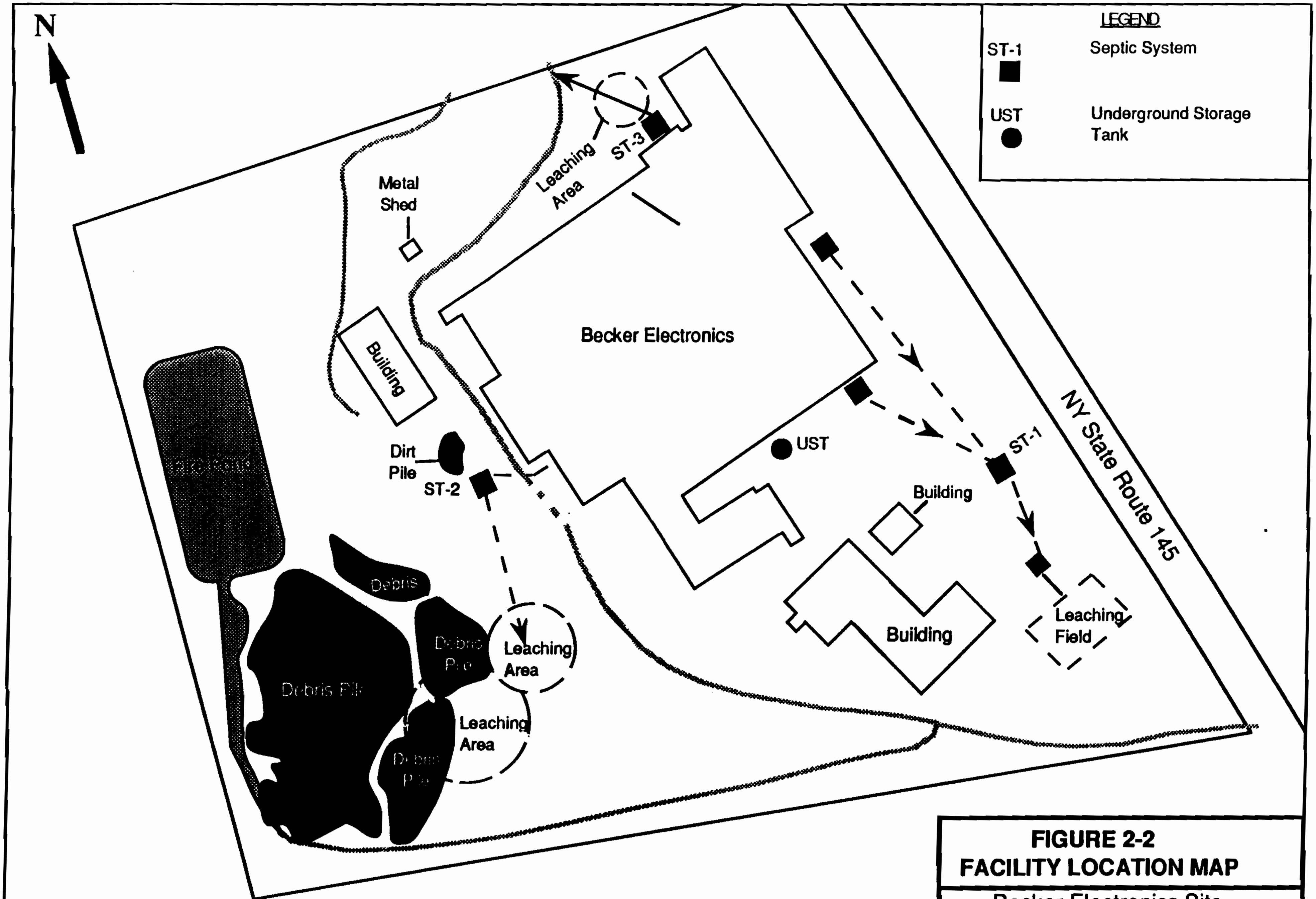


FIGURE 2-2
FACILITY LOCATION MAP

Becker Electronics Site
East Durham, New York

Metcalf & Eddy of New York, Inc.

Approximate Scale: 1" = 120'

Figure 2-2. The existing facilities consist of an approximate 96,000 square feet (sq ft) plant/office building with a 13,850 sq ft garage area, a 4,700 sq ft sawdust storage building, and a small pump house. Other than the existing buildings/structures and several paved and gravel parking areas, the site is grass covered and contains a few small wooded areas, several large piles of debris, a fire pond and four drainage ditches.

Known subsurface structures include three septic systems and one fuel storage tank. The three septic systems are identified in Figure 2-2 as ST-1, ST-2 and ST-3. Two septic systems, ST-3 (SPDES #001) and ST-1 (SPDES #002), were permitted for sanitary waste with a total permitted discharge rate of 2,000 gallons per day. The remaining septic tank system (SPDES #003) was permitted as an industrial waste discharge with a daily rate not to exceed 250 gallons. The fuel storage tank, estimated 5,000 gallon capacity, was used to fuel the Becker Electronics boilers. It is shown on Figure 2-2.

2.1.2 Geology

The bedrock at the site is covered by a thin veneer of fine silty sand. The overburden at the Becker Electronics site is primarily glacial in origin. Some alluvial sediments were encountered in the drainage swales at the site. The overburden ranges from 3 feet to 17 feet in thickness on the eastern portion of the Becker Electronics site. Overburden thickness in the vicinity of Monitoring Wells MW-4 and MW-5 was minimal and thickened toward MW-6 in the southeast.

West of a scarp, crossing the site roughly from north to south and located west of the facility buildings, the bedrock is exposed at the surface in several areas where there are no anthropogenic disturbances. The depth to bedrock on the upland area was not determined other than where it was observed at the surface.

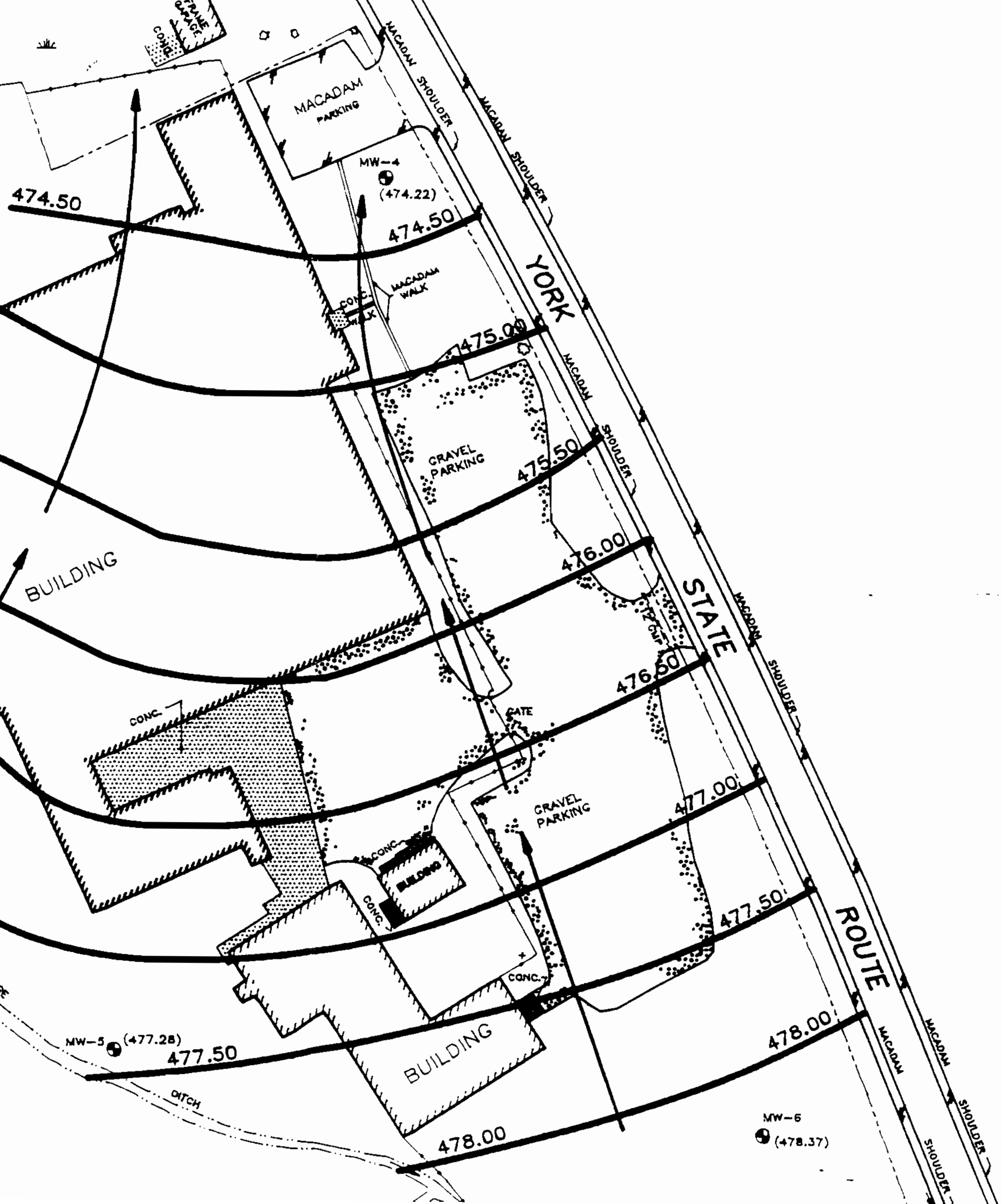
Bedrock encountered during drilling activities conducted as part of the Phase I RI consisted of shale and siltstone of the Catskill formation. The maximum borehole depth was 75 feet below ground surface at the MW-6 monitoring well location. The bedrock encountered was reddish brown, green and gray in color and was mottled to various degrees.

The majority of bedrock cores obtained displayed high rock quality designation (RQD) values. Bedrock characterized by low RQD values and a moderate to high degree of fracturing was found to be concentrated between depths of approximately 429 feet to 441 feet Mean Sea Level (MSL). A high degree of jointing was observed throughout the cored intervals. Fractures observed were predominantly high angle.

2.1.3 Hydrogeology

Groundwater underlying the Becker Electronics site was found to occur under unconfined conditions primarily within the shales and siltstones of the Catskill formation as well as in the overlying unconsolidated deposits. Unconsolidated deposits found varied in thickness throughout the site averaging less than five feet in areas of the site investigated. Groundwater in the unconsolidated deposits appears to be perched at the MW-2S monitoring well location as evidenced by the large discrepancy in groundwater elevations between MW-2S and the on-site bedrock monitoring wells. Groundwater elevations at MW-2S are approximately 10 feet higher in elevation than the bedrock monitoring wells on a consistent basis. It should be noted that a high percentage of clay was observed in a two foot thick interval overlying bedrock at this location. It is likely that perched lenses of groundwater are present in the unconsolidated deposits throughout the site due to permeability changes in the material. The pump test conducted at Becker well No. 2 had no significant impact on MW-2S which supports the idea of perched groundwater in the shallow unconsolidated deposits at the site. Groundwater recharge at the site is primarily the result of precipitation infiltration. Correlation between precipitation and recharge was inconclusive due to the lack of significant rainfall events during site activities and the lack of continuous groundwater level recording capabilities.

The average depth to groundwater from ground surface for bedrock monitoring wells was from 7 to 10 feet. A comparison of bedrock groundwater elevations shows a variation of approximately 5 feet across the site. Using groundwater elevations from the MW-4 and MW-6 monitoring well locations an average hydraulic gradient of 7.87×10^{-3} ft/ft was calculated. Groundwater elevation data obtained on December 12, 1990 and January 23, 1991 was contoured in Figures 2-3 and 2-4.



WELL LOCATION

(474.22) GROUNDWATER ELEVATION ABOVE M.S.L. AS OBSERVED ON DECEMBER 12, 1990

PROPERTY LINE

EDGE OF ASPHALT PAVEMENT

CHAIN LINK FENCE

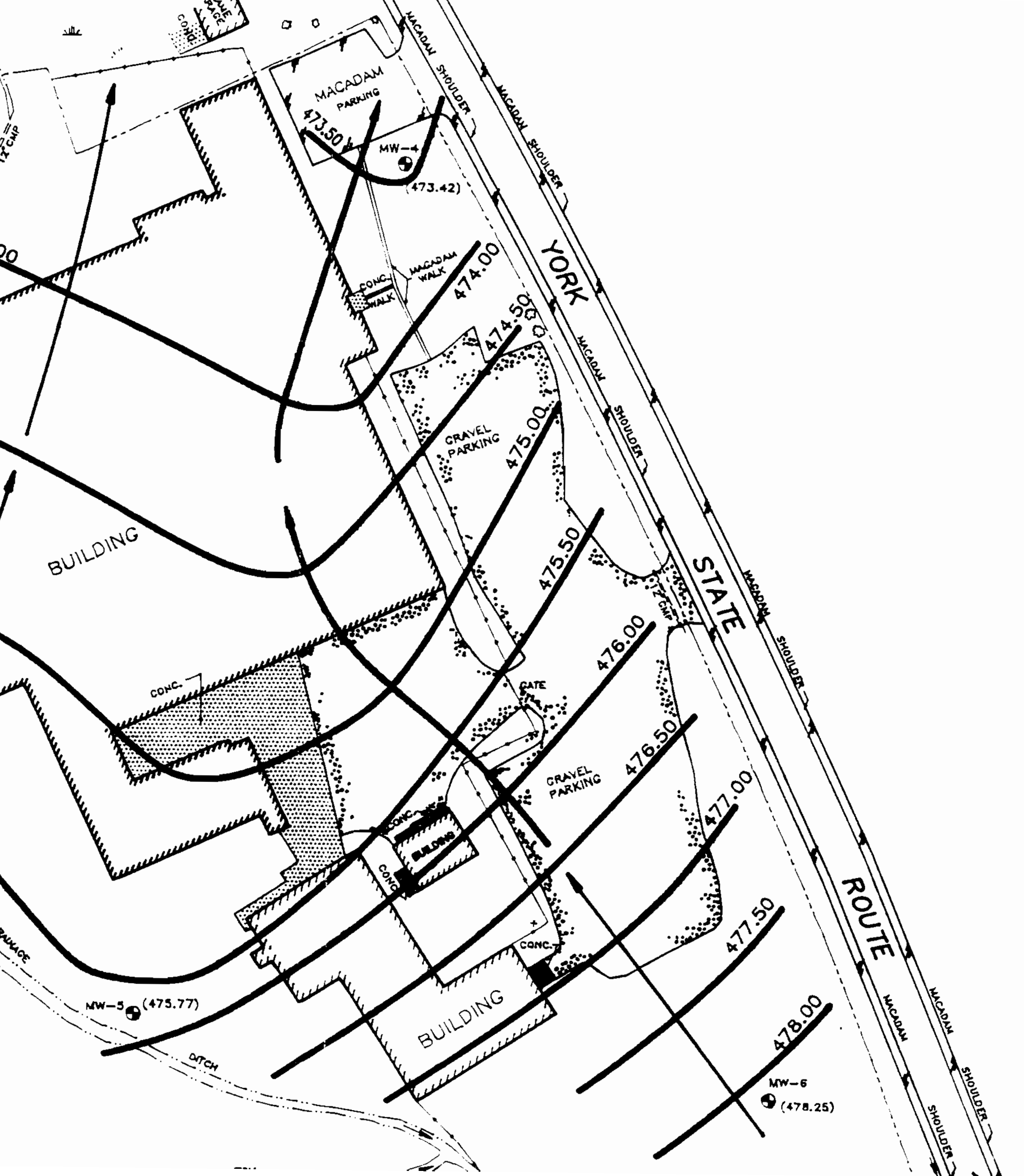
STONE WALL

SWAMP

GROUNDWATER FLOW DIRECTION

NOTE:

GROUNDWATER CONTOURS SHOWN ARE BASED ON DECEMBER, 1990 GROUNDWATER DATA AND ARE NECESSARY INTERPOLATIONS BETWEEN MONITORING WELLS. ACTUAL SUBSURFACE CONDITIONS MAY VARY.



WELL LOCATION

(473.42) GROUNDWATER ELEVATION ABOVE M.S.L. AS OBSERVED ON JANUARY 23, 1991

PROPERTY LINE

EDGE OF ASPHALT PAVEMENT

CHAIN LINK FENCE

STONE WALL

SWAMP

GROUNDWATER FLOW DIRECTION

NOTE:

GROUNDWATER CONTOURS SHOWN ARE BASED ON JANUARY, 1991 GROUNDWATER DATA AND ARE NECESSARY INTERPOLATIONS BETWEEN MONITORING WELLS. ACTUAL SUBSURFACE CONDITIONS MAY VARY.

Based on these maps groundwater is shown to be moving generally in a north to northeast direction. Judging from these flow directions it does not appear topography is having a significant influence but that groundwater flow direction is being controlled by joint/fracture orientations in the bedrock. This is supported by the elliptical shaped cone of depression with its long axis oriented northeast-southwest created by the constant head pump test (see RI for more detail). An additional influence on both groundwater flow direction and potential velocity are effects resulting from the pumping of private wells surrounding the Becker Electronics site.

Hydraulic conductivity values calculated for bedrock monitoring wells resulted in values ranging from 4.31E-03 to 1.73E-05 cm/s. As was previously mentioned these values are consistent with those cited in the literature for fractured sedimentary and metamorphic rock units.

2.2 SITE HISTORY, PREVIOUS INVESTIGATIONS AND RESPONSE ACTIONS TO DATE

2.2.1 Site History

The Becker Electronics facility is a former manufacturer of high fidelity speakers and speaker components. As part of the plant operations, 1,1,1-trichloroethane was used to remove oil from speaker magnet plates and to degrease mechanical machinery. The Brinnier & Larios Report, prepared in 1981 for Becker Electronics, indicates the solvent and manufacturing process was initially used in 1976. Project records also show the process was discontinued in March 1982.

In September 1980, a private water supply well used by the neighboring Weldon House property was found by the NYSDOH to be contaminated with 72,000 μg/l (parts per billion) of 1,1,1-trichloroethane. Subsequent sampling of other private wells in the vicinity of the Becker Electronics site revealed that several domestic water supply wells were contaminated by industrial solvents. As a result, NYSDOH implemented a well sampling/monitoring program to inform surrounding landowners of the potable groundwater quality. These sample results are summarized in the Phase I RI.

In March of 1981, the NYSDOH conducted a round of sampling on the Becker property. Samples taken from the fire pond, drainage ditches, leach field, and water supply wells all detected 1,1,1-trichloroethane. The maximum 1,1,1-trichloroethane concentration detected was 5,500 $\mu g/l$. These sample results are summarized in the Phase I RI. Becker Electronics hired Brinnier and Larios in March of 1981 to review its manufacturing process and recommend a treatment process for the contaminant 1,1,1-trichloroethane. As part of the 1981 Brinnier and Larios report, Dunn Geoscience of Albany, NY prepared a hydrogeologic evaluation.

In January of 1983, Dunn Geoscience, on behalf of Becker Electronics, prepared a Hydrogeologic Investigation Interim Report. The purpose of this report was to summarize activities to date, address preliminary findings, and present recommendations for monitoring well installation and initial clean-up activities. No project records exist that indicate any actions were undertaken as recommended in the Dunn Geoscience Report.

Becker Electronics entered into an agreement with the NYSDEC in June 1986. This judicial order required Becker Electronics to monitor private wells affected by the contamination release from the site and to install and maintain carbon filtration systems on those private wells which had unacceptable drinking water quality. In 1988 Becker Electronics closed the plant and declared bankruptcy. Since that time Becker Electronics has sporadically maintained the carbon filters and collected groundwater samples from a portion of the impacted private wells. As of March 1991, M&E is currently sampling and providing maintenance of the treatment systems as part of an interim remedial measure under the RI/FS (see RI Report for further details).

2.2.2 Previous Investigations

Previous Investigations at the Becker Electronics site have included the following:

- Industrial Waste Study by Brinnier and Larios (July 1981)

- Interim Report by Dunn Geoscience (January 1983)
- NYSDEC and Dunn Geoscience (March 1983)
- NYSDEC file information to M&E (December 1989)
- NYSDOH file information to M&E (May 1989)

The available information obtained from previous investigations consists of general background information on the site and analytical results of soil, surface water and groundwater samples taken at the site and surrounding study area. This information, and laboratory analytical results, provides an extensive historical data base of contaminants detected and suspected to exist at the Becker Electronics site.

In evaluating the existing data base, caution must be exercised and the following factors must be taken into consideration:

- analytical methods
- analytical parameters
- age of data
- detection limits of analytical methods
- QA/QC procedures and documentation

2.2.3 Response Actions To Date

Four Interim Remedial Measure (IRM) areas were proposed by M&E and approved by the NYSDEC in the Becker Electronics site Work Plan (October 1990). The following four IRMs were based on a review of NYSDOH and NYSDEC records along with Site visits on December 20, 1989 and May 2, 1990:

- Overpack and stage approximately 6 containers of 5 gallons or less and about 12 55-gallon capacity containers that are scattered about the site.
- Inspect and then prepare a replacement and maintenance plan for the private water supply well treatment systems located at approximately 12

residences and businesses surrounding the site that have been impacted by contaminants from the site.

- Locate, uncover, and sample three known septic systems on the Becker property.
- Locate an on-site underground storage tank and determine the nature of its contents.

In the time interval between the submittal of the Becker Phase I RI Work Plan in October 1990 until the field investigation mobilization on November 1, 1990 the containers scheduled for overpacking and staging were removed from the site by unknown parties.

During November 1990, M&E (and a subcontractor AquaScience) and NYSDEC inspected several of the existing granular activated carbon (GAC) filter treatment systems at the residences and business establishments whose private water supply wells had shown signs of contamination according to the prior NYSDOH sampling and monitoring program. Following that, in April and early May 1991, M&E (and its subcontractor, Megohmetrics Corp.) inspected all of the identified GAC systems at the impacted properties. Based on the observations made during the 1991 inspection and analytical results of samples obtained by M&E from each of the systems in early May, Megohmetrics installed one new system, modified some of the existing systems, and replaced the carbon at several existing systems in May 1991. M&E sampled all of the systems again in August 1991, and based on the analytical results of these samples, Megohmetrics installed two new systems, modified two existing systems, and replaced the carbon at one location in November, 1991. This IRM is discussed in further detail in the RI report.

The three septic systems specified in the July 3, 1984 draft SPDES permit were to be located and sampled as part of the M&E Phase I RI. Sediment/sludge and aqueous samples were obtained from the septic tanks, and soil samples were taken from test pits in leaching fields or near the septic tanks.

In addition, it should be noted that due to laboratory QA/QC problems the above mentioned samples were resampled on May 6 and 7, 1991. A detailed discussion of the initial sampling program in 1990 and the resampling program in 1991 is provided in the Phase I RI report.

The underground storage tank was located and M&E determined that it still contained some product.

2.3 RESULTS OF THE PHASE I REMEDIAL INVESTIGATION

The Phase I Remedial Investigation (Phase I RI) involved the review and analysis of existing information and environmental data. This was combined with a field sampling program, targeted to the investigation of on-site and off-site media. The media investigated included groundwater and private well water (drinking water), and surface water and sediment in the vicinity of the site (on-site and off-site), surface and subsurface soils, subsurface structures (septic systems and underground storage tank) on the site and debris piles. The purpose of this phase was to provide an initial confirmation regarding the location and characterization of sources of contamination, and to begin refining migration pathways, extent of contamination and exposed populations, as well as to assist in defining the type and location of additional sampling for subsequent investigation.

2.3.1 Groundwater

The groundwater investigation program at the Becker Electronics site consisted of the installation and sampling of three bedrock monitoring wells and one overburden well as well as the sampling of two existing Becker wells. Each of these six wells was sampled and analyzed for target compound list (TCL) volatiles, semi-volatiles, pesticides/PCBs and metals. Detailed discussion of these analyses can be found in the RI report. Table 2-1 presents the contaminants of concern for groundwater. These contaminants exceeded New York State Standards, Criteria, and Guidances (SCGs) for groundwater underlying the Becker Electronics site. Due to the possibility of off-site pumping wells creating a reversal in the hydraulic gradient in the vicinity of monitoring well MW-6, and due to the complexities of bedrock fracture flow, caution should be used in regarding MW-6 as an upgradient well representing background conditions.

TABLE 2-1

CONTAMINANTS OF CONCERN IN GROUNDWATER

	SCG[a]	MW-2S	Becker-2	Becker-3	MW-4	MW-5	MW-6	Site Background[b]
Volatile Organic Compounds (µg/l)								
1,1-Dichloroethene	5	96*	11*	U	230*	63*	U	U
1,1-Dichloroethane	5	230*	85*	40*	290*	670*	7*	7
1,2-Dichloroethene (Total)	5	U	5*	U	400*	U	U	U
1,1,1-Trichloroethane	5	2200*	12*	U	1700*	650*	23*	23
Trichloroethene	5	U	5*	U	530*	U	U	U
Tetrachloroethene	5	U	U	U	52*	U	U	U
Toluene	5	U	U	U	62*	21*	U	UJ
Inorganics (µg/l)								
Iron	300	3140*	5610*	U	16,900*	12,800*	10,700*	10,700
Lead	25	U	U	U	25.6*	U	U	U
Manganese	300	1580*	U	U	470*	U	3450*	3450*
Mercury	2	2.3*	U	U	U	U	U	U
Sodium	20000	22700*	U	U	U	U	U	U
Zinc	300	23	1050*	R	192	163	64	64

* Exceeds New York State standards, criteria or guidance values

a New York State SCGs are the NYSDEC Standards (s) and guidance values (g) for class GA groundwater

b Concentrations from "background" monitoring well MW-6 sample.

Note: U = Not Detected
R = Value was rejected due to deficient laboratory QA/QC
UJ = Compound not detected - the sample quantitation limit is an estimate

2.3.2 Private Well Water (Drinking Water)

Samples were collected from 12 private residences in May, 1991 and 10 residences in August 1991. All of these samples were analyzed for volatile organics. The contaminants of concern, those found to exceed SCGs, are presented in Table 2-2. Further details and a map showing the well locations can be found in the RI report.

2.3.3 Surface Water

Two on-site surface water bodies, a fire pond and drainage ditches, and two off-site surface water bodies, Thorp and Catskill Creeks, were investigated. The fire pond feeds the drainage ditches which ultimately discharge to Thorp and Catskill Creeks. These creeks are approximately 800 feet from the site. The on-site and off-site surface water bodies are classified as Class C waters. Class C waters include waters used for fishing or fish propagation. Three surface and three basal water samples were obtained from the Fire Pond during the Remedial Investigation. These samples were analyzed for TCL volatiles, semi-volatiles, pesticides/PCBs and metals. Table 2-3 summarizes the contaminants which exceeded SCGs and therefore are a concern. The complete set of results is included in the RI report. For the drainage ditch water a total of nine samples were collected and analyzed for the same parameters. Table 2-4 presents the contaminants of concern in the drainage ditch water. Details are discussed in the RI report.

Water samples were also collected at two locations along Thorp Creek and two locations along Catskill Creek. All samples obtained were analyzed for TCL volatiles, semi-volatiles, pesticides/PCBs and metals. There were no compounds found, in either Thorp or Catskill Creek surface water, that exceeded SCGs. Further discussion is presented in the RI report.

2.3.4 Sediment

Sediment samples were collected from the fire pond and drainage ditches on-site and analyzed for TCL volatiles, semi-volatiles, pesticides/PCBs and metals. The results of these samples, as discussed in the RI and summarized here, show some

TABLE 2-2

CONTAMINANTS OF CONCERN IN PRIVATE WELL WATER (DRINKING WATER)

	SCG[a]	PW-1	PW-2	PW-3	PW-4	PW-6	PW-7	PW-8	PW-9	PW-10	PW-11	PW-12	PW-13
Volatile Organic Compounds (μg/l)													
1,1-Dichloroethane	5	29*/30*	UJ/2.2	3.0/3.4	2.4/U	55*/60*	UJ/NS	UJ/NS	3.3/2.5	14*/U	5.4*/4.2	UJ/NS	NS/8.0*
1,1,1-Trichloroethane	5	U/5.8*	1.6/4.0	UJ/U	UJ/4.3	0.6/1.3	UJ/NS	UJ/NS	UJ/1.5	UJ/0.8	22*/12*	UJ/NS	NS/4.1

* Exceeds New York State standards, criteria or guidance values

a New York State SCGs are the NYSDEC Class GA Groundwater standards and guidance values

Note: U = Not detected
NS = Not Sampled
Two values are listed for each sample. The first value is the result of sampling in May, 1991 and the second value from August 1991. For sample locations at which several samples were obtained both pre and post filtration, the samples shown are always the prefiltration sample.

LEGEND

Sample Number	Name
PW-1	Keogh's Cottages
PW-2	Supersonic Speedway
PW-3	Star Synthetics
PW-4	Guaranteed Irish
PW-5	Keogh's Cottages (Duplicate)
PW-6	Weldon House
PW-7	Erin's Melody House
PW-8	Van Tassel Residence
PW-9	Puzzles Pub
PW-10	Becker Residence
PW-11	The Gallery
PW-12	Brennan Residence
PW-13	McGuire Property

TABLE 2-3

CONTAMINANTS OF CONCERN IN FIRE POND WATER

	SCG[a]	FP-1-SW	FP-1-BW	FP-2-SW	FP-2-BW	FP-3-SW	FP-3-BW
Inorganics (μg/l)							
Beryllium	11	UJ	15*	UJ	5	UJ	UJ
Cadmium	0.9	UJ	9*	UJ	5*	UJ	UJ
Cobalt	5	UJ	64*	UJ	18*	UJ	UJ
Copper	9	7	202*	9*	136*	10*	21*
Iron	300	770*	80200*	780*	29700	802*	7660*
Lead	2	R	185*	R	84*	R	R
Nickel	74	UJ	147*	UJ	47	UJ	UJ
Vanadium	14	UJ	79*	UJ	35*	UJ	11
Zinc	30	61*	710*	56*	R	63*	R

* Exceeds New York State standards, criteria or guidance values

a New York State SCGs are the NYSDEC Class C surface water standards (s) and guidance values (g). Values are calculated based on a hardness of 71 mg/l

Note: U = Not Detected
UJ = A value followed by a U or a UJ is an elevated detection limit due to blank contamination.
R = Data rejected due to deficient laboratory QA/QC

TABLE 2-4

CONTAMINANTS OF CONCERN IN DRAINAGE DITCH WATER

	SCG[a]	DD-1	DD-2	DD-3	DD-4	DD-5	DD-6	DD-7	DD-8	DD-9
<u>Volatile Organic Compounds (μg/l)</u>										
Trichloroethene	11	U	12*	U	U	U	U	U	3	U
<u>Semi-VOCs (μg/l)</u>										
Bis(2-ethylhexyl)phthalate	0.6	U	14*	UJ	U	UJ	UJ	UJ	UJ	U
<u>Inorganics (μg/l)</u>										
Aluminum	100	504*	428*	335*	R	6410*	219*	3680*	166*	R
Beryllium	11	UJ	UJ	UJ	UJ	2	UJ	UJ	UJ	27*
Cadmium	0.9	UJ	UJ	UJ	14*	5*	UJ	UJ	UJ	21*
Cobalt	5	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	105*
Copper	9	18*	24*	24*	85*	32*	8	28*	8	447*
Iron	300	1110*	968*	675*	6570*	11300*	449*	6280*	266	144000*
Lead	2	8.1*	2.9*	1.8	99*	42*	18.6*	12.5*	0.7	125*
Mercury	0.2	U	U	U	U	U	U	U	U	0.32*
Nickel	74	UJ	UJ	UJ	21	18	UJ	UJ	UJ	283*
Vanadium	14	UJ	UJ	UJ	UJ	17*	UJ	9	UJ	112*
Zinc	30	97*	117*	212*	548*	1100*	43*	77*	33*	1370*

* Exceeds New York State standards, criteria or guidance values

a New York State SCGs are the NYSDEC Class C surface water standards (s) and guidance values (g). Values are calculated based on a hardness of 71 mg/l

Note: U = Not Detected
UJ = Compound not detected. Sample quantitation limit is an estimate.
R = Data rejected due to deficient laboratory QA/QC
Sample DD-9 was obtained from an area of ponded surface drainage

exceedances of NYSDEC sediment criteria and New York-specific natural background levels in soils and therefore are contaminants of concern. These results are presented in Tables 2-5 and 2-6.

The Phase I RI also included the collection of four off-site sediment samples taken along Catskill and Thorp Creeks, at the same locations where surface water samples were obtained. Each of these four samples was analyzed for TCL volatiles, semi-volatiles, pesticides/PCBs and metals. As discussed in the Phase I RI no contaminants of concern were identified for Thorp and Catskill Creek sediment.

2.3.5 Soil

As discussed in the RI report 19 surface soil and 5 subsurface soil boring samples were taken at various locations across the site. These samples were analyzed for TCL volatiles, semi-volatiles pesticides/PCBs and metals. Concentrations of contaminants in the soil samples collected were compared to applicable NYSDEC SCGs. The results of these found contaminants of concern for both surface and subsurface soil. The contaminants of concern for these matrices are presented in Tables 2-7 and 2-8. Further details can be found in the RI report.

2.3.6 Septic Systems

Three matrices within the septic systems were sampled and analyzed as part of the Phase I RI. These matrices included the following: water samples taken directly from the septic tanks; three sediment/sludge samples collected from the septic tanks and one sample collected from a discharge pipe emanating from the Becker facility and; three soil samples obtained from test pits excavated within the vicinity of the septic systems. These samples were analyzed for TCL volatiles, semi-volatiles, pesticides/PCBs and metals. Tables 2-9 to 2-11 present the contaminants of concern for each of these matrices. The contaminants of concern were selected based on the number of samples analyzed that had contaminants exceeding SCGs. Further details are provided in the Phase I RI report.

TABLE 2-5

CONTAMINANTS OF CONCERN IN FIRE POND SEDIMENT

	SCG[a]	FP-1	FP-2	FP-3
Semi-VOCs (μg/kg)				
4-Nitrophenol	9	UJ	180*	U
Inorganics (mg/kg)				
Cadmium	0.8	UJ	0.91*	1.3*
Copper	19	15.4	693*	UJ
Iron	24000	20200	23900	32600*
Lead	27	14.0	32.7*	5.0
Manganese	428	218	557*	354
Nickel	22	25.4*	36.4*	47.0*
Zinc	85	58.1	88.2*	79.2

* Exceeds New York State standards, criteria or guidance values

[a] New York State SCGs are from either the "Partitioning Theory" of Kenaga and Goring or the NYSDEC Fish and Wildlife Division's Sediment Criteria Guidance

Note: U = Not detected
UJ = Compound not detected - the sample quantitation limit is an estimate

TABLE 2-6

CONTAMINANTS OF CONCERN IN DRAINAGE DITCH SEDIMENT

	SCG[a]	DD-1	DD-2	DD-3	DD-4	DD-5	DD-6	DD-7	DD-8	DD-9
Semi-VOCs (μg/kg)										
1,4-Dichlorobenzene	209[a]	U	U	230*	U	130	85	U	130	U
Chrysene	23[b]	U	UJ	U	U	U	64*	U	U	U
Bis(2-ethylhexyl)phthalate	2083[a]	U	13000*	U	65000*	2900*	U	U	2900*	4700*
Benzo(b)fluoranthene	23[b]	U	UJ	U	U	U	U	U	85*	U
Benzo(a)anthracene	23[b]	U	UJ	U	U	U	62*	U	U	U
Inorganics (mg/kg)										
Arsenic	5	5.3*	1.1	4.1	5.4*	4.3	5.2*	6.0*	3.1	1.80
Cadmium	0.8	1.5*	2.1*	2.0*	13.1*	1.8*	1.0*	1.6*	2.0*	UJ
Chromium	26	22.4	33.5*	88.1*	74.5*	27.9*	19.0	34.3*	32.9*	12.9
Copper	19	28.1*	55.4*	22.1*	44.2*	15.9	26.7*	27.4*	18.6	10.6
Iron	24000	28600*	20900	37500*	14300	23900	24300*	30400*	27100*	16100
Lead	27	R	R	R	159*	R	R	R	R	8.2
Manganese	428	R	R	R	652*	R	R	R	R	307
Nickel	22	36.7*	35.1*	48.8*	23.6*	36.2*	32.1*	40.5*	31.7*	21.7
Zinc	85	61.6	256*	323*	215*	395*	88.7*	135*	135*	71.3

* Exceeds New York State standards, criteria or guidance values
a New York State SCGs are from the NYSDEC Fish and Wildlife Division's Sediment Criteria Guidance - Aquatic Toxicity Basis (12/89)
b New York State SCGs are from the NYSDEC Fish and Wildlife Division's Sediment Criteria Guidance - Human Health Basis (12/89)

Note: U = Not detected
UJ = Compound not detected - the sample quantitation limit is an estimate
R = Data rejected due to deficient laboratory QA/QC
Sample DD-9 was obtained from an area of ponded surface drainage.

TABLE 2-7

CONTAMINANTS OF CONCERN IN SURFACE SOIL

	SCG[a]	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10
Volatile Organic Compounds (μg/kg)											
1,1,1-Trichloroethane	23	U	U	UJ	U	U	U	U	U	U	U
1,1-Dichloroethane	5	U	U	UJ	U	U	U	U	U	U	U
2-Butanone	7	U	U	UJ	UJ	UJ	UJ	U	UJ	UJ	U
4-Methyl-2-pentanone	N/A	U	U	UJ	U	U	U	U	U	U	U
Semi-VOCs (μg/kg)											
Benzoic Acid	75	U	U	UJ	U	U	U	U	U	U	U
Chrysene	12	U	68*	UJ	U	U	U	U	U	UJ	U
Dibenzofuran	N/A	U	U	UJ	U	U	U	U	U	U	U
Bis(2-ethylhexyl)phthalate	10838	3100	4600	13000*	U	6400	5500	U	U	1800	U
Di-n-octylphthalate	3578	U	U	500	U	550	240	UJ	U	84	340
Phenol	0.43	U	54	U	U	U	U	U	U	UJ	U
Benzo(b)fluoranthene	33	U	130*	UJ	U	U	U	UJ	U	UJ	U
Benzo(a)pyrene	ND	U	63*	UJ	U	U	U	UJ	U	UJ	U
Indeno(1,2,3-cd)pyrene	96	U	U	UJ	U	U	U	UJ	U	UJ	U
Inorganics (mg/kg)											
Barium	250-350	107	72.9	763*	78.8	56.8	109	306	89.5	334	112
Beryllium	0-0.9	4.0*	2.9*	2.3*	3.1*	2.9*	6.3*	4.0*	3.1*	5.6*	5.9*
Cadmium	0.0001-0.1	1.4	0.80*	42.9*	0.78*	UJ	1.4*	UJ	UJ	1.2*	1.5*
Calcium	150-1650	1470	1390	51100*	1490	2010*	3990*	2080*	2340*	2530*	11600*
Chromium	1.5-25	28.5*	14.9	205*	15.8	12.5	29.1*	24.0	16.0	28.1*	26.5*
Cobalt	2.5-6	11.0*	9.0*	26.0*	10.9*	8.1*	19.1*	11.6*	11.3*	16.0*	18.1*
Copper	<1-15	160.0*	14.6	106*	11.9	31.3*	16.2*	28.3*	47.6*	18.6*	10.4
Iron	17500-25000	24,400	17300	15100	19900	16900	37300*	24500	19300	33600*	34900*
Lead	1-12.5	R	R	404*	11.7	5	8.4	6	14.2*	12.4	6.6
Magnesium	1700-6000	3590	2630	6120*	2690	2930	5700	3640	3040	5240	5520
Manganese	400-600	686*	414	2590*	313	179	265	199	442	192	465
Mercury	0.042-0.066	1.2*	U	U	U	U	U	U	U	U	U
Nickel	6-12.5	30.2*	22.8*	33.8*	26.2*	23.8*	56.7*	34.7*	28.3*	50.1*	53.2*
Zinc	37-60	472*	90.5*	390*	97.7*	97.4*	109*	263*	93.2*	157*	104*

* Exceeds New York State Soil Cleanup Criteria/Natural background level

a New York State SCGs are the NYSDEC Soil Cleanup Criteria for VOCs/Semi-VOCs. There are no SCGs for inorganics, therefore the NYSDEC range of natural background levels in soil will be used for comparison.

Note: U = Not Detected
UJ = Compound not detected -- the sample quantitation limit is an estimate
R = Data rejected due to deficient laboratory QA/QC
N/A = Not Available

TABLE 2-7 (continued)

CONTAMINANTS OF CONCERN IN SURFACE SOIL

	SCG[a]	SS-11	SS-12	SS-13	SS-14	SS-15	SS-16	SS-17	SS-18	SS-19
Volatile Organic Compounds (μg/kg)										
1,1,1-Trichloroethane	23	470*	14	U	U	U	U	UJ	U	U
1,1-Dichloroethane	5	U	U	U	U	U	U	U	8*	U
2-Butanone	7	U	U	U	U	U	U	U	56*	U
4-Methyl-2-pentanone	N/A	U	U	U	U	U	U	UJ	9	U
Semi-VOCs (μg/kg)										
Benzoic Acid	75	130*	15000*	U	U	U	U	U	140*	U
Chrysene	12	U	U	170*	UJ	U	U	U	U	U
Dibenzofuran	N/A	U	U	U	U	62	U	U	U	U
Bis(2-ethylhexyl)phthalate	10838	U	45000*	UJ	UJ	1500	31000*	26000*	11000*	14000*
Di-n-octylphthalate	3578	U	U	UJ	UJ	U	1000	4400*	340	7400*
Phenol	0.43	U	U	U	U	U	U	U	U	U
Benzo(b)fluoranthene	33	U	U	UJ	UJ	420*	U	U	UJ	U
Benzo(a)pyrene	ND	U	U	UJ	UJ	230*	U	U	UJ	U
Indeno(1,2,3-cd)pyrene	96	U	U	UJ	UJ	220*	U	U	UJ	U
Inorganics (mg/kg)										
Barium	250-350	94.2	62.1	80.8	154	65.7	85.2	194	52.2	65.1
Beryllium	0-0.9	7.3*	4.6*	4.5*	0.66	3.3*	4.5*	4.1*	4.2*	3.7*
Cadmium	0.0001-0.1	1.9*	1.2*	4.5*	UJ	1.4*	1.60*	5.1*	0.85	1.2*
Calcium	150-1650	4380*	6940*	30500*	299000*	12600*	8920*	131000*	1030	6540*
Chromium	1.5-25	24.3	23.5	21.4	3.9	17.3	24.9	24.9	22.5	22.7
Cobalt	2.5-6	16.3*	14.1*	14.0*	UJ	10*	14.6*	15.7*	14.4*	11.8*
Copper	<1-15	53.5*	38.6*	26.0*	10.9	21.0*	34.2*	330*	48.6*	21.2*
Iron	17500-25000	49100*	28600*	26600*	4720	20400	25800*	25300*	24800	22100
Lead	1-12.5	54.5*	27.7*	17.2*	5.5	R	R	74.4*	R	24.3*
Magnesium	1700-6000	3750	4390	5760	11200*	4720	5080	9010*	4860	3800
Manganese	400-600	672	585	508	150	472	503	423	183	474
Mercury	0.042-0.066	U	U	U	U	U	U	U	U	U
Nickel	6-12.5	48.7*	38.6*	38.4*	6.6	24.3*	38.4*	36.5*	39.1*	31.8*
Zinc	37-60	280*	328*	115*	104*	88.6*	663*	505*	960*	188*

* Exceeds New York State Soil Cleanup Criteria/Natural background level

[a] New York State SCGs are the NYSDEC Soil Cleanup Criteria for VOCs/Semi-VOCs. There are no SCGs for inorganics, therefore the NYSDEC range of natural background levels in soil will be used for comparison.

Note: U = Not Detected
UJ = Compound not detected – the sample quantitation limit is an estimate
R = Data rejected due to deficient laboratory QA/QC
N/A = Not Available

TABLE 2-8

CONTAMINANTS OF CONCERN IN SUBSURFACE SOIL

	Natural Background Levels in Soil[a]	BL-1	BL-2 (2-4')	BL-2 (4-6')	BL-3	BL-4
Inorganics (mg/kg)						
Beryllium	0-0.9	2.7*	4.5*	2.9*	6.2*	4.7*
Cadmium	0.0001-1.0	0.9	0.90	UJ	1.0*	0.86
Calcium	150-6500	1760	4050	8010*	2340	5020
Cobalt	2.5-6	9.3*	14.9*	9.3*	15.3*	15.2*
Iron	17500-25000	18400	27700*	17900	36000*	28300*
Nickel	6-12.5	23.6*	41.0*	28.1*	51.1*	28.1*
Zinc	37-60	68.6*	75.7*	R	92.5*	72.3*

* Exceeds NYSDEC natural background level in soil

a Since there are no New York State SCGs for inorganics the NYSDEC range of natural background levels in soil will be used for comparison.

Note: U = Not Detected
UJ = Compound not detected - the sample quantitation limit is an estimate
R = Data rejected due to deficient laboratory QA/QC

TABLE 2-9

CONTAMINANTS OF CONCERN IN SEPTIC SYSTEMS - WATER

	SCG[a]	ST-1	ST-2	ST-3
<u>Volatile Organic Compounds (µg/l)</u>				
1,1-Dichloroethane	5	9*	23*	U
1,1,1-Trichloroethane	5	27*	34*	U
<u>Inorganics (µg/l)</u>				
Iron	300	1720*	NS	R
Zinc	300	850*	NS	R

* Exceeds New York State standards and guidance values
a New York State SCGs are the NYSDEC standards and guidance values for Class GA groundwater

Note: U = Not detected
N/A = Not Available
NS = Not sampled
R = Rejected data due to deficient laboratory QA/QC
UJ = Compound not detected - the sample quantitation limit is an estimate
Sample ST-2 was collected from building discharge pipe water.

TABLE 2-10

CONTAMINANTS OF CONCERN IN SEPTIC SYSTEMS - SEDIMENT/SLUDGE

	SCG[a]	ST-1	ST-2	ST-3[1]	PP-1
Volatile Organic Compounds (μg/kg)					
Chloroethane	6	U	380*	U	R
1,1-Dichloroethane	5	U	76*	U	R
1,1,1-Trichloroethane	23	U	53*	U	R
Toluene	45	U	54*	320*	R
Semi-VOCs (μg/kg)					
Chrysene	12	140*	U	UJ	U
Bis(2-ethylhexyl)phthalate	10838	6700	38000*	170000*	6500
Inorganics (mg/kg)					
Arsenic	<0.1-6.5	5.8	2.6	166*	14.6*
Barium	250-350	277	1400*	3250*	4380*
Beryllium	0-0.9	5.1*	7.0*	57*	28.5*
Cadmium	0.0001-1.0	3.9*	8.0*	118*	13.1*
Calcium	150-6500	28000*	17000*	27800*	86900*
Chromium	1.5-25	23.4	70.1*	1240*	257*
Cobalt	2.5-6	16.2*	14.9*	253*	30.7*
Copper	<1-15	117*	189*	34200*	1140*
Iron	17500-25000	31800*	56700*	361000*	240000*
Lead	1-12.5	23.4*	59.7*	4000*	181*
Magnesium	1700-6000	3720	3120	68600*	6210*
Manganese	400-600	411	15000*	3920*	12800*
Mercury	0.042-0.066	0.23*	U	2*	0.16*
Nickel	6-12.5	42.6*	41.3*	926*	112*
Sodium	6000-8000	UJ	876	2970	8020*
Zinc	37-60	1580*	9150*	224000*	29400*

* Exceeds New York State standards, criteria or guidance values

a New York State SCGs are the NYSDEC Soil Cleanup Criteria except for inorganics where no SCGs are available. Inorganics are compared with NYSDEC natural background levels in soil.

1 Results for ST-3 expressed in μg/l due to lab preparation method.

Note:
U = Not detected
N/A = Not Available
R = Rejected data due to deficient laboratory QA/QC
UJ = Compound not detected - the sample quantitation limit is an estimate.
Sample PP-1 was calculated from building discharge pipe sediment.

TABLE 2-11

CONTAMINANTS OF CONCERN IN SEPTIC SYSTEMS - TEST PIT SOIL

	SCG[a]	ST-1	ST-2	ST-3
Semi-VOCs (μg/kg)				
Benzo(b)fluoranthene	33	140*	U	U
Benzoic Acid	75	310*	U	U
Inorganics (mg/kg)				
Beryllium	0-0.9	5*	1.9*	3.5*
Cadmium	0.0001-1.0	1.2*	2.9*	1.0*
Chromium	1.5-25	27.0*	15.3	38.4*
Cobalt	2.5-6	21.2*	6.1*	9.3*
Copper	<1-15	79.0*	13.2	13.1
Iron	17500-25000	3100*	11400	21700
Lead	1-12.5	14.9*	19.0*	R
Manganese	400-600	980*	252	324
Nickel	6-12.5	42.5*	16.4*	24.1*
Zinc	37-60	348*	46.7	174*

* Exceeds New York State standards and guidance values

a New York State SCGs for semi-VOCs are the NYSDEC soil cleanup criteria. Since SCGs are not available for inorganics values will be compared to NYSDEC natural background levels in soil.

Note: U = Not detected
N/A = Not Available
R = Rejected data due to deficient laboratory QA/QC

2.3.7 Debris Piles

As discussed in the RI report there are piles of debris located in various areas of the site. A few surface soil samples and one soil boring were taken near the debris. These samples showed some contaminants at low levels (i.e., volatiles and semi-volatile compounds and metals). Based on the data collected during the Phase I RI the contaminated leachate from the debris piles may be impacting other site media (i.e. soil, and drainage ditch water and sediment). This data is presented in the Phase I RI report.

2.3.8 Underground Storage Tank

As discussed in the RI report an underground storage tank was used to fuel the Becker Electronics boilers. A preliminary inspection by M&E indicated there was fuel remaining in the tank; however, neither the condition nor the integrity of the tank is known. Based on the age of the tank it is not likely to comply with Federal and State UST regulations, and the presence of a residual quantity of fuel in the tank poses a potential risk to soil and groundwater due to possible leakage. This data is presented in the Phase I RI report.

In addition, it is important to note that a fuel pump was found at the front of a small building/garage located in the southeast portion of the site. It is not known whether an underground storage tank is still present near this pump and further investigation may be warranted.

Section Three

SECTION 3

3.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND RESPONSE ACTIONS

In order to identify appropriate remedial action technologies potentially applicable to the Becker Electronics site, it is necessary to determine remedial action objectives and general response actions. This section of the report will first identify and characterize areas and media requiring remediation, and then will develop remedial action objectives addressing the contaminants and media of concern and exposure pathways, and develop general response actions for accomplishing the remedial action objectives.

3.1 IDENTIFICATION OF MEDIA AND CHEMICALS OF CONCERN

Based on the results of the Phase I RI and previous investigations at the site, the media identified as potentially requiring remedial action at the Becker Electronics site are groundwater, drinking water, surface water, sediment, soil, debris piles, septic systems, and an underground storage tank. The chemicals of concern in each matrix evaluated in the Draft Health and Environmental Risk Assessment, hereafter referred to as the Draft Risk Assessment, are presented in Table 3-1. The chemicals of concern in the drinking water would be the same as the groundwater. A detailed description of the selection and evaluation of each site medium is presented in the Draft Risk Assessment.

The Draft Risk Assessment determined that the groundwater and drinking water are media of concern as discussed in Section 3.3. Additional data collection and further evaluation of the other site matrices, such as surface water, sediment, soil, debris piles, septic systems and the underground storage tank are needed to determine whether remedial measures are necessary and what types would be applicable. This will be discussed below in Section 3.3

3.2 EXPOSURE PATHWAYS

The exposure pathways evaluated in the Draft Risk Assessment for the

Table 3-1

Chemicals of Concern at the Becker Site

Chemicals Detected Above Applicable Criteria	Exposure Media: Groundwater	Surface Soil	Fire Pond Sediment	Drainage Ditch Sediment	Fire Pond Water	Drainage Ditch Water
2-butanone		X				
1,1-dichloroethane	X	X		X		
1,1-dichloroethene	X					
1,2-dichloroethene (total)	X					
tetrachloroethene	X					
1,1,1-trichloroethane	X	X				
trichloroethene	X	X				X
toluene	X					
benzo(a)anthracene		X		X		
benzo(a)pyrene		X		X		
benzo(b)fluoranthene		X		X		
benzo(k)fluoranthene				X		
benzoic acid		X	X	X		
bis(2-ethylhexyl)phthalate		X	X	X		
chrysene		X		X		
di-n-octylphthalate		X		X		
1,4-dichlorobenzene				X		
indeno(1,2,3-cd)pyrene		X		X		
4-nitrophenol			X			
phenol		X				
Aroclor - 1254				X		
aluminum						X
barium		X				
beryllium	X				X	
cadmium		X	X	X		X
chromium		X	X	X		
cobalt					X	
iron					X	X
lead	X		X		X	X
mercury	X	X				
nickel		X	X	X	X	
vanadium					X	X
zinc					X	X

groundwater/drinking water included ingestion, dermal contact, and inhalation. For the other media of concern (soil, sediment and surface water) the ingestion and dermal contact exposure pathways were evaluated.

The Draft Risk Assessment concluded that the carcinogenic and noncarcinogenic risks for the site are dominated by the groundwater exposure pathways. However, it must be noted that although groundwater is an exposure pathway at the present time, all identified affected private well users are currently filtering their water with carbon filters and are therefore protected. In addition, the calculated risks are based on concentrations of chemicals which were only detected on the site itself. For the exposure routes of dermal contact with surface soil and dermal contact with drainage ditch sediments which may occur during trespassing on-site, the chemical with the highest carcinogenic risk is benzo(a)pyrene.

It is unlikely however that a single individual will be exposed to all site contaminants at calculated concentrations and via all of the exposure pathways outlined in the Draft Risk Assessment.

3.3 IDENTIFICATION OF OPERABLE UNITS REQUIRING REMEDIATION

The following sections identify the media requiring remediation based on data presented in the remedial investigation report and Draft Risk Assessment.

3.3.1 Groundwater

As presented in the Draft Risk Assessment the potential risks for the groundwater exposure routes were significant and therefore the groundwater requires remediation. The groundwater, at the present time, does present a risk; however, all identified affected private well users within the vicinity of the site are currently using carbon filtration systems and are therefore protected from this risk. Remediation of groundwater involves an extensive program to extract the groundwater, and may require a treatment system train to remove all of the groundwater contaminants. Therefore, this study will evaluate remedial technologies and alternatives for this medium of concern.

3.3.2 Private Well Water (Drinking Water)

Private well water, within the vicinity of the site, is fed by on-site groundwater and therefore presents a potential risk. However, the private well water is not an exposure pathway at the current time because all identified affected private well users are currently treating their water with carbon filters. Remediation of this medium will be done in conjunction with the site groundwater. Therefore, remedial technologies for this medium will be evaluated in Section 4 of this report.

3.3.3 Surface Water

Data collected during the Phase I Remedial Investigation indicated that the presence of some contaminants in this medium may exceed some pertinent standards, criteria and guidelines. As previously discussed in the Draft Risk Assessment there are some exceedances (lead, cobalt, iron) of the NYSDEC Class C Surface Water Standards for the Fire Pond and Drainage Ditch surface waters and these surface water bodies may be impacting other media of concern on the site (e.g., sediments). However, a majority of the data, collected during the Phase I Remedial Investigation and subsequently used in the Draft Risk Assessment, are estimated and therefore, at this point, can only be used as a screening tool. Additional data for the surface water will be collected and evaluated during the Second Phase Remedial Investigation. After the Second Phase data is evaluated this medium will be reevaluated to determine if remedial measures are necessary.

3.3.4 Sediment

Data collected for this medium during the Phase I Remedial Investigation indicated that the concentrations of some contaminants exceed some of the applicable standards, criteria and guidances. As discussed in the Draft Risk Assessment, dermal contact with drainage ditch sediments during trespassing on-site presents a risk, and the lead criterion was exceeded in the fire pond sediment. However, a majority of the data, collected during the Phase I Remedial Investigation and subsequently used in the Draft Risk Assessment, are estimated values. Therefore, at this point in time, this data can only be used as a screening tool. Additional data for this medium will be collected and analyzed during the Second Phase Remedial Investigation. After the Second Phase data is evaluated then this medium will be reevaluated to determine what remedial actions are required.

3.3.5 Soil

Data collected for this medium during the Phase I Remedial Investigation indicates that some contaminants exceed applicable standards, criteria and guidances. However, a majority of this data is estimated, and therefore should only be used as a screening tool. Based on the Draft Risk Assessment, dermal contact with surface soil could present a risk during trespassing on site. The site is only partially fenced at present. If the site was completely fenced, this risk would be significantly reduced; therefore an IRM for this medium is proposed. The IRM would provide fencing of the site to reduce exposures until such remedial measures as may be required are implemented. The proposed IRM is presented in Section 3.7.

3.3.6 Septic Systems

Sampling performed during the Phase I RI found some chemicals of concern. Although there is no direct exposure pathway the septic systems may be a source of contamination for other media of concern. Therefore, an IRM has been proposed for removing the contamination from the septic tanks in these systems. The IRM is presented in Section 3.7 of this report. The Second Phase RI will further delineate and identify any other contaminated media which needs to be addressed within or near the septic systems (i.e., leaching fields).

3.3.7 Debris Piles

Based on data collected during the RI from other on-site media (e.g., soil, drainage ditch water and sediment) the debris piles may be producing contaminated leachate which is impacting the other media of concern. In addition, the condition of the soil and levels of contamination beneath the debris piles are presently not known. Therefore, during the Second Phase Remedial Investigation the debris piles and the underlying soils will be sampled in order to better characterize the waste and delineate the extent of contamination. Therefore, at this point, no remedial actions are proposed for this medium.

3.3.8 Underground Storage Tank

A preliminary inspection in 1990 showed there was a fuel like liquid remaining in the underground storage tank used to fuel the site boilers. This may be a potential source of soil and groundwater contamination. Therefore the contents of the storage tank should be removed and disposed of in accordance with applicable regulations.

The remediation of the underground storage tank is a fuel storage issue and has been referred to the Spills Response Unit for implementation. In addition, the presence of a fuel pump on-site is reason to suspect that another underground storage tank may require attention. This situation warrants further investigation.

3.4 IDENTIFICATION OF NEW YORK STANDARDS, CRITERIA AND GUIDANCE VALUES

The National Contingency Plan (NCP) which is used as guidance requires the determination of the extent to which Federal, State or local public health and environmental standards are applicable or relevant and appropriate to sites. In addition, Federal or State advisories, criteria and guidance must be reviewed to determine if they are relevant in developing remedial actions at the site. Because the Becker Electronics site is a New York State Superfund Site, New York State SCGs are applicable requirements pertinent to this project.

SCGs may be categorized as contaminant-specific, location-specific, or action-specific. A summary of the SCGs for the Becker Electronics site is presented in Table 3-2. Some of the potential location-specific SCGs do not pertain to the Becker Electronics site. This is based upon available information that the site does not contain any protected wetlands, floodplain or flood hazard zones, endangered species, wild or scenic rivers, or historical or archeological areas. SCGs for the site, therefore, will be based primarily on waste or remedy-related

TABLE 3-2

STANDARDS, CRITERIA AND GUIDANCE VALUES FOR THE BECKER ELECTRONICS SITE

Statute, Regulation or Program	Applicability	Category
NYSDEC Ambient Water Quality Standards and Guidance Values	Applicable to all groundwaters and surface waters of NYS.	Action-specific Contaminant-specific Location-specific (point of discharge classification)
NYSDOH Requirements for General Organic Chemicals and Metals in Drinking Water (PHL; Sections 201 and 205)	Applicable to sources of potable water supply.	Contaminant-specific
Safe Drinking Water Act/USEPA Health Advisories (40 C.F.R. Parts 141, 142 and 143)	Applicable MCLs to sources of groundwater, surface water, potable water supply where more stringent or where specific NYSDEC standards or guidelines do not exist	Contaminant-specific
NYSDEC Air Guide-1	Applicable where remedial activities will impact the ambient air quality	Action-specific Contaminant-specific
NYSDEC Air Cleanup Criteria	Applicable where remedial activities will impact the ambient air quality.	Action-specific Contaminant-specific
NYSDEC Soil Cleanup Criteria Based upon Partitioning Theory	Applicable for contaminated soil remediation and to be protective of water quality	Action-specific Contaminant-specific Location-specific
Eastern United States Background Concentrations of Twenty Elements in Soils	To be considered, for comparative purposes for concentrations of metals in soil	Contaminant-specific Action-specific
NYSDEC Sediment Criteria	Applicable for contaminated sediment remediation	Contaminant-specific Location-specific

TABLE 3-2 (Continued)

STANDARDS, CRITERIA AND GUIDANCE VALUES FOR THE BECKER ELECTRONICS SITE

Statute, Regulation or Program	Applicability	Category
NYSDEC Solid Waste Management Facilities (6 NYCRR Part 360)	Applicable site closure requirement for the on- or off-site management of site materials which have been tested and rendered non-hazardous	Action-specific
NYSDEC Hazardous Waste Treatment, Storage Disposal Facility Permitting Requirements (6 NYCRR Part 373 et seq.)	Applicable standards and requirements for protection of groundwater and for treatment, storage and disposal of hazardous waste.	Action-specific Contaminant-specific
NYSDEC Requirements for Handling and Storage of Petroleum (6NYCRR of Part 613)	Applicable tank closure requirements	Action-specific Contaminant-specific
Resource Conservation and Recovery Act - Groundwater Protection Standards (40 CFR Part 264.90-264.109)	Applicable standards to sources of groundwater, surface water, potable water supply where more stringent or where specific NYSDEC standards or guidelines do not exist	Contaminant-specific
Clean Water Act - Ambient Water Quality Criteria (EPA 44/5-86-001)	To be considered, depending upon the designated or potential use of the water body of concern	Contaminant-specific Location-specific
Toxic Substances Control Act (40 CFR Part 702-799)	Applicable with respect to the disposal of soils contaminated with PCBs	Contaminant specific
OSHA Standards (29 CFR 1900-1999)	Applicable to workers and the work place throughout implementation of investigation activities and remedial actions at the Becker Electronics site	Action-specific Contaminant-specific Location-specific
U.S. Army Corps of Engineers Dredge and Fill Departments (CWA, Section 404)	Applicable to discharges of dredged or fill material into waters of the United States	Action-specific Location-specific

characteristics.

It should be noted that a Draft Baseline Risk Assessment has been performed for select indicator chemicals in each environmental medium of concern. Both the SCGs and the Draft Risk Assessment conclusions will be reviewed and used to determine the appropriate remedial alternatives to be evaluated at the Becker Electronics site.

Based upon the media investigated at the Becker Electronics site during the Phase I RI and the data generated from this study, the primary New York State SCGs include the following:

- New York State Department of Environmental Conservation's Ambient Water Quality Standards and Guidance Values

  These water quality standards and guidance values are a compilation of the values contained in 6NYCRR Parts 701, 702, and 703; New York State Department of Health (NYSDOH) regulations 10NYCRR, Subpart 5-1, maximum contaminant levels; and the NYSDOH Part 170 standards. It should be noted that some of the standards are dependent upon the hardness of the water matrix sampled and chemical state.

- New York State Department of Health's Requirements for General Organic Chemicals and Metals in Drinking Water (Public Health Law, Sections 201 and 205), dated January, 1990

  These standards, from 10NYCRR Subpart 5-1, were established to protect the health of those persons that utilize a groundwater or surface water resource as a potable water supply.

- New York State Department of Environmental Conservation's Division of Air Resources, Air Guide-1; Guidelines for the Control of Toxic Ambient Air Contaminants, dated September, 1989

  This document lists Ambient Guideline Concentrations (ACGs) to be utilized as guidance values and standards. These contaminant-specific ACGs have been determined by NYSDEC or NYSDOH. The Air Guide-1 document also incorporates federal standards for criteria pollutants, and National Emission Standards for Hazardous Pollutants (NESHAPs). In addition to the above, Air Guide-1 includes proposed ACGs which may be reviewed only for comparative purposes.

- New York State Department of Environmental Conservation's Division of Air Resources, Air Cleanup Criteria, dated January, 1990

  This document relates specifically to air emissions from contaminated sites. While it references the NYSDEC Air Guide-1 ACGs, it also lists "Action Limits," which are more realistic exposure limitations based upon normally abbreviated remedial construction schedules.

- New York State Department of Environmental Conservation Hazardous Waste Treatment, Storage Disposal Facility Permitting Requirements (6 NYCRR Part 373 et seq.)

  The groundwater protection standards of these requirements are appropriate because many of the known contaminants are those substances listed in the regulations and are potentially present in groundwater above background levels. The hazardous waste requirements applicable to the treatment, storage and disposal of hazardous waste are also potentially applicable to the site.

- New York State Department of Environmental Conservation (6 NYCRR Part 360, Solid Waste Management Facilities)

  The Becker Electronics site may be subject to the requirements of closure in 6 NYCRR Part 360, Solid Waste Management Facilities. Applicable sections of this standard refers to on-site disposal of treated site materials. Technical requirements for cap construction and materials are specified.

- New York State Department of Environmental Conservation's Division of Water, Handling and Storage of Petroleum (6NYCRR Part 613)

  The Becker Electronics site may be subject to the requirements of closure in 6NYCRR Part 613. Applicable sections of this standard refer to closure of out-of-service tanks part 613.9. Technical requirements for tank closure are specified.

- Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) (40 CFR Part 141.11-141.16)

  The Safe Drinking Water Act has set compound-specific Maximum Contaminant Levels (MCLs) (enforceable standards) at concentrations which would minimize adverse health effects relative to waters used for potable supply. These standards will be considered as ARARs for this study only in cases where they are more stringent than the established New York State standards or guidance values, or where New York State ARARs do not exist.

- Resource Conservation and Recovery Act (RCRA) Groundwater Protection Standards (40 CFR Part 264.90-264.109)

  The Resource Conservation and Recovery Act established groundwater protection standards or Maximum Concentration Limits for 14 selected contaminants. These standards mirror those established under the SWDA and should be considered as ARARs only for those cases described above under the SDWA discussion.

- Clean Water Act - Ambient Water Quality Criteria for Protection of Human Health (Fish Consumption Only) and Freshwater Aquatic Life (EPA 44/5-86-001)

  The ambient water quality criteria are non-enforceable guidelines developed under Section 304 of the Clean Water Act and apply to the designated or potential use of the water body of concern. These criteria are "to be considered" (TBC) guidelines for the purpose of this study.

- Toxic Substances Control Act (TCSA) (40 CFR Part 702-799)

  The Toxic Substances Control Act has established rules and regulations pertaining to the disposal of soils contaminated with polychlorinated biphenyls (PCB). PCBs were found in the sediment at the Becker Electronics site. These requirements are to be considered as ARARs for the purposes of this study only if they are more stringent than New York State established standards or where no New York State standards exist.

- New York State Department of Environmental Conservation's Division of Fish and Wildlife Sediment Criteria Guidance, dated December, 1989

  This guidance document provides sediment cleanup criteria for both organic compounds and metals. The document addresses aquatic toxicity, human health residue and wildlife residue for organic compounds, and no-effect levels, lowest-effect levels and limit of tolerance levels for metals.

- Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1900-1999)

  All occupational safety and health requirements are applicable for workers conducting the RI activities. Many OSHA requirements, regarding dermal contact and breathing zone requirements, have been incorporated into the Health and Safety Plan for the site.

- U.S. Army Corps of Engineers Dredge and Fill Departments (CWA, Section 404)

  Any alteration to the sediments of Catskill and Thorp Creeks and its associated wetlands as part of the remedial action at the Becker Electronics site would be subject to the requirements of CWA, Section 404. Applicable sections of these regulations refer to disposal of dredge material wetlands, capping and construction of berms and levees.

In addition to the New York State SCGs listed above, the following guidance documents will be used:

- "Relationship Between Water Solubility, Soil Sorption, Octanol-Water Partitioning, and Concentration of Chemicals in Biota," by E.E. Kenaga and C.A.I. Goring, 1980

  The NYSDEC recommends utilization of this "Partitioning Theory" to calculate cleanup criteria for specified contaminants in soil media, in order to mitigate contaminant leaching and thereby protect groundwater and surface water quality in New York State. This theory is based upon the solubility of compounds in water, and is usable only for select non-polar compounds and not for soluble metals or other polar compounds. In addition, it is recommended that for compounds for which the calculated cleanup criteria are low, alternate criteria, based upon the protection of human health be utilized.

- Eastern United States Background Concentrations of Twenty Elements in Soils, Undated

  This paper, prepared by E. Carol McGovern of the NYSDEC's Wildlife Resources Center, provides information relative to background concentrations of twenty metals detected in soils of the eastern United States.

NYSDEC Sediment and Soil Criteria calculations were performed using the NYSDEC Sediment Criteria Guidance and the NYSDEC Soil Cleanup (Partitioning Theory), respectively, which is based upon the solubility of compounds in water. In addition, if contaminants in sediment were not listed under the NYSDEC Sediment Criteria Guidance, then the Partitioning Theory was considered.

3.4.1 Groundwater - Private Well Water

The primary New York State SCGs for this medium are the NYSDEC Class GA Groundwater Standards and Guidance Values, and the NYSDOH Drinking Water Standards.

3.4.2 Surface Water

The primary New York State SCGs for surface water are the NYSDEC Class C Surface Water standards and guidance values. The Fire Pond and Drainage Ditches are the on-site surface water bodies of concern. Catskill and Thorp Creeks are the off-site surface water bodies of concern relative to this study. Both the on-site and off-site surface water bodies are designated as Class C water bodies (a water body of which is primarily used for fishing). Although the on-site surface water bodies are not used for fishing, per se, they are hydraulically connected to the off-site surface water bodies.

It should be noted that the NYSDEC standards and guidance values for Class C Surface Waters include compounds, the standards for which are based upon the degree of hardness of the surface water and in some cases ionic species and valence of the metal. For such cases, the SCG has been calculated on a sample-specific basis using the hardness values for surface water in the vicinity of the site. The hardness value was obtained from the NYSDEC Bureau of Monitoring and Assessment.

3.4.3 Sediment

Concentrations of contaminants detected in surface water sediments have been compared to those levels calculated or listed in NYSDEC's Sediment Criteria Guidance by the Bureau of Environmental Protection Division of Fish and Wildlife. Where sediment criteria do not exist, concentrations were compared to values calculated using the Partitioning Theory. If an Aquatic Toxicity Value was available for the contaminant, this was used; if not, the Human Health value was considered.

3.4.4 Surface and Subsurface Soil

Concentrations of contaminants detected in surface and subsurface soils (surface and borehole soil and test pit/test trench sampling and analysis) are compared, where applicable, to those levels calculated in accordance with the Partitioning Theory tentatively adopted by the NYSDEC. Such levels will be listed as NYSDEC Soil Cleanup Criteria. This model is used in those cases where the potential exists for contaminants to leach from soils into groundwater supplies. Other guidelines to be considered are the eastern USA background concentrations for metals.

3.4.5 Underground Storage Tanks

The primary New York State SCG for underground storage tanks containing petroleum products is NYSDEC's Handling and Storage of Petroleum (6NYCRR Part 613). The regulation governs the closures of tanks and removal of product.

3.4.6 Air

The New York State SCGs for site contaminants that may be released during remedial actions are covered in NYSDEC's Air Guide-1 and Air Cleanup Criteria documents.

3.5 REMEDIAL ACTION OBJECTIVES/GOALS

Remedial action objectives are site specific goals that address the protection of human health and the environment. These objectives are typically media specific. Establishing remedial action objectives includes considering the chemical contaminants of concern at a site, evaluating exposure pathways and receptors, and presenting acceptable contaminant levels or ranges for each exposure route. The prime focus of the FS is directed at eliminating potential hazards to known human receptors off-site specifically via the groundwater-potable well water pathway. In addition, IRMs are already in operation or being proposed to minimize or eliminate further contamination of site media, and to restrict access to the site and exposure of human populations to on-site and off-site contaminated media. A secondary objective is to protect the ecosystem. The remedial objectives are designed to:

- Prevent significant hazards both on- and off-site to human populations
- Reduce contamination of off-site drinking water supplies to acceptable levels for protection of human health
- Protecting the ecosystems at the site and potentially impacted by the site

Specifically, the remedial action objectives can be described as:

- Remediating groundwater contamination so that use at off-site wells does not pose a hazard to human populations
- Protecting the surface waters from site contamination which would adversely affect their uses
- Reduce significant hazards both on- and off-site to human populations, fish and wildlife

3.6 GENERAL RESPONSE ACTIONS

General response actions for each medium of interest are developed to satisfy the remedial action objectives for the site, the medium or the specific operable unit. The screening process is initiated by identifying broad General Response Actions (GRAs). Associated with GRAs are specific remedial technology types and process options which may be used to implement the GRAs. A screening process is used to identify technologies effective under each of the GRAs.

GRAs to be applied to the Becker Electronics site are based on the NYSDEC TAGM HWR-90-4030. A no-action general response is added to serve as a baseline to assess the effectiveness of other response actions.

According to the NYSDEC TAGM, the hierarchy of preferred remedial actions, from most desirable to least desirable, is as follows:

(1) Destruction: This type of remedy will irreversibly destroy or detoxify all or most of the hazardous substances, pollutants, or contaminants to "acceptable cleanup levels." The treated materials will have no residue containing unacceptable substances, pollutants or contaminants. This type of remedy will result in permanent reduction in the toxicity of all or most of the hazardous substances, pollutants, or contaminants to "acceptable level(s)." Most organic contaminants can be destroyed. Many inorganic hazardous constituents, such as heavy metal contaminants, cannot be destroyed.

(2) Separation/Treatment: This type of remedial action will typically separate the hazardous substances, pollutants or contaminants from the affected media and produce a concentrated waste stream with high levels of contaminants and reduced volumes; e.g., treatment of

contaminated leachate with granular activated carbon. This type of remedy will result in a permanent and significant reduction in the volume of hazardous substances, pollutants or contaminants. In those instances where the concentrated waste stream can then be destroyed or detoxified as in (1) above, preference will be given to this additional treatment.

(3) Solidification/Chemical Fixation: This type of remedy will significantly reduce the mobility of inorganic hazardous substances, pollutants or contaminants. This type of remedy may not significantly reduce the toxicity or volume of the inorganic hazardous substances, pollutants or contaminants, but will significantly and permanently reduce the mobility and hence the availability of the inorganic hazardous substances to environmental transport and uptake.

(4) Control and Isolation Technologies: This type of remedial action will reduce the mobility of organic and inorganic hazardous substances, pollutants or contaminants, but will not significantly reduce the volume or toxicity. Construction of physical barriers to control migration of leachate, contaminated groundwater and surface runoff are included.

GRAs developed in accordance with the above remedial action hierarchy as applicable to specific environmental media of concern at the Becker Electronics site are presented in the following sections:

3.6.1 General Groundwater Response Actions

Table 3-3 presents the general response actions and associated types of potentially applicable remedial technology types for groundwater remediation.

Under the no-action general response action for groundwater remediation, the option no action (natural attenuation) with groundwater monitoring will be evaluated. In addition, institutional restrictions on water use will be evaluated.

Any contaminated groundwater to be treated or disposed of will be collected via groundwater extraction/recovery wells or subsurface drains. Treatment of contaminated groundwater may be performed on-site. On-site treatment measures include in situ methods as well as extractive techniques involving the construction of on-site facilities or use of mobile treatment units.

TABLE 3-3

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR GROUNDWATER REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Monitoring	Groundwater and Sampling and Analysis
Institutional Restriction	Water Use Restrictions
Destruction	
Incineration	Thermal Treatment
Pyrolysis	Thermal Treatment
Wet Air Oxidation	Thermal Treatment
Separation and Treatment	
In situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Extraction/Collection	Extraction/Recovery Wells (Pumping) Well Point System (Pumping) Enhanced Removal Subsurface Drains/Interceptor Trenches Subsurface Barriers
On-site Treatment	Physical Treatment Biological Treatment Chemical Treatment
Off-site Treatment and Disposal (of contaminated groundwater)	Treatment and Disposal at RCRA/TSCA permitted facility
On-site Disposal (of treated groundwater)	Discharge to Surface Water Discharge to Groundwater/Aquifer Recharge
Off-site Disposal (of treated groundwater)	Discharge to Surface Water Discharge to POTW
Control/Isolation	
Control	Extraction/Recirculation
Containment	Horizontal Barriers Vertical Barriers

Technologies screened include destruction (thermal treatment) biological, physical, and chemical treatments. Treated groundwater may be discharged to surface waters, recharged to groundwater, or disposed via a local publicly owned treatment works (POTW) or at a RCRA/TSCA permitted facility. Disposal of untreated residual wastes may be sent to a RCRA/TSCA permitted facility for treatment, destruction, and/or land disposal.

Control measures include extraction and recirculation of groundwater, and installation of barriers to reduce the mobility of contaminated groundwater to mitigate further transport of contaminants.

Section 4.0 of this report will develop process options for groundwater remediation utilizing the technologies presented under the general response actions. These options will then be prescreened for effectiveness and implementability in accordance with NYSDEC guidance.

3.6.2 General Private Well Drinking Water Response Actions

Table 3-4 presents the general response actions and associated potentially applicable remedial technologies for drinking water remediation.

Under the no-action general response action for drinking water, the options of continued private well monitoring (sampling of well water at residences) and no action (no point of use treatment) will be evaluated. However, at the present time identified affected private well systems are treated with activated carbon and this treatment is likely to continue unless it can be shown that the use of untreated well water poses no significant health risks.

In addition to point-of-use treatment, connection to an existing community water supply system or the development of a community water supply system to serve the residences/commercial establishments affected by the contamination will be evaluated.

Section 4.0 of this report will develop process options for each of these technologies presented under the general response actions for private well water

TABLE 3-4

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR PRIVATE WELL (DRINKING WATER) REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Monitoring	Private Well Sampling and Analysis
Separation/Treatment	
Point-of-Use Treatment Units	Chemical Treatment Physical Treatment
	Chemical Treatment Physical Treatment
Community Water Supply System	
Connection to an existing community water supply system	
Development of New Community Water Supply System	

contamination. In addition, these options will be prescreened for effectiveness and implementability in accordance with NYSDEC guidance.

3.6.3 General Surface Water Response Actions

As discussed in Section 3.3.3 currently available data indicates that surface water remedial measures may be warranted. Additional data will be collected and evaluated during the Second Phase Remedial Investigation to better define the contaminants and to delineate the extent of contamination in this medium. The results of this data will then be used to determine if remedial actions are necessary. However, this section, which is based on preliminary data, discusses the general response actions which could be implemented if further investigation determines that mitigation measures are required. Table 3-5 presents the general response actions and associated remedial technologies for potential surface water remediation. There are two surface water matrices of concern associated with the Becker Electronics site. These are the Fire Pond and Drainage Ditches on-site. Catskill and Thorp Creeks which are off-site surface water bodies have not been found to be significantly impacted by site contamination at the present time.

General response actions for all surface water matrices include no-action, destruction, separation/treatment and control/isolation alternatives. Under the no action alternative, access and/or use restrictions are considered. Use restrictions may include prohibitions or limitations to be imposed on the surface waters for drinking, bathing, or fishing.

Surface water requiring treatment may be collected through various surface controls designed to divert flow. Treatment technologies include various thermal, biological, chemical, and/or physical process options. After treatment, waters can be discharged back to the surface water body or to a local POTW for additional treatment with subsequent discharge typically to surface waters.

Control measures to prevent contact with contaminants of concern in surface water may include liners, barriers and surface control measures.

TABLE 3-5

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SURFACE WATER REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis
Use Restrictions	Drinking Bathing Fishing
Destruction	
Pyrolysis	Thermal Treatment
Separation/Treatment	
Collection	Surface Controls
Treatment	Biological Chemical Physical
Discharge (after treatment)	Discharge to POTW Discharge to Surface Waters
Control/Isolation	
Control	Diversion/Collection Surface Controls
Containment	Barriers

These actions will be further evaluated after the Second Phase Remedial Investigation has been completed and the data has been analyzed and evaluated.

3.6.4 General Sediment Response Actions

As discussed in Section 3.3.4 currently available data indicate that sediment remedial measures may be warranted. Additional data will be collected during the Second Phase Remedial Investigation to better define the contaminants and to delineate the extent of contamination in this medium. The results of this data will then be used to determine if remedial actions are necessary. However, this section, which is based on preliminary data, discusses the general response actions which could be implemented if further investigation determines that mitigation measures are required. Table 3-6 presents the general response actions and associated remedial technologies for sediment remediation.

If sediment removal is required, dredging and dewatering processes are to be evaluated to reduce volume and increase solids content of dredged sediment.

Applicable technologies for sediment remediation are grouped into the no action, destruction, separation/treatment, solidification/chemical fixation and control/isolation groups of general response actions. The no action response for sediment remediation, as well as for most of the other environmental media, involves implementing access or institutional restrictions such as fencing or deed restrictions, respectively, along with long-term monitoring for changes in site conditions over time.

Destruction technologies to be considered for evaluation include incineration, and pyrolysis processes. Treatment actions such as biological, chemical and/or physical processes may be utilized in situ or for excavated sediments. Either on-site or off-site treatment facilities may be considered.

If contaminated sediment is to remain on-site, solidification or chemical fixation measures can be considered for reducing the mobility of contaminants. Such methods include solidification, chemical fixation, stabilization and immobilization process options. Containment actions that isolate the

TABLE 3-6

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SEDIMENT REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis of Groundwater
Destruction	Incineration Pyrolysis
Separation/Treatment	
In Situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Dredging/Off-site Disposal	Disposal at RCRA or TSCA permitted facility
Dredging/On-site Treatment and Disposal	Dewatering Biological Treatment Chemical Treatment Physical Treatment
Dredging/Off-site Treatment and Disposal	Treatment at RCRA or TSCA permitted facility
Solidification/Chemical Fixation	Solidification/Fixation
Control and Isolation	
Containment	Barriers Cover/Sealing

contaminants are also considered. These include various barriers, sealing and covers to mitigate the mobility of contaminants or to isolate contact with contaminated sediment.

These actions will be further evaluated after the Second Phase Remedial Investigation has been completed and the data has been analyzed and evaluated.

3.6.5 General Soil Response Actions

Currently available data indicates that surface soil contains numerous contaminants of concern including volatile organic compounds, semi-volatiles and metals. The semi-volatile bis(2-ethylhexyl)phthalate and the metals beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, nickel, and zinc all exhibited high detection frequencies with respect to concentrations exceeding SCGs and are found throughout the site. However, since the natural background levels of metals have not been determined for this specific area, background soil samples will be tested during the Second Phase RI to provide more appropriate guidance values. These soils were likely contaminated by past waste disposal practices, as well as ongoing degradation of waste debris piles. The contaminated surface soils represent a potential source of contamination with respect to all surface water bodies on-site and may impact off-site locations to some extent.

The Phase I RI also identified contaminants of concern for subsurface soils. These include the following metals: beryllium, cadmium, calcium, cobalt, iron, nickel, and zinc. The primary path of migration for contaminants in subsurface soil would be via groundwater. Due to the presence of leaching fields utilized for the disposal of industrial wastes, there is potential for considerably more contaminated subsurface soil than that detected from soil borings.

Therefore, as discussed above and in Section 3.3.5 currently available data indicates that soil remedial measures may be warranted. Additional data will be collected and evaluated during the Second Phase Remedial Investigation to provide site specific background values, to better define the contaminants and delineate the extent of contamination in the medium. The results of this data will then be used to determine if remedial actions are necessary. This section, which is based on preliminary data, discusses the general response actions which could be implemented if data collected during the Second Phase Remedial Investigation indicates that mitigation measures are required. Table 3-7 presents the general response actions and associated remedial technologies for soil remediation.

Response actions and applicable remedial technologies for soil are similar to those for the sediment remediation previously discussed. Noticeably different are the excavation processes that would be utilized to remove contaminated soils compared to dredging methods for sediments.

These actions will be further evaluated after the Second Phase Remedial Investigation has been completed and the data has been analyzed and evaluated. However, since the site is only partially fenced, and in need of some repair, exposure to on-site surface soil contamination will be addressed by an IRM. See Section 3.7.

3.6.6 General Septic System Response Actions

A section of this matrix will be remediated via an IRM as discussed in Section 3.7 of this report. Additional data will be collected and evaluated during the Second Phase Remedial Investigation to better delineate the extent of contamination in the associated medium. The results of this data will then be used to determine if further remedial actions are necessary. This section, based on preliminary data, presents the general response actions and associated potentially applicable remedial technologies. These may be used for additional septic system remediation if data collected during the Second Phase Remedial Investigation indicates that further mitigation measures are required. Tables 3-8 and 3-9 list these potentially applicable remedial technologies. Response actions and applicable remedial technologies for the liquid and sediment (sludge) fractions in the septic systems are similar to those previously discussed for the sediment, soil and groundwater remediation, respectively. The excavation and removal processes of the medium in the tank may differ from the removal process discussed for the other media in that the entire septic systems (i.e., liquid and sludge) may be removed via a vacuum truck and taken for off-site treatment and

TABLE 3-7

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SOIL REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis of Groundwater
Destruction	Incineration Pyrolysis
Separation/Treatment	
In situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Excavation/Off-site Disposal	Disposal at RCRA or TSCA permitted facility
Excavation/On-site Treatment and Disposal	Biological Treatment Chemical Treatment Physical Treatment
Excavation/Off-site Treatment and Disposal	Treatment at RCRA or TSCA permitted facility
Solidification/Chemical Fixation	Solidification Fixation Stabilization
Control and Isolation	
Control	Surface Controls
Containment	Capping/Sealing Barriers

TABLE 3-8

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SEPTIC SYSTEM REMEDIATION (LIQUID)

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis of Groundwater
Destruction	Incineration Pyrolysis
Separation/Treatment	
In situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Collection	Pumping Vacuum Truck Removal
On-site/Off-site Treatment	Biological Treatment Chemical Treatment Physical Treatment
On-site/Off-site Disposal (after treatment)	Surface Water Discharge Reinjection/Infiltration Local POTW
Control and Isolation	
Containment	Barriers Capping/Sealing

TABLE 3-9

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SEPTIC SYSTEM REMEDIATION (SLUDGE/SEDIMENT)

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action (Natural Attenuation)	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis of Groundwater
Destruction	Incineration Pyrolysis
Separation/Treatment	
In situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Pumping/On-site Treatment and Disposal	Dewatering Biological Treatment Chemical Treatment Physical Treatment
Vacuum Truck Removal/Off-site Treatment and Disposal	Treatment and Disposal at RCRA or TSCA permitted facility
Solidification/Chemical Fixation	Solidification Fixation Stabilization
Control and Isolation	
Containment	Barriers Capping/Sealing

disposal to a permitted facility.

Section 3.7 of this report proposes an IRM to address the contamination in the septic tanks which are part of these systems.

3.6.7 General Debris Pile Response Actions

As discussed in Section 3.3.7 the data currently available for this medium although limited indicate that remedial measures may be necessary. Additional data, which will be collected and analyzed during the Second Phase Remedial Investigation, are required to further assess the extent of contamination and any impacts this medium may be having on other site media. After the results of the additional data are available the mitigation measures will be further evaluated. Although this matrix will be further evaluated upon completion of the Second Phase Remedial Investigation this section presents the general response actions and associated potentially applicable remedial technologies which may be necessary for remediating the debris piles. Table 3-10 lists these general response actions and potentially applicable remedial technologies.

Response actions and applicable remedial technologies for the debris piles are grouped into no action, destruction, separation/treatment, solidification/chemical fixation and control/isolation groups of general response actions. The no action response for debris pile remediation involves implementing access or institutional restrictions such as fencing or deed restrictions, respectively, along with long-term monitoring for changes in site conditions over time.

Destruction technologies to be considered for evaluation include incineration and pyrolysis processes. Treatment actions such as biological, chemical and/or physical processes may be utilized in situ or for excavated debris. Either on-site or off-site treatment facilities are to be considered.

If the debris pile is to remain on-site, solidification or chemical fixation measures can be considered for reducing the mobility of contaminants. Such methods include solidification, chemical fixation, stabilization and

TABLE 3-10

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR DEBRIS PILE REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action	
Access/Institutional Restrictions	Fencing Deed Restrictions
Monitoring	Sampling and Analysis of Groundwater
Destruction	Incineration Pyrolysis
Separation/Treatment	
In situ Treatment	Biological Treatment Chemical Treatment Physical Treatment
Excavation/Off-site Disposal	Disposal at RCRA or TSCA permitted facility
Excavation/On-site Treatment and Disposal	Biological Treatment Chemical Treatment Physical Treatment
Excavation/Off-site Treatment and Disposal	Treatment at RCRA or TSCA permitted facility
Solidification/Chemical Fixation	Solidification Fixation Stabilization
Control and Isolation	
Control	Surface Controls
Containment	Capping/Sealing Barriers

immobilization process options. Containment actions that isolate the contaminants are also considered. These include various barriers, sealing and covers to mitigate the mobility of contaminants or to isolate contact with the debris.

These actions will be further evaluated after the Second Phase Remedial Investigation is completed and the data has been analyzed and evaluated.

3.6.8 General Underground Storage Tank Response Actions

This matrix will be referred to by the NYSDEC Spill Response Unit. However, this section presents general response actions and potentially applicable remedial technologies, which could be implemented, if necessary, for remediating the storage tank. Table 3-11 lists these general response actions and associated potentially applicable remedial technologies for the tank remediation.

Response actions and applicable remedial technologies for the tank and possible fuel in the tank include no action and monitoring, and removal, treatment, and disposal of the fuel and the tank. Similarly to the septic system response the contents of the tank may be removed via a vacuum truck and taken off-site for treatment and disposal to a permitted facility. The tank could then be excavated and disposed of at a permitted facility. No control/isolation measures are included because it is assumed the system is closed and not leaking. If further investigation proves that this is incorrect then contaminated media surrounding the tank will be remediated.

3.7 PROPOSED IRMS

IRMs are proposed in the RI report to address contamination both existing in and resulting from the following on-site media and operable units:

- Septic Systems
- Surface Soil

The two IRMs proposed for the Becker Electronics site are directed to accomplish these general objectives:

TABLE 3-11

GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR UNDERGROUND STORAGE TANK REMEDIATION

General Response Action	Potentially Applicable Remedial Technology
No-Action	
No-Action	
Monitoring	Sampling and Analysis of Groundwater
Separation/Treatment	
Vacuum Truck Removal of Fuel/Off-site Treatment and Disposal of Fuel	Treatment and Disposal at RCRA or TSCA permitted facility
Excavation of Tank/Off-Site Disposal of Tank	Disposal at RCRA or TSCA permitted facility

- Restrict access to site
- Remove sources of further contamination

The proposed IRMs deal with the following issues:

- Repair existing fence and gate and new fence installation where necessary to restrict access to site in order to reduce contact with contaminated surface soils and other media of concern

- Removal of contaminated sludge/sediment and liquid in the septic tanks.

While available data indicate that human health issues associated with surface soil contaminants are moderately low, access to the site should be restricted. Existing septic systems (and underground fuel storage tank) are potential sources of subsurface soil and groundwater contamination.

Additional site study is recommended in the RI Report for a Second Phase Investigation of surface soil to delineate hot spots for subsequent removal and disposal. The present risks associated with contact with surface soil are addressed by the IRM limiting access to the site.

Additional site study is recommended to determine if another underground storage tank is present on site (near the fuel pump) and if it contains any fuel. If another tank is located then the proposed responses dealing with the known on-site underground storage tank can be applied in the future.

Groundwater

The highest calculated potential health risk exposure is associated with the groundwater pathway. Ingestion of and contact with potential contaminants in potable wells surrounding the site presents the highest health risks (see Draft Baseline Health Risk Assessment). The situation has been addressed by prior IRM's which involved the installation of point of use treatment systems on identified affected wells. Maintenance of these treatment systems is being performed on an on-going basis.

The FS will examine the various options available and applicable to treating contaminated groundwater at the site, and at private drinking water wells, in addition to the point-of-use treatment.

Section Four

SECTION 4

4.0 IDENTIFICATION AND INITIAL TECHNICAL SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES

This section of the Feasibility Study identifies and screens specific remedial technologies for destruction, removal, separation and treatment, and disposal, and/or containment (fixation or control/isolation) of specific contaminants identified in the environmental media of concern at the Becker Electronics site in accordance with the NYSDEC TAGM HWR-90-4030. The identification of remedial technologies is done in order to present an adequate number of technologies, along with their associated process options, which are appropriate for remediating contaminated media at the site and surrounding study area. The initial screening of each remedial technology is performed to determine whether it is effective to satisfy the applicable standards, criteria and guidelines (SCGs), and can be implemented technically. A detailed description of process options for each general response action (GRA) and applicable technology is provided below. Technologies remaining after this initial screening process are then assembled, either singularly or in combination, to form remedial alternatives that address the complete remediation of the contaminated media.

4.1 POTENTIALLY APPLICABLE GROUNDWATER REMEDIATION TECHNOLOGIES/REMEDIES

Remedial technologies and associated process options for groundwater treatment are listed and prescreened in Table 4-1. Various remediation technologies, alone or in combination, may be required for the treatment of groundwater at the site. The known and potential contaminants in the groundwater at the Becker Electronics site and surrounding area are primarily volatile organic compounds (VOCs) and metals, respectively. Therefore, only those technologies that will contain, remove or reduce the level of these types of contaminants (VOCs and metals) will be discussed. A few semi-volatile organic compounds and one pesticide were detected, however, they are not contaminants of concern based on the results of the Draft Risk Assessment and based on applicable state criteria and guidelines.

TABLE 4-1

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR GROUNDWATER BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
No Action					
No Action/Natural Attenuation	None	N/A	No Action	Y	Consideration Required
Monitoring	Monitoring	N/A	Monitoring of Groundwater	Y	Applicable
Institutional Restrictions	Water Use	N/A	Restrictions on Water Use	Y	Potentially Applicable
	Deed Restrictions	N/A	Deeds for Property in the Area May Include Future Restrictions	N	Not Necessary
Destruction	Thermal	Incineration Pyrolysis Wet Air Oxidation	Destruction of Organic Contaminated Waste Streams Using High Temperature Treatment	Y	Potentially Applicable
Separation/Treatment					
In Situ Treatment	Biological	Biodegradation	Breakdown of Organic Contaminants through Microbial Degradation	N	Not Applicable Due to Site Specific Conditions
	Chemical	Permeable Treatment Beds	Downgradient Trenches Filled with Various Treatment Materials to Remove Contaminants	N	Not Applicable Due to Site Specific Conditions
	Physical	Physical Treatment Processes	Membrane System Technologies Carbon Adsorption (See Description Under Chemical Treatment - Permeable Treatment Beds)	N	Not Applicable Due to Site-Specific Conditions
Collection	Pumping	N/A	Extraction of Groundwater through Wells	Y	Potentially Applicable

TABLE 4-1 (Continued)

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR GROUNDWATER
BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
Collection (Cont'd)	Enhanced Removal	N/A	Use of Injection and Extraction Wells to Enhance Groundwater Removal	N	Not Applicable Due to Site Specific Conditions
	Subsurface Drains	Interceptor Trenches	Installation of Subsurface Conduits to Collect and Convey Groundwaters	N	Not Applicable Due to Site Specific Conditions
	Subsurface Barriers	Cut-Off Walls, Piling, Grout	Installation of Low Permeability Walls or Diversions Below Grade to Contain or Direct Groundwaters	N	Not Applicable Due Site Specific Conditions
On-Site Treatment	Biological Treatment	Biodegradation	Breakdown of Organic Contaminants through Microbial Degradation	N	Not Applicable Due to Types and Levels of Contaminants in Groundwater
		Enhanced-Activated Sludge/ Powdered Activated Carbon	Physical Adsorption and Biological Oxidation	N	Not Applicable Due to Types and Levels of Contaminants in Groundwater
	Chemical Treatment	Neutralization	Chemical Adjustment to pH of a Waste Stream	Y	Potentially Applicable
		Oxidation/ Reduction	Use of a Reagent to Detoxify a Contaminant	Y	Potentially Applicable
		pH Adjustment/ Precipitation/ Flocculation	Process where Contaminants (Metals) precipitated as Solids then Agglomerate to Facilitate Settling	Y	Potentially Applicable

TABLE 4-1 (Continued)

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR GROUNDWATER
BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
On-Site Treatment (Cont'd)	Chemical Treatment (Cont'd)	Iron-based Coprecipitation	Process where Soluble Ferrous Ions are Added to the Waste Stream, which Oxidize and Entrap Metals in an Insoluble Iron Matrix when Iron is Precipitated from the Solution	Y	Potentially Applicable
		Ion Exchange	Process where Wastewater is Passed through an Ion Exchange Resin and Metal Ions Exchange with the Cations (or Anions) at the Charged Sites on the Resin	Y	Potentially Applicable
	Physical Treatment	Flow Equalization/ Detention	Process Used to Regulate Fluctuations in Wastewater Flows and Varying Concentrations of Contaminants in order to Prevent the Upsetting of Downstream Treatment Units	Y	Potentially Applicable
		Sedimentation	Process Used to Remove Suspended Solids form the Wastewater Prior to Downstream Treatment Units. Provide Settling by Use of Gravitational Forces	Y	Potentially Applicable

TABLE 4-1 (Continued)

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR GROUNDWATER
BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
On-Site Treatment (Cont'd)	Physical Treatment (Cont'd)	Filtration	Process Used to Remove Suspended Solids from Wastewater Prior to Downstream Treatment Units as well as a Final Polishing Step After Treatment Units. Removal of Suspended Particles by Filtering through a Porous Medium	Y	Potentially Applicable
		Carbon Adsorption	Removal of Wastes by Passing Waste Streams through Carbon Adsorption Columns	Y	Potentially Applicable
		Air Stripping	Removal of VOCs through Air Stripping	Y	Potentially Applicable
		Steam Stripping	Passing of Steam through the Aqueous Waste Stream to Remove VOCs	N	Not Applicable Due to Levels of Contaminants in Site Groundwater
		Freeze Crystallization	Freezing Process Used to Separate Hazardous Waste Components in a Waste Stream	N	Not Applicable Due to types and Levels of Contaminants in Site Groundwater
		Reverse Osmosis	Membrane Separation Process	N	Not Applicable Due to Types and Levels of Contaminants in Site Groundwater
		Ultrafiltration	Membrane Separation Process	N	Not Applicable Due to Types and Levels of Contaminants in Site Groundwater
Off-Site Treatment	Biological Chemical Physical	See On-Site Treatment Options	Collected residual wastes are Treated by Off-Site RCRA Permitted Facilities	Y	Potentially Applicable

TABLE 4-1 (Continued)

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR GROUNDWATER BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
Disposal (After Treatment)	Discharge to Surface Waters	N/A	Discharge Treated Groundwaters to Nearby Surface Water	Y	Potentially Applicable
	Discharge to Groundwater	Leaching Field Recharge Basin Injection Wells	Recharge of Groundwater with Treated Effluent	N	Not Applicable Due to Site Specific Conditions
	Discharge to Collection System then to a POTW	N/A	Discharge Treated Waters into Separate Sewer System, Possible Further Treatment by Local POTW	N	POTW Cannot Accept Any Additional Water
Control/Isolation	Subsurface Vertical Barriers	Slurry Walls Grout Injection Sheet Piling	Install Low Permeable Walls to Control, Contain or Redirect Groundwater Flow	N	Not Applicable Due to Site Specific Conditions
	Horizontal Barriers	Capping	Installation of Various Capping Methods to Reduce Leaching of Contaminants to Groundwaters	Y	Potentially Applicable

4.1.1 No-Action

The selection of this remedial action alternative would mean that contaminated groundwater at and adjacent to the Becker Electronics site would not be contained, collected, treated or disposed. Natural attenuation would be the process by which degradation and/or dilution of the hazardous waste constituents would occur. The selection of the no-action alternative would require groundwater monitoring at the site and in surrounding areas to assure protection of public health concerns. The existing monitoring wells at the site and possibly off-site private wells could be used for monitoring the groundwater. This alternative will be retained as a baseline for comparison with other alternatives selected.

4.1.1.1 Institutional Restrictions

Institutional restrictions are not a category of technologies but several types of restrictions or institutional controls which can be used when no remediation measures will be implemented. The restrictions for this matrix may include water use restrictions and permitting requirements.

Water Use Restrictions. Water use restrictions may include prohibiting use of the water for domestic purposes. It would require an alternate water supply for residential use. The restrictions may require that the New York State Department of Health issue notices to nearby property owners to prohibit such uses and enforce these notices via property easements. It may also include adding new laws regulating well installation. Currently New York State does not issue well permits.

These types of requirements might restrict or regulate the depth and placement of all wells at the site or in the vicinity of the contamination. They may be regulated by the county government or the state. All residents or potential developments would be required to abide by these laws. New well permit requirements might be necessary and would require residents and developments to have their wells monitored on a regular basis to determine if the contaminants have migrated into their wells. In addition, if contaminants have been found in residential and development wells, the regulations may require that residents install a technology to remove the contaminants from the water. These types of restrictions may be difficult to implement. They will constitute the legal "taking" of property if the orders do not have a time limitation. They can be developed into a viable alternative for the site and therefore will be retained for additional evaluation.

Deed Restrictions. Deed restrictions may be similar to water use restrictions in that they would prohibit certain activities on the property (i.e., the use of groundwater for residential or agricultural purposes). Unlike water use restrictions, deed restrictions require voluntary agreement by the owners of the property.

Deed restrictions are very difficult to implement. They require voluntary agreement by the owner and they result in taking the owners' property which is a restraint on alienation. Therefore, if the groundwater cleanses itself a permanent deed restriction would not be necessary. For these reasons this alternative is infeasible and will not be retained for further evaluation.

4.1.2 Destruction Technologies

Destruction technologies result in irreversibly destroying or detoxifying all or most of the hazardous substances, pollutants or contaminants. The treated materials will have no residual contaminants. This type of remedy results in a permanent reduction in the toxicity in all or most of the hazardous materials. Destructive technologies are mostly thermal types of treatments involving oxidation processes. The nature of this medium and site geological conditions require that the groundwater be extracted and collected prior to treatment. Therefore destruction technologies will be discussed under on-site treatment in Section 4.1.3.3 of this report.

4.1.3 Separation and Treatment Technologies

Separation and treatment technologies result in a permanent and significant reduction of the volume and/or toxicity and/or mobility of hazardous waste. Where these processes result in concentrating waste streams which then can be further treated and detoxified, preference will be given to these additional treatment processes.

Separation technologies for groundwater remediation at the Becker Electronics site would involve collection of contaminated groundwater, for subsequent treatment and disposal.

Remedial treatment alternatives for groundwater include in situ, on-site and off-site technologies. Disposal options for treated groundwater at the Becker Electronics site include recharge of groundwater, discharge to a surface water body, or discharge to a local POTW. In addition, untreated groundwater may be disposed at a RCRA/TCSA permitted facility. Residual wastes, end products of the treatment process, (e.g., metallic sludge, spent carbon, etc.) may be disposed off-site at RCRA/TSCA permitted facilities. Control and isolation technologies may include extraction and recirculation of contaminated groundwater and construction of subsurface barriers as discussed in Section 4.1.3.2 and 4.1.4, respectively. The following subsections will discuss each of these remedial alternatives for contaminated groundwater.

4.1.3.1 In Situ Treatment of Contaminated Groundwater

In situ treatment technologies involve treating contamination in place rather than physically removing the contaminated medium and treating at an on-site or off-site treatment facility. Various biological, chemical and physical methods may be employed for in situ treatment of contaminated groundwater as discussed below.

Biological Treatment: Biodegradation, also commonly known as bioreclamation, uses microorganisms to breakdown organic contaminants. Aerobic processes sometimes require that oxygen be provided along with nutrients via injection wells to enhance microbial activity. Anaerobic treatment techniques achieve the reduction of organic matter, in an oxygen free environment. Anaerobic digestion can handle certain halogenated organics better than aerobic treatment. Aerobic/anaerobic processes have been used in conjunction and can be utilized in situ; however, when used as a controlled treatment process, an air-tight reactor is required for the anaerobic process.

In situ biological treatment systems are difficult to implement due to the need to control and maintain optimal conditions for microbial activity. In addition, certain types of contaminants in site groundwaters (i.e., metals) may inhibit microbial growth or may poison the microbes. The site groundwater is flowing through a fractured bedrock aquifer making containment and thus control of conditions technically infeasible. In addition, some of the of the contaminants (e.g., metals) cannot be treated via this process to meet applicable cleanup levels. Therefore, this technology is eliminated from further evaluation.

Chemical Treatment. In situ chemical treatment processes involve detoxification methods which include neutralization, hydrolysis, oxidation/reduction and enzymatic degradation. Permeable treatment beds can be utilized to administer the previous detoxification methods to contaminated groundwater. Permeable treatment beds are excavated trenches installed perpendicular to, and downgradient of, groundwater flow and filled with appropriate materials to treat the contaminated groundwater as it flows through the material. Materials that can be used in these permeable treatment beds are limestone, activated carbon, crushed sea shell, glauconitic green sands, and synthetic ion exchange resins. The use of these materials can neutralize acidic groundwater, remove heavy metals, and remove non-polar organic compounds. Systems such as these would be most applicable to relatively shallow groundwater tables. Groundwater at the site is flowing through a fractured bedrock aquifer. The direction and depth of water flow makes it technically infeasible to intercept and treat the contaminated groundwater via this method. Other problems associated with this technology include the high cost associated with the purchase and maintenance of treatment materials, the short bed life, bed saturation and plugging of the bed with precipitates. Additionally, the groundwater is contaminated with a variety of contaminants (i.e., VOCs and metals) that may require more than one treatment agent. Therefore, this technology is eliminated from further evaluation.

Physical Treatment. Physical treatment processes including membrane system technologies, carbon adsorption, air stripping and steam stripping have been used for treating contaminants in groundwater. However, implementing them as in situ treatment processes at the Becker Electronics site is technically infeasible because the contaminated groundwater at the site is flowing through a fractured bedrock aquifer. The direction and depth of water flow and the fact that this is a fractured bedrock aquifer (i.e., containment of water is probably not possible) makes it technically infeasible to ensure that the contaminated groundwater can be treated to required clean-up levels. Furthermore, the presence of various types and levels of contaminants (i.e., VOCs and metals) in the groundwater requires the use of several technology types that complicate treatment processes. Under in situ conditions the needed controls are difficult to maintain. Therefore, due to these reasons, this technology will be eliminated from further evaluation.

4.1.3.2 Extraction/Collection of Contaminated Groundwater

Extraction/ collection technologies to remove, contain, and/or redirect contaminated groundwater can be used in conjunction with on-site or off-site treatment or off-site disposal. Extraction of groundwater utilizing various pumping and gravity drain technologies are discussed below.

Groundwater Pumping: In general, groundwater pumping typically involves the removal of contaminated groundwater using subsurface pumps installed in groundwater extraction wells. Groundwater containing dissolved contaminants can be removed using conventional extraction well and pump designs or possibly a well point system. A conventional well and pump design involves the installation of individual, separately-operated recovery/extraction wells to remove contaminated groundwater for treatment. A well point system involves the installation of a system of interconnected recovery/extraction wells. In both designs, the extraction wells would be located downgradient of the main areas of contamination. The groundwater would be pumped with submersible pumps at rates determined by hydrogeological considerations. Based on the flow rate, and other factors such as radii of influence, water table depression, etc., the required number of extraction wells can be determined.

Recovery wells and well point systems can be installed in both unconsolidated deposits of the overburden aquifer and fractured bedrock of the shallow portion of the bedrock aquifer. Well point systems are best suited for shallow aquifers where extraction is needed at less than 22 feet below the ground. Recovery wells can be used for extraction depths greater than 20 feet. Pumping from both aquifers (overburden and bedrock) would be technically feasible and effective if a system to effectively intercept contaminated groundwater could be designed and constructed. Groundwater modeling could assist in this effort to identify optimal well locations. Because of its demonstrated effectiveness and wide acceptability, groundwater pumping will be retained for further discussion and evaluation.

__Enhanced Removal Technology:__ Enhanced removal technology involves the construction of injection wells to enhance plume removal or to control plume movement. The contaminated groundwater at the Becker Electronics site is flowing through bedrock in several possible directions and therefore an enhanced removal system would not accelerate or aid in the collection of the contaminated groundwater. It might even accelerate the movement of the contaminated groundwater away from the Becker Electronics site. Therefore it will not be retained for further evaluation.

__Subsurface Drains/Interceptor Trenches:__ This technology includes installation of a buried conduit to collect and convey groundwater by gravity flow. This method typically includes a drain pipe or gravel bed (interceptor trenches, french drains, tile drains), to convey groundwater flow to the drain or bed, a filtering system, backfill to prevent ponding, and a pump system for groundwater removal for subsequent treatment and/or disposal.

The system is a passive collection system. One disadvantage is that it would likely require more time to remove a given volume of groundwater than an active system using extraction wells. Trench drains do not draw the groundwater into the trenches as do extraction wells. In addition, trench drains are mainly applicable where contaminated groundwater exists in shallow zones. Another disadvantage would be the large quantity of suspended solids that would collect in the trenches. The suspended solids would interfere with and inhibit effective operation of collection and treatment processes. Due to site specific conditions, the contaminated groundwater being in a bedrock aquifer, this technology would not be very effective and would be difficult to implement. Therefore, it will not be retained for further evaluation.

Subsurface Barriers: This refers to methods that require installation of low permeability cut-off walls or diversions below the ground surface that control, contain or redirect groundwater flow. These include walls of soil/bentonite, cement/bentonite, grouted barrier/slurry walls or sheet pilings. Grouting can also be used in certain situations to install a horizontal barrier to seal the bottom of contaminated areas. Because the groundwater at the site is flowing through a fractured bedrock aquifer subsurface, barriers would be difficult to install. Such barriers would not be effective in containing the groundwater, since it would be difficult to ensure that all voids and fractures have been filled. Therefore, this technology will not be retained for further evaluation.

4.1.3.3 On-Site Treatment of Contaminated Groundwater

Once collected, contaminated groundwater can be treated for metals and organics removal to meet New York State chemical-specific standards, criteria or guidelines (SCGs), then either be recharged to groundwater, discharged to surface water or otherwise disposed. Treatment on-site could be by either biological, chemical, physical or thermal processes or a combination of these processes. Individual processes can be assembled into treatment trains to remove different types of contaminants.

Biological Treatment: Organic matter can be broken down to simpler substances by microorganisms using aerobic and anaerobic mechanisms. In general, aerobic processes are more often used for biodegradation because the process is more rapid and more complete, and produces fewer undesirable end products (methane, hydrogen sulfide). Anaerobic degradation, however, is effective for dehalogenation.

In aerobic respiration, organic molecules are oxidized to carbon dioxide (CO_2), water, and other end products using oxygen. Oxygen may also be incorporated into intermediate products of microbial catabolism making them more susceptible to further biodegradation.

All aerobic microorganism require adequate levels of mineral and organic nutrients, growth factors (vitamins, magnesium, copper, manganese, sulfur, potassium, etc.), water, oxygen, carbon dioxide and sufficient biological space for survival and growth. Recently developed specially adapted and/or genetically engineered bacteria have been shown to be effective for treating specific hazardous wastes.

Anaerobic biological treatment processes achieve the reduction of organic matter to methane and carbon dioxide in an oxygen-free environment. This is accomplished by using cultures of bacteria which include facultative and strict anaerobes. The strict anaerobes require totally oxygen-free environments. A number of proprietary engineered processes based on such systems are actively being marketed, each with distinct features.

The volatile organics found in the groundwater underlying the Becker Electronics site are halogenated, and thus are difficult to biodegrade, particularly via aerobic biological treatment. Aerobic biological treatment would not achieve comparable removal to other more proven technologies. Aerobic biodegradation is therefore eliminated from further consideration.

Anaerobic digestion can handle certain halogenated organics better than aerobic treatment. Anaerobic degradation can take place in native media or in a controlled treatment process such as an airtight reactor. In the later case, it is common to vent or burn (flare) the methane and other gases formed. However, volatile hazardous materials could be released via such gas venting or flaring systems. Thus, controlled off-gas burning could be required. The low level of contaminants in the groundwater would not provide enough nutrients to support the microbes. Additional nutrients would be required. In addition, the environment for this system must be carefully controlled and maintained in order to provide optimal conditions for microbial activity. Any slight upset in the system can adversely affect the microbes' ability to degrade the contaminants and possibly not meet effluent criteria. Since the level of contaminants in the groundwater is low, and the level of control and maintenance required for the system is high, and other proven technologies are available it is not feasible to use this technology. Therefore, it is eliminated from further consideration.

Powdered Activated Carbon Enhanced-Activated Sludge: Powdered Activated Carbon Enhanced-Activated Carbon Treatment (PACT) is a proprietary process developed by Dupont and currently offered by Zimpro Passavant. This process combines physical adsorption and biological treatment by adding powdered activated carbon to the activated sludge system in order to improve the removal of organics, toxics and other resistant compounds. Physical adsorption and biological oxidation take place in the same vessel of the PACT system. Following aeration, the treated wastewater settles in a clarifier. The effluent is drawn off, and spent carbon and biological sludge are either recycled or wasted. The wasted sludge portion can be dewatered to a high-solids cake and disposed of. The spent carbon can be regenerated thus renovating the carbon for reuse.

This system may be effective in the adsorption and treatment of a number of volatile organics and metals. However, successful operation of biological degradation processes are questionable. Any biological upset of the PACT system can produce an effluent that does not meet the cleanup levels. Once the upset takes place, it would take several days or even longer to get the system functioning effectively again. Furthermore, the levels of contaminants in the groundwater are insufficient to support the microbes and additional nutrients would be required. The use of activated carbon by itself will remove the low levels of volatile organic contaminants in the groundwater. Therefore, for these reasons this technology has been eliminated at this point.

Chemical Treatment: Chemical treatment processes involve the use of specific chemicals to contaminated media to achieve detoxification. Chemical treatment is used to transform the waste to an innocuous or less toxic form through a variety of chemical processes including neutralization, oxidation or reduction, as discussed below.

- Neutralization - Neutralization is used to adjust the pH of a waste stream to an acceptable level for discharge or treatment. Neutralization can be used as a pretreatment process or for post-treatment. The pH is adjusted by adding acids or bases as appropriate. Therefore, this technology will be retained for future consideration.

- Oxidation/Reduction - These are processes by which the oxidation state of a contaminant is changed by loss or gains of electrons. Oxidation refers to a process by which an oxidizing agent, such as hydrogen peroxide, ozone or hypochlorite, is used to detoxify organics in the groundwater. Irradiation with ultraviolet light (UV) has also been utilized in some applications. Chemical reducing agents are applicable for treating certain inorganics such as chromium or selenium to convert them to less toxic states or make them more amenable for removal. A disadvantage with these processes is that they are not specific with respect to chemical compounds and may pose problems with sites with mixed waste streams, such as those expected to be encountered at the Becker Electronics site. It is usually difficult to find a single oxidant effective for destroying all organic contaminants; some organics may not be oxidizable using any of the above oxidants. The oxidants may be hazardous and care must be taken in their handling. In some cases, byproducts formed are more toxic or more difficult to remove.

  The volatile organics found in the contaminated groundwater at Becker Electronics can be effectively treated or even completely destroyed by oxidation using an oxidizing agent in conjunction with UV radiation. Tests would have to be performed to determine the treatability and effectiveness of this approach. A metals removal process may be required as a pretreatment process. This technology will be retained for further evaluation.

Groundwater at the Becker Electronics site and surrounding study area contains elevated levels of several metals at concentrations exceeding groundwater and drinking water standards. As discussed previously, the high levels of these metals may foul or interfere with the effective operation of treatment processes for organics removal. Therefore, treatment of contaminated groundwater will likely be necessary for metals removal in order to maintain the effectiveness of subsequent treatment processes, as well as to reduce the concentrations of these metals to acceptable levels. Several methods of metals removal are discussed below.

- pH Adjustment and Precipitation — pH adjustment and precipitation for heavy metals removal is a well-established technology. There are three types of metals precipitation systems, namely, the carbonate system, hydroxide system and sulfide system. In each process the pH of the water is adjusted to the level at which the metals of concern in the water have their lowest aggregate solubility in the precipitating medium. The carbonate system relies on the use of soda ash and pH adjustment in the range of 8.2 to 8.5 but is difficult to control. The hydroxide system is most widely used for the removal of metals. This system uses either lime, sodium hydroxide, or magnesium hydroxide to raise the pH of the water to precipitate the metals. The sulfide system is effective in the removal of metals, except for arsenic, to low levels. The increased removal afforded by the sulfide process is offset by the susceptibility of sulfide sludges to oxidize, resulting in the resolubilization of the metals.

  A large disadvantage of these processes relates to the fact that different metals have minimum solubilities at different pH values. At a given pH some of the metals are more soluble than others and may pass through the system.

  Another disadvantage of these systems is the volume of sludge generated. In general, pH adjustment and precipitation systems generate a larger volume of sludge than the iron-based coprecipitation system discussed below. This would result in higher sludge disposal costs. However, this technology is feasible and will be retained as a process option.

- Iron-based Coprecipitation — This technology involves the addition of soluble ferrous ions to the waste stream at a predetermined rate (usually about four times the total amount of all the metals). Such systems usually operate at a pH range of 7.0 to 8.0. The oxidation of ferrous ions in the waste stream results in the precipitation of iron with the occlusion of other metals. The heavy metals are entrapped in an insoluble iron matrix when the iron precipitates from the solution. The iron matrix is a gelatinous ferric "oxy" hydroxide formation, into which other metals are attached or adsorbed.

  Iron-based coprecipitation has several advantages over pH adjustment/ precipitation in that it generates a smaller volume of sludge and its effectiveness depends on the solubility of iron, not on the solubility of the other metals present. This technology is feasible and will be retained as a process option.

<u>Physical Treatment:</u> This treatment technology uses physical processes to separate contaminants from the specific medium of concern. Description of potentially applicable physical processes are presented below.

- <u>Ion Exchange</u> — The ion exchange process involves the reversible exchange of ions in solution with ions retained on a reactive solid substrate, i.e., ion exchange resin. Ion exchange resins have either the ability to exchange positively-charged ions (cation exchange) or negatively-charged ions (anion exchange). A typical ion exchange system consists of a fixed bed(s) of ion exchange resin(s) with cations or anions held by electrostatic forces to the charged sites on the resin. As wastewater passes through the resin, metal ions generally exchange with the cations at the charged sites; however, metal complexes are often negatively charged and exchange with anions. When the resin reaches its breakthrough point and is exhausted, it is regenerated by passing regenerant, such as an acid, through it to strip the metals. The regeneration solution must be treated prior to discharge. Some systems electrolytically recover the metals from the regenerant acid so the regenerant can be reused. Others simply precipitate the metals from the regenerant.

  Ion exchange systems are used primarily for treatment of industrial wastewater and demineralization of process water. The technology may encounter difficulties in treating groundwater. Colloidal particles and bacteria may foul the resin. If metals and metal complexes (e.g., permanganate and chromate) are present, both anion and cation exchange resins both would be needed for treatment. This operation would create a hazardous sludge requiring disposal. This technology is feasible and will be retained as a process option.

- <u>Flow Equalization/Detention</u> — Since it may be desirable for an on-site groundwater treatment facility to handle several additional types of extraneous flows including drainage and surface runoff from excavated contaminated soils, some of which may be intermittent, flow equalization/detention may be warranted to regulate fluctuations. Flow/equalization is achieved by collecting the waste flow in storage tanks, ponds or lagoons. The various wastewater streams are commingled into a single stream which reflects an average flow and concentration of contaminants, and will prevent the upsetting of downstream treatment units. The techniques for flow equalization involve the use of either on-line or off-line equalization tanks or lagoons. On-line equalization is performed by passing flow through the equalization basin. Off-line equalization is performed when only those waste streams that have above average flow rates are diverted to the equalization basin and then fed back into the main waste stream at a lower, constant flow rate to the treatment unit. This technology will be retained for further discussion.

- Sedimentation — It is possible that sedimentation might be required in order to remove suspended solids from the aqueous waste stream(s) prior to other treatment technologies. Sedimentation occurs by using gravitational forces to allow suspended solids in an aqueous solution to settle in a quiescent regime. The apparatus used for sedimentation includes a vessel or basin to maintain the aqueous waste to be treated in a quiescent state, a means of directing the aqueous waste to the vessel and a means of physically separating the liquid and the settled particles (i.e., either removing the settled particles, or removing the liquid). The sedimentation system can be designed as either a batch or continuous process. The settling vessel can be a lined surface impoundment, a conventional settling basin, a clarifier (usually circular) or a high-rate gravity settler. Sedimentation basins and clarifiers are typically designed with a built-in mechanical solids removal device such as a sludge scraper and/or a sludge draw-off mechanism. Sedimentation can be aided through the use of flocculents, such as polymers which conglomerate smaller particles facilitating settling. This technology will be retained for further consideration.

- Filtration — Filtration may be used to remove suspended solids from an aqueous waste stream and is often employed as a pretreatment step (i.e., prior to carbon adsorption) or as a final polishing step. Filtration is a physical process whereby suspended solids are removed from solution by forcing the liquid through a porous medium. Granular media filtration is commonly used for treating aqueous waste streams. The filtration apparatus typically contains sand (or sand with a mixture of anthracite or coal) which is supported by an underdrain system that collects the filtrate. Multimedia filtration systems can be used to remove different size particles at different stages. The filtration process can be used after sedimentation when the concentration of suspended solids is low (less than 100 to 200 mg/l of suspended solids). This technology will be retained for further consideration.

- Carbon Adsorption - Activated carbon adsorption is an effective technology for the removal of a large variety of organic compounds and some metals. Contaminated water is pumped through a vessel or canister containing a bed of activated carbon. The vessel or canister is sized to provide sufficient retention time for adsorption of organics from the water. Depending on the cleanup levels required, the effluent from the canister may pass through another similar unit prior to discharge. Carbon adsorption does not differentiate between biodegradable and refractory organics, and will remove both. When more than one adsorbate is present in solution there will be competition for available surface on the carbon, resulting in preferential adsorption of particular components. In such cases, the economics of the process will be determined in part by the pollutant exhibiting the least adsorbability. Removal of the organic compounds ultimately exhausts the adsorption sites on the carbon surface. The resulting spent carbon can be regenerated (on-site or off-site) and re-used, or disposed of at a suitable facility.

The effectiveness of activated carbon adsorption has been demonstrated in numerous full-scale and pilot studies as a technology for low level, mixed organic contaminant removal. Granular activated carbon may be used to provide treatment, or effluent polishing. The carbon adsorption process is well suited for mobile treatment systems as well as on-site installation. Therefore, activated carbon adsorption will be retained for further consideration.

- Air Stripping - Air stripping is accomplished by cascading the water down through a bed of packing media, while forcing air to flow through the media in the opposite direction. Packed towers are vertical columns filled with a medium having a large surface area. Packed columns are capable of achieving very high removals of non-polar volatile organic compounds. Removal efficiencies in excess of 99 percent can commonly be obtained with materials that have relatively low water solubility. Several field applications of air stripping with counter-current packed towers have been successful in removal of halogenated and non-halogenated volatile compounds from contaminated groundwater. Off gases from this process may be directly vented to the atmosphere or treated by a carbon adsorption system or destroyed by a catalytic incineration system. In many cases, the use of air stripping has been applied in conjunction with carbon adsorption (to remove other less volatile organics). Therefore, packed-tower aeration will be retained for further consideration.

- Steam Stripping - Steam stripping uses steam to evaporate organics from aqueous wastes. Steam stripping is essentially a continuous fractional distillation process carried out in a packed or tray tower.

  Steam stripping can treat less volatile and more soluble wastes than air stripping and can handle higher contaminant concentrations. The steam stripping process may require some type of air pollution control mechanism to eliminate toxic emissions.

  Steam stripping is a viable alternative process when air stripping could not produce desired results in stripping organics from groundwater. Since the groundwater at the site is contaminated in relatively low concentrations with volatile organics which can be easily air stripped, steam stripping would not be considered cost-effective. Therefore, this technology is eliminated from further consideration.

- Freeze Crystallization - Freeze Crystallization is a method used to crystallize relatively pure ice from a solution. Although surface washing techniques can reduce some accumulation of contaminants in the ice matrix, the process would not be effective with the low contaminant levels found in the site's groundwater. The process tends to be energy intensive and will be eliminated from further consideration.

- Reverse Osmosis - Under normal conditions, solvent will flow across a semi-permeable membrane from a dilute solution to a more concentrated solution until equilibrium of osmotic pressure is reached. The application of high pressure to the concentrated side will cause this process to reverse. This results in a solvent flow away from the concentration solution, resulting in a solution of higher concentration of solute. In practice a waste stream under pressure flows across a membrane as solvent is forced through the membrane's pores. The remaining solutes which do not pass through the membrane become more concentrated (on the influent side of the membrane). Reverse osmosis can be used to remove dissolved solids to meet drinking water standards.

  For an efficient reverse osmosis process, the chemical and physical properties of the semi-permeable membrane must be compatible with the waste stream's chemical and physical characteristics. Some membranes may be attacked by certain wastes. Suspended solids and some organics may foul the membrane's surface. Low-solubility salts may precipitate onto the membrane's surface. Reverse osmosis requires treatment or disposal of the rejected concentrate which could be 10 to 25 percent of the treated volume.

  Reverse osmosis often requires pretreatment to remove suspended solids. The variety of contaminants (i.e., VOCs and metals) in the groundwater at the Becker Electronics site may disrupt the system. For these reasons, this technology will be eliminated from further evaluation.

- Ultrafiltration - Ultrafiltration involves the use of specific membranes capable of rejecting organic and inorganic molecules with a molecular weight above 300. Although surfactants may be added to the waste stream to enhance the ultrafiltration of contaminants with lower molecular weights, most of the low molecular weight materials of concern at the Becker Electronics site would not be effectively retained by such a process. Therefore this technology will be eliminated from consideration.

Thermal Treatment. Thermal destruction technologies for aqueous waste treatment will result in a permanent and significant reduction in toxicity of the contaminants of concern. Three main types of thermal destructive technologies that are applicable to aqueous waste remediation are incineration, pyrolysis and wet oxidation. Incineration involves the controlled combustion of organic wastes under net oxidizing conditions and encompasses most of the well-developed thermal technologies. In pyrolysis, thermal decomposition occurs when wastes are heated in an oxygen deficient atmosphere. The process conditions range from pure heating (thermolysis) to conditions where only slightly less than the theoretical (stoichiometric) air quantity is supplied. Wet oxidation is a thermal process in which organic materials are destroyed through the use of high temperature and pressure in a water solution or suspension.

Thermal destruction as a treatment process is most applicable for waste streams containing high concentrations of organic contaminants.

Since the site groundwater contains relatively low levels of volatile organic contaminants, a thermal treatment process may not be efficient for treating the site groundwater. However, such processes may be feasible for treating any residual contaminants from other treatment processes such as emissions from an air stripper. For these reasons, thermal treatments will be retained for further evaluation.

4.1.3.4 Off-Site Treatment and Disposal of Contaminated Groundwater and/or Residual Waste

In addition to, or as an alternative to, the aforementioned on-site remedial treatment techniques, off-site treatment and disposal of waste streams may be utilized. Typically, off-site treatment facilities utilize one or more of the treatment and disposal processes previously discussed under on-site treatment. Off-site treatment may be used for small volumes of highly concentrated waste where it can economically be transported from a site and treated at a lower cost than building and operating an on-site treatment facility. Untreated effluent constituents or side streams (i.e., residual wastes such as metals sludge) from on-site facilities could be transported to an off-site RCRA/TSCA-permitted facility for further destruction, treatment or disposal, or it may be accepted and treated by an available local Publicly Owned Treatment Works facility (POTW). The closest POTW is in the town of Greenville. Discussions with this POTW have found that the POTW cannot accept any additional water or residual waste for treatment. Therefore, the use of a POTW will be eliminated from further evaluation. Several RCRA/TSCA permitted treatment and disposal facilities could accept the residual wastes from the Becker Electronics site. Therefore, the off-site treatment and disposal of residual wastes at a RCRA/TSCA permitted facility will be retained for further evaluation.

4.1.3.5 On-Site Disposal of Treated Groundwater

Once extracted and treated to applicable New York State Standards, groundwater can be discharged to an on-site or off-site surface water body or reinjected or recharged back into the groundwater.

- On-Site or Off-Site Discharge - Treated groundwater may be discharged to either Catskill or Thorp Creeks, located approximately 800 ft. east of the site, or to the drainage ditches on-site, which are tributaries to these creeks. All NYSDEC SPDES permit requirements would be met although a SPDES permit per se may not be required. This technology will be retained for further evaluation.

- On-Site Reinjection or Infiltration - Injection wells are frequently used in combination with extraction wells in order to facilitate groundwater restoration where the hydraulic conductivity and transmissivity are high. Injection wells can be used to direct contaminants to the extraction wells and to accelerate groundwater restoration.

  Potential problems involved with the use of injection wells include sand clogging, dead spots, air locks and plugging by chemical precipitation.

  Infiltration could occur through the use of infiltration galleries, leaching fields or recharge basins.

  Both reinjection and infiltration would need to meet SPDES permit requirements although a SPDES permit per se may not be required.

  As discussed earlier under enhanced removal technologies, the groundwater is flowing through a fractured bedrock aquifer. For this reason the use of reinjection wells may interfere with collecting and treating all of the contaminated groundwater. It may even exacerbate the problem by pushing the contaminated groundwater further from the site. In addition, on-site discharge as discussed above is a feasible option which would be more cost effective and would not interfere with collecting all contaminated groundwater. Therefore this technology will be eliminated from further evaluation.

- Discharge to Off-Site Publicly Owned Treatment Works (POTW) - With this technology, treated or untreated groundwater could be transported by tank truck to a Publicly Owned Treatment Works (POTW) or to a separate collection system feeding a POTW. For treated groundwater this option would only be reasonable if effluent quality levels could not meet drinking-water or surface water discharge standards.

  The closest POTW to the site is in the town of Greenville. Discussions with the POTW indicate that the plant is running at full capacity and could not treat or accept any additional water. Therefore, this technology is not feasible for this site and will not be retained for further evaluation.

4.1.4 Control and/or Isolation Technologies for Groundwater Remediation

4.1.4.1 Subsurface Vertical Barriers

Subsurface barriers refer to methods that require the installation of low permeability cut-off walls or similar structural diversions below the ground surface that are capable of controlling, containing or redirecting groundwater flow. By utilizing these methods the lateral migration of contamination can be prevented from spreading to uncontaminated ground or surface waters. As previously discussed, it is not feasible to design and construct subsurface horizontal and/or vertical barriers to control the migration of contaminated groundwater through the bedrock aquifer. It is not possible to seal all voids and fractures in the bedrock. Therefore, subsurface barriers would not effectively reduce the threat of further contamination and are not retained for further evaluation.

4.1.4.2 Horizontal Barriers

Horizontal barriers include the use of capping methods to reduce the leaching of contaminants through the soil to the groundwater. Low permeability caps are installed to prevent rainfall and run-on from percolating through the contaminated soil and leaching and/or mobilizing contaminants that might be present. This technology would reduce some of the contaminants entering the groundwater and therefore will be retained for further evaluation.

4.2 POTENTIALLY APPLICABLE PRIVATE WELL WATER (DRINKING WATER) REMEDIATION TECHNOLOGIES/REMEDIES

Remedial technologies and associated process options for private well water treatment are listed and prescreened in Table 4-2. Several technologies alone or in combination, may ultimately be required for the treatment of private well water. The known contaminants in the private wells sampled are volatile organic

TABLE 4-2

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES FOR PRIVATE WELL WATER BECKER ELECTRONICS SITE

General Response Action	Remedial Technology Type	Process Option	Description	Retain	Screening Comments
No Action					
No Action/Natural Attenuation	None	N/A	No Action	Y	Consideration Required
Monitoring	Monitoring	N/A	Monitoring of Private Wells	Y	Applicable
Separation/Treatment					
Point-of-use Treatment	Point-of-use Treatment	Filtration Carbon Adsorption Reverse Osmosis	Installation of commercially available well head treatment systems on existing wells	Y	Potentially Applicable
Community Water Supply System					
Alternate Water Supply	Connection to existing sources	N/A	Tie-in local residents to water mains	N	Not applicable - Public Water Supply Too Far From Site
	Development of new sources	N/A	Development of new potable water supply and distribution system	Y	Potentially applicable

compounds. However, the samples were not analyzed for metals and since metals were found in on-site groundwater samples this may be a matter of concern. Further analysis during the Phase II Field Program will clarify this issue. Since there is no available data for metals in private off-site wells, only technologies for removing volatile organic compounds will be screened at this time. During the Phase II RI the private wells will be resampled and analyzed for metals and the FS may be revised at that time if required.

4.2.1 No Action

The selection of this remedial action alternative would mean that the existing private water supply IRM program would continue, and natural attenuation would remediate the site groundwater. Natural attenuation would be the gradual process by which degradation of the hazardous waste constituents would occur. Along with the selection of the no-action alternative private well monitoring would be performed. Currently, several private wells within the vicinity of the site are being monitored and some of them do have point-of-use treatment systems in operation (discussed in Section 4.2.2). These wells would continue to be monitored and the point-of-use systems would continue to be maintained unless further testing shows no health risks would be associated with drinking or using the untreated water. However, under the no action alternative no new point of use treatment systems would be installed. Monitoring would be performed periodically to determine whether contaminant concentrations have decreased to safe levels through natural flushing. This alternative will serve as a baseline for comparison with other remedial alternatives.

4.2.2 Point of Use Treatment Units

Point of use treatment is effective for individual wells (i.e. private residential and commercial wells). Treatment technologies normally utilize a form of pre-filtration, along with carbon adsorption or reverse osmosis, either alone or in combination. Currently several private wells within the vicinity of the site are using point of use activated carbon treatment units which are effective in removing the organic contaminants of concern. The units require monitoring and periodic replacement. The spent units are then treated at an off-site RCRA/TCSA treatment and disposal facility. This technology is feasible for current users and potential future users who may be impacted by groundwater contamination and will be retained for further evaluation.

4.2.3 Connection To Public Water Supply

Currently most residents in the area rely on private wells. The town of Cairo is planning to create a public water supply system. However, pumping the water to residents within the vicinity of the Becker Electronics site is not feasible due to the distance and elevations of the area. Therefore, this technology is eliminated from further evaluation.

4.2.4 Development of Community Water Supply System

This technology would include creating a new community water supply system to serve all residences affected by contamination. Currently, wells drilled to a depth of approximately 345 feet show contamination. New wells could be drilled deeper into the aquifer, and a new community water supply system could be created. The groundwater is flowing through a fractured bedrock aquifer and these new wells may also become contaminated therefore a treatment system for the new wells may also be required. More data would be necessary to determine optimal placement of new wells and if a treatment system is necessary. However, an advantage to having a community water supply system is that the monitoring and maintenance of the system is centralized. This technology is feasible and will be retained for further evaluation.

Section Five

SECTION 5

5.0 SUMMARY OF TECHNOLOGY SCREENING

Some of the technologies screened in Section 4.0 of this report are applicable for implementation as remedial options addressing multiple environmental media of concern at the present time at the Becker Electronics site. Some selected technologies are media specific whereas others may be applied to different media types, such as both solid and liquid hazardous materials. For instance, some incineration or thermal destruction technologies need only minor modifications to their handling or feed systems to destroy either liquid, solid or gaseous hazardous waste materials.

Table 5-1 presents a generic list of remedial actions applied to the two main media of concern at the Becker Electronics site, groundwater and private well-drinking water. As discussed previously, additional data must be collected to delineate the extent of contamination and to characterize the waste in the other site media. Therefore, the other on-site media will be addressed at the completion of the Second Phase Remedial Investigation or by IRMs. The screening section focused on the selection and screening of technologies and process options within the broad classes of remedial actions for each medium. Technologies were screened based on their ability to be implemented technically for a specific medium. For some media, representative technologies or the remedial action itself were not applicable and therefore eliminated from consideration for those media.

Table 5-2 summarizes the selected technology types and treatment process options for the groundwater and the private wells (drinking water) at the Becker Electronics site. Presented on this table are only those treatment and destructive process options retained during the screening. Solidification/-stabilization, control, or isolation technologies are not included since most of these are media or media-type specific.

As shown in Table 5-2, there are numerous remedial options under consideration

TABLE 5-1

GENERIC LIST OF REMEDIAL ACTIONS

No-Action

- No-Action
- Monitoring
- Institutional Restrictions
- Alternative Water Supply

Destruction

- On-site
- Off-site

Separation/Treatment

- Separation
  - • Extraction/Collection
- Treatment
  - In situ Treatment*
  - On-site Treatment
    - • On-site Disposal
    - • Off-Site Disposal
  - Off-site Treatment w/Off-site Disposal

Control/Isolation

- Containment
- Surface Controls
- Isolation
- Diversion/Collection

* Screened out in Section 4.0 of this Feasibility Study.

TABLE 5-2

APPLICABILITY OF SELECTED DESTRUCTION AND TREATMENT PROCESS OPTIONS TO GROUNDWATER AND PRIVATE WELL-DRINKING WATE BECKER ELECTRONICS SITE

Technology Type	Process Option	Media: Groundwater	Media: Private Wells - Drinking Water
DESTRUCTION			
• Thermal Treatment		X	
TREATMENT			
• Chemical	Neutralization	X	
	Oxidation/Reduction	X	
	ph Adjustment and Precipitation	X	
	Iron-based Coprecipitation	X	
• Physical	Ion Exchange	X	
	Flow Equalization/Detention	X	
	Sedimentation	X	
	Filtration	X	X
	Carbon Adsorption	X	X
	Air Stripping	X	
	Reverse Osmosis		X

for implementation at the Becker Electronics site. The reason for this is the broad range of possible organic and inorganic contaminants suspected at this time. While some of these processes are chemical or chemical class specific in their application, other are not and may be applied to remediate diverse types of both organic and inorganic hazardous waste. Typically at hazardous waste site remediation projects, several process options are incorporated into treatment trains with each component of the train targeted for removing a specific class of compounds. Taking this into account, a specific process would not be ruled out based solely on the fact that it is not applicable to all suspected waste types anticipated to be encountered.

At this point in the FS process, it is the usual practice to assemble response actions and selected process options, which represent the various technology types for each medium, into alternative plans to address the overall contamination of the site. These site or operable unit alternative plans are then further screened in the following FS phases. Since the Becker Electronics site has a number of media of concern and applicable process options which are based on an incomplete characterization of the site, it is not practical, at this time, to assemble all of these options into site-specific alternative plans. As discussed earlier, the proposed Second Phase RI will gather the additional data necessary to screen and evaluate the other on-site media. The technologies for treating the private well-drinking water have been screened. However, until the additional data is collected during the Second Phase RI, no alternatives for this medium will be formulated. The residences at the private wells are currently protected by an ongoing IRM (point of use treatment) and this IRM will continue until other measures providing protection are implemented. Therefore, at this time, only alternatives for site groundwater will be evaluated in the next section.

Two IRMs, as presented in the RI in detail, have also been proposed for the Becker Electronics site. The IRMs are designed to achieve two general objectives: restrict site access, and remove matrices that may be sources of further contamination. These IRMs along with additional site information obtained through the Second Phase Remedial Investigation will aid in the development of remedial alternatives for all site media and will simplify the analysis of site-wide alternatives.

Section Six

SECTION 6

6.0 POTENTIALLY APPLICABLE GROUNDWATER REMEDIATION ALTERNATIVES

This step of the feasibility study process involves evaluating the selected options for site groundwater based on effectiveness and implementability consistent with the results of the Phase I Remedial Investigation. In addition, at the request of NYSDEC and following CERCLA guidance, order of magnitude costs are also included. These costs are preliminary costs and are based on currently available data. They will be refined as collection of additional data during the Second Phase Remedial Investigation progresses. Effectiveness in this case refers to the ability of the selected option to meet the medium-specific remedial action objectives, such as protection of human health and environment and attainment of ARARs. Both short-term and long-term effectiveness are evaluated in this step. Options will also be evaluated and screened based on their ability to be implemented both technically and administratively. In general, the goal of this section is to select the best suited process option/technology types for each medium. The no-action alternative will be maintained throughout the analysis for comparative purposes. At the conclusion of this step, remaining options may be combined into site- or operable unit-specific plans and then further evaluated in the detailed analysis step (Phase III) prior to choosing a recommended remedial program.

The groundwater remediation alternatives will focus on treating volatile organics and heavy metals in the bedrock aquifer. Limited data collected during the Phase I RI indicates that heavy metals are a potential problem in the groundwater. Additional data will be collected during the Second Phase RI to reevaluate this. However, at this point in time, removal of metals may be required. Therefore, metals removal technologies have been included as part of the alternative for remediating the groundwater at the site.

Due to the variety of contaminant types (e.g., VOCs, heavy metals) found in the groundwater, a treatment train consisting of two or more technologies most likely will be required for complete treatment of the groundwater. Individual technologies will be screened in this section. Combinations of alternatives for treatment of the various classes of contaminants will be addressed in the Phase III Feasibility Study which will be performed at a later date. However, some treatment processes which would have limited effectiveness on their own will be evaluated in the context of supplements to other treatment technologies. Disposal options will also be discussed in this section. Table 6-1 presents a summary of the remedial alternatives evaluated in this section.

6.1 NO ACTION

The selection of this alternative would mean that contaminated groundwater at the Becker Electronics site would not be contained, collected, treated or disposed. This alternative involves the gradual restoration of groundwater to acceptable contaminant levels via natural attenuation. Natural attenuation would be the process by which degradation and/or dilution of the contaminants would occur. Along with the selection of the no-action alternative, groundwater monitoring would be performed at and in the vicinity of the site to assure the protection of public health and environmental concerns identified in the RI/FS report. At this point in time it is assumed that three on-site wells and three off-site wells will be monitored. Samples would be collected on an annual basis for a 30 year period. Samples will be analyzed for volatile organic compounds and metals. The results of the monitoring program would be assessed annually and re-evaluated every five years for a 30 year period. Changes to the program may be made based on data collected through this program.

Assuming the source of groundwater contamination is removed this alternative over the long term would reduce the volume of contaminants in the groundwater to below the state required levels for public drinking water standards. However, present and future users of the site groundwater still face a potential risk from use of this water. Currently identified receptors have point of use treatment systems and therefore are currently protected. However, these treatment systems may be subject to failure and must be monitored on a regular basis. Additionally the contaminated groundwater will continue to migrate and therefore may impact new receptors in the future. Furthermore, it will take many years for natural attenuation to achieve the remedial action goals.

TABLE 6-1

PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES FOR GROUNDWATER AT BECKER ELECTRONICS SITE

Response Media	Remedial Technology	General Response Actions	Process Options	Effectiveness	Implementability
Groundwater	No Action	None	Not Applicable	May not achieve all remediation objectives. Potential risks to Public Health and Environment remain	Easily implemented. Administrative management required.
	Institutional Actions	Water use restrictions	Well Permit Restrictions Public Drinking Water Regulations	May not achieve all remedial action objectives. Effectiveness dependent upon continued monitoring and site impacts on off-site groundwater quality.	Legal requirements and authority may be difficult to implement.
		Monitoring/Sampling	Groundwater/private well monitoring	Useful for documenting conditions. Does not reduce contamination.	Easily implemented. Existing wells can be used. Services and materials readily available.
	Collection/Treatment/Discharge	Extraction	Extraction Wells	Properly designed system could effectively remove contaminated groundwater requiring treatment, thus meeting all remedial action objectives.	Modeling may be required to assist in proper placement of wells. Technologies are proven and commercially available.
		Physical/Chemical Treatment	Precipitation	Effective and reliable for metals removal.	Readily implementable; proven commercially available, technology. Sludge byproducts would require treatment and disposal.
			Ion Exchange	Effective for metals removal.	Materials and equipment readily available. Probably requires pretreatment for suspended solids removal. Treatment byproducts may require subsequent treatment prior to disposal.

TABLE 6-1 (Continued)

PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES FOR GROUNDWATER AT BECKER ELECTRONICS SITE

Response Media	Remedial Technology	General Response Actions	Process Options	Effectiveness	Implementability
Groundwater (Continued)	Collection/Treatment/Discharge (Continued)	Physical/Chemical Treatment (Continued)	Carbon Adsorption	Effective and reliable for organics	Readily implementable using commercially available equipment; proper pretreatment required. requires carbon disposal or regeneration.
			Air Stripping	Effective and reliable for volatile organics.	Readily implementable; proper pretreatment required; may require treatment of stack gases to meet emission limits.
		On-site or Off-Site Discharge	Pipeline to drainage ditches Pipeline to creeks	Effective and reliable discharge method	Easily implemented due to proximity of drainage ditches or creeks.
	Containment	Capping	Multi-media	Can reduce surface water percolation. However, would not significantly reduce mobility of contaminants or volume of contaminated groundwater.	Can be implemented; conventional construction; requires long-term maintenance and monitoring.

This alternative would present minor risks to on-site workers during implementation. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

This alternative could be easily implemented at this site because it would require no new construction. Existing and proposed on and off site wells could be used for monitoring purposes. This process is an established process that would provide data on contaminant migration.

Based on currently available data there are no capital costs for this alternative. The annual operation and maintenance cost associated with this alternative is estimated to be $7,900 (per year for 30 years).

This alternative will be retained and provides the baseline against which other alternatives can be compared.

6.2 INSTITUTIONAL ACTION

Institutional actions as discussed in the screening section of this report may include a variety of institutional controls governing the use of water. The controls may include permitting requirements and other water use restrictions.

6.2.1 Water Use Restrictions

This alternative may include a variety of legal restrictions governing the use of water on or within the vicinity of the site. These restrictions may prohibit the use of water for domestic purposes or they may place new restrictions on the installation of new wells within the vicinity of the site. New laws might require that the New York State Department of Health — Oneonta District Office issue notices to nearby property owners to prohibit such uses. Property easements might be necessary to enforce the new laws. These restrictions may also include requiring point of use treatment systems on all newly installed wells. A monitoring program would also be implemented to monitor the quality of the groundwater. The monitoring program would be the same as described under the

No Action alternative. This alternative would provide protection to current and new residents using the groundwater and over the long-term would meet the remedial action objectives for this site, regarding protection of human health. However, it would not reduce the mobility of the contaminated groundwater. The groundwater would continue to migrate thereby potentially impacting new receptors.

This alternative would present minor risks to on-site workers during implementation. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

The technologies needed to implement this alternative are all demonstrated and are commercially available. From an administrative standpoint legal restrictions would require administrative management to ensure that they are enforced and that the monitoring program is implemented. In addition, it would require the cooperation of individual residents.

This alternative is feasible for this site, it would provide immediate protection to human health, and therefore will be retained. It may also be employed in conjunction with a pump and treat alternative (see Section 6.3) to provide public health protection until the groundwater is fully remediated.

Based on currently available data the capital cost for this alternative is estimated to be $10,000. The annual operation and maintenance costs associated with this alternative is estimated to be $7,900.

This alternative will be retained for detailed analysis.

6.3 COLLECTION/TREATMENT/DISCHARGE

The following section presents the evaluation of selected alternatives which involve the extraction of groundwater, followed by treatment processes needed to remove the contaminants of concern and disposal of the treated groundwater.

6.3.1 Extraction

Extraction of the groundwater involves the installation of extraction (pumping) well(s) to remove a plume of contaminated groundwater for treatment and subsequent reintroduction (recharge) into the aquifer or discharge to surface waters. Based on available data it is assumed that a system consisting of one recovery well could be used to capture the contaminant plume. Based on preliminary data the extraction well would be located in the central section of the site. The groundwater would be pumped with submersible pumps at a rate determined by slug tests and/or pump tests. Based on current pump test information it is assumed the pumping rate would be about 50 gpm. Additional field studies to be performed during the Second Phase RI and modeling would be needed prior to design of an extraction well system in order to optimize performance and to estimate the time required for carrying out the remediation. In addition, to ensure that the quality of the water is improving over time, a groundwater monitoring program similar to the No Action Alternative would be implemented during the remediation.

This alternative would meet the remedial action goal of reducing the amount of contaminated groundwater in the aquifer. Over the long-term it would reduce the level of contaminants in the groundwater to below the state required levels for public drinking water standards. Therefore the mobility and volume of contaminated groundwater would be significantly reduced. Currently all identified receptors are on point of use treatment and therefore would be protected while this alternative is implemented. However, any future users of site groundwater nearby still face a potential risk until this alternative is completed.

Currently available data is not sufficient to adequately estimate contaminant transport through the bedrock aquifer. Additional sampling and groundwater modeling are needed to better estimate the effectiveness of a pump and treat system for fully remediating the groundwater to attain the remedial goal. Nevertheless, pump and treat techniques will help to reduce the contaminant levels in the groundwater and act as a source control measure.

This alternative would pose some risks to on-site workers during the implementation of this alternative. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

The equipment and technologies required for this remedial technology are all demonstrated and commercially available. Access to the site presents no problem at this time.

Based on currently available data the capital cost for this alternative is estimated to be $75,000. The annual operation and maintenance costs associated with this alternative are estimated to be $102,600.

Based on the above discussions pumping will be retained for detailed analysis.

6.3.2 Physical/Chemical Treatment

Based on preliminary data collected during the Phase I RI two types of groundwater contaminants are of concern in the groundwater at the Becker Electronics site:

- Volatile Organic Compounds

  Limited water solubility

- Heavy Metal Compounds (or ionic species)

  Solubilities in water dependent on the specific metal, pH of the aqueous medium, and anions present in the medium

Each of these contaminant types lends itself to specific treatment processes which may be ineffective for the other class of contaminants. Since the presence of one contaminant type may interfere with the treatment of another contaminant class, the contaminant mix present may dictate the order of treatment steps. For some of the treatment techniques, such as chemical precipitation, it may be necessary to perform a treatability study in order to design an operating system.

The treatment technologies discussed below represent a displacement of the contaminant from the aqueous phase to an immobile solid phase in three of the processes, and to a vapor phase with a fourth technique (air stripping). The latter typically results in a diluted form of the contaminant in the stripping air, while the solid immobilization techniques tend to concentrate the contaminant species.

Since any on-site groundwater treatment facility may need to handle variable flow conditions, some type of equalization/detention may be desirable. This may be achieved using holding tanks to average the flow over time. The groundwater streams can be commingled into a single flow which reflects an average flow and concentration of contaminants, and will tend to prevent upsetting of treatment units. The techniques for flow equalization involve the use of either on-line or off-line equalization tanks. Off-line equalization is generally used when the waste streams have above average flow rates. In the latter case, excess flows are diverted to the equalization basin and subsequently fed back into the main waste stream.

A sedimentation process may also be required as an adjunct to the treatments discussed in the following sections. Sedimentation is used to remove suspended solids from the aqueous streams prior to the actual treatment itself. Sedimentation is performed by allowing suspended solids in an aqueous solution to settle in a quiescent regime. The equipment used for sedimentation typically includes a basin to maintain the aqueous waste in a quiescent state and a means of physically separating the liquid and the settled particles (i.e., either removing the settled particles or removing the liquid). The sedimentation system can be a conventional settling basin, a clarifier (usually circular), or a high-rate gravity settler. Sedimentation basins and clarifiers are typically designed with built-in mechanical solids removal devices such as a sludge scraper and/or sludge draw-off mechanism. Sedimentation can be aided through the use of flocculating agents such as polymers which conglomerate smaller particles and facilitate settling.

It may be necessary to employ a filtration process to remove suspended solids from the waste stream prior to other treatment processes, such as ion exchange.

Filtration may also be used as a final polishing step to reduce suspended solids following other treatment processes such as chemical precipitation. Filtration entails passing the liquid through a porous medium. The porous medium may be a fibrous fabric (paper or cloth), a screen, or a bed of granular material. The filter medium may be pre-coated with a filtration aid such as ground cellulose or diatomaceous earth. Fluid flow through the filter medium may be accomplished by gravity or by pressure.

6.3.2.1 Chemical Precipitation

Based on preliminary data the groundwater at the site appears to contain elevated levels of several metals at concentrations exceeding groundwater standards. The presence of these metals (e.g., iron) may also interfere with effective operation of treatment processes to be used for organics removal. Therefore, treatment for metals removal may be necessary to maintain the effectiveness of subsequent treatment processes, as well as to reduce the concentrations of these metals to acceptable levels.

Chemical precipitation for heavy metals (cations) removal using pH adjustment is a well-established technology. There are three common types of metals precipitation systems: the carbonate system, hydroxide system, and sulfide system. Each adjusts the pH of the water to the level at which the metal cations in the water have their lowest solubility. The carbonate system is difficult to control and relies on the use of soda ash to adjust the pH of the water to the range of 8.2 to 8.5 to facilitate metals precipitation. The hydroxide system is most widely used for the removal of these metals. The system uses either lime, sodium hydroxide, or magnesium hydroxide to raise the pH of the water to precipitate the metals. Except for arsenic, the sulfide system is effective in removing metals. It uses sulfide ions to precipitate metals, generally resulting in lower metal solubilities. The increased removal of this process is offset by the susceptibility of sulfide sludges to oxidize, resulting in the resolubilization of the metals.

One disadvantage of a chemical precipitation system is the different pH levels at which the various metals have their minimum solubilities. At a given pH, some of the metals are more soluble than others. Metals that do not have their minimum solubility at the pH of the treatment may not be effectively removed. Another disadvantage is the volume of sludge generated. The sludge may be hazardous and may require treatment and disposal at a suitable facility.

Oxidation/Reduction may be used as an adjunct to a precipitation process. Oxidation/Reduction processes involve changing the oxidation state of a contaminant. Such treatment may be required for metal complexes to convert the metal to a valence state amenable to treatment by precipitation. Oxidation usually employs an oxidizing agent, such as hydrogen-peroxide, ozone, or hypochlorites. Chemical reducing agents are mainly applicable for treating certain specific inorganics (e.g., iron, lead, and mercury).

The specific treatment system must be tailored to the specific metals to be removed, their influent concentrations, other ionic species present, and the required effluent levels to be attained.

Iron-based coprecipitation involves the addition of soluble ferrous ions to the waste stream at a predetermined rate (usually about four times the total amount of all the metals). Such systems usually operate in a pH range of 7.0 to 8.0. The oxidation of ferrous ions in the waste stream results in the precipitation of iron and the other metals. Thus the heavy metals present are entrapped in an insoluble matrix as the iron is precipitated from the solution as a gelatinous matrix which can occlude other metals by becoming attached or adsorbed to the iron precipitate.

Iron-based coprecipitation has several advantages over pH adjustment and precipitation. It generates a smaller volume of sludge in comparison with pH adjustment and precipitation systems, and its effectiveness depends on the solubility of iron, not on the solubility of the various metals present in the water.

A typical heavy metals precipitation system consists of a reaction tank(s), flocculator, and a sludge handling system for thickening and dewatering. Separation of the precipitated metal sludge from the treated liquor can be accomplished by such equipment as a settling tank, a chevron plate settler, or a vacuum filter. The metal sludge would the require further treatment prior to disposal. Such treatment could include metals recovery or stabilization prior to landfilling.

This treatment would remove the metal contaminants of concern in the groundwater thereby reducing the mobility and volume of contaminants in the groundwater. There are some risks to on-site workers implementing this treatment. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

The equipment and technologies required to implement the chemical precipitation processes discussed above are all demonstrated and are commercially available. Pilot scale tests would be needed to design the system. However, a properly designed system would effectively remove the metals of concern (lead, mercury, and iron). Access to the site presents no problem at this time.

Based on currently available data the capital cost for this alternative is estimated to be $175,000. The annual operation and maintenance cost associated with this alternative is estimated to be $210,000.

This treatment process will be retained for detailed analysis.

6.3.2.2 Ion Exchange

The ion exchange process involves the reversible exchange of ions in a solution with ions retained on a solid ion exchange resin. Ion exchange resins can be either a cationic or anionic exchange type. Typically, ion exchange systems consist of a single fixed bed or multiple beds of ion exchange resin in a column. As wastewater passes through the resin, metal ions exchange with the ions in the resin. When the resin reaches its breakthrough point and is exhausted, it must be regenerated. The regeneration solution then must be treated prior to discharge or disposal.

Ion exchange systems are used primarily for treatment of industrial wastewater and demineralization of process water. To apply the technology for treating groundwater at the Becker Electronics Site some potential difficulties may need to be addressed. Colloidal particles and bacteria may foul the resin, necessitating pretreatment such as filtration. If metals, metal complexes, and anionic species are present, both anion and cation exchange resins would be needed for treatment of the water. Pilot scale studies would be required to design the system; however a properly designed system would remove the metals of concern (lead, mercury, iron) thereby reducing the mobility and volume of contaminants in the groundwater to below applicable SCGs. Ion exchange systems present some risks to on-site workers during their implementation. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

The equipment and materials required to implement an ion exchange system is readily available through several vendors and could be installed on-site with few problems.

Based on currently available data the capital cost for this alternative is estimated to be $395,000. The annual operation and maintenance costs associated with this alternative are estimated to be $200,000.

This treatment process will be retained for detailed analysis.

6.3.2.3 Air Stripping

Air stripping is most effectively used for removing volatile organic compounds from groundwater. Air stripping is usually performed in packed towers. Packed towers are vertical columns filled with a medium that creates a large surface area. Air stripping can also be performed in stripping towers containing a number of perforated plates (trays).

The water is pumped to the top of the tower and allowed to cascade over the bed of packing media (or through the series of trays) while air from a blower is forced through the tower in the opposite direction. As the water flows downward, air enters the bottom of the tower and moves counter-currently upward. When the water contacts the air, volatile compounds transfer from the liquid phase to the vapor phase and are carried off in the air stream out from the top of the tower. The propensity of an organic compound to volatilize in such a process is a function of its concentration in the aqueous medium, the temperature of the medium, Henry's Law constant for the compound in water, the concentration of the compound in the air stream, and the effective contact area for mass transfer.

The air leaving the tower may be discharged directly to the atmosphere or may be treated prior to discharge, depending on effluent concentrations and air pollution regulations. Treatment of effluent air can be accomplished by using vapor phase carbon adsorption or using an after burner.

Vapor phase carbon adsorption systems can be used to treat the air emissions generated from other treatment systems such as an air stripper. As discussed above in the air stripping treatment, the volatile organics in the groundwater are transferred from the liquid phase to the vapor phase and are carried in the air stream out the top of the tower. Depending on the concentrations of contaminants in the air stream and State emission limitations, a vapor phase carbon adsorption system may be a necessary component of the treatment (i.e., if air stripping is selected). Similarly to liquid phase carbon adsorption systems when the carbon becomes exhausted, it is regenerated for reuse, incinerated or disposed of at an off-site licensed facility. A vapor phase carbon adsorption system would provide a flexible and effective method for controlling any air emissions.

An after burner is a thermal destruction method which can be used to destroy organic contaminants in the vapor phase prior to discharge to the atmosphere. This treatment could be used as a final vapor phase treatment for the air emissions generated during the stripping process. However, the use of an after burner raises other air emissions concerns. The vapor phase carbon adsorption system is a very effective and well proven technology for handling the types of contaminants expected in the air emissions; therefore, the use of an after burner will be eliminated from consideration at this point in time.

Packed columns can achieve very high removals of volatile organic compounds under the right conditions. Removal efficiencies in excess of 99 percent have been reported. Field applications of air stripping with counter-current packed towers have been successful in removing halogenated and non-halogenated volatile compounds from contaminated groundwater. In some cases, the use of air stripping has been applied to waste streams in conjunction with carbon adsorption, the later for removing other less volatile organic compounds.

Volatile organic compounds (see RI for Report details) which have been detected in monitoring wells at the site, can effectively be removed by air stripping. Therefore this treatment would reduce the volume and mobility of organic contaminants in the groundwater. However, the groundwater also contains inorganic contaminants (metals) that may interfere with the air stripping process. It would probably be necessary to remove the metals from the groundwater via chemical precipitation or ion exchange (as discussed earlier) prior to air stripping. Since air stripping is feasible for treating some of the groundwater contaminants, although it would not remediate all, it could be used as part of a treatment train. An air stripper presents some risks to on-site workers during its implementation. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations. It may also pose additional emission problems; however, proven technologies are available to treat air emissions generated by the process. Air stripping is a proven, commercially available technology which could be easily implemented at the site. Access to the site presents no problem.

Based on currently available data and assuming a vapor phase carbon adsorption system is necessary, the capital cost for this alternative is estimated to be $54,600. The annual operation and maintenance costs associated with this alternative are estimated to be $187,200.

For these reasons air stripping will be retained for detailed analysis.

6.3.2.4 Carbon Adsorption

Field experience at numerous hazardous waste sites has shown activated carbon adsorption to be effective for removing a large variety of organic compounds from groundwater. Many organics can be removed to levels of 1 to 10 ppb, depending on the waste stream characteristics. All of the volatile organic contaminants in the Becker site groundwater can be removed by adsorption on carbon.

In a typical carbon adsorption system, water containing contaminants is pumped through a vessel containing a bed of activated carbon. The vessel is sized to provide sufficient retention time for adsorption of organics from the water. Depending on the cleanup levels, the effluent from the carbon column may pass through a second carbon column prior to discharge. When the carbon bed becomes exhausted, it is regenerated for reuse, incinerated, or disposed of at an approved facility.

Isotherms are used to predict carbon requirements in terms of adsorptive capacity for specific compounds. Compounds most easily adsorbed by carbon are those with relatively high molecular weights and boiling points. Ideally, the higher the concentration of the compound to be adsorbed, the greater the capacity of the carbon to remove it. Carbon adsorption capacities for organics can vary by several orders of magnitude, depending on the specific compound.

When more than one adsorbate is present in the solution, competition for available surface on the carbon may result in preferential adsorption of a particular adsorbate. Isotherms can be used to predict the carbon usage rates for individual known compounds, but would not necessarily give an accurate determination of the carbon usage rate for a mixture of compounds. In such cases, pilot treatability tests are recommended prior to system design. These systems are very reliable and commercially available through several vendors.

Carbon adsorption systems present some risks to on-site workers during implementation. However, all potential risks would be mitigated using personal protection equipment, construction safeguards and enforcement of all applicable regulations.

Based on currently available data the capital cost for this alternative is estimated to be $96,000. The annual operation and maintenance costs associated with this alternative is estimated to be $201,100.

This treatment process will be retained for detailed analysis

6.3.3 Discharge of Treated Groundwater

Once extracted and treated to applicable New York State standards or guidance values, groundwater can be discharged to a surface water body. Discharge of effluent from an on-site groundwater treatment system to the on-site drainage ditches or off-site to Catskill or Thorp Creeks would need to meet the substantive requirements of a State Pollution Discharge Elimination System (SPDES) permit but would not require a permit, per se. These requirements would set discharge limitations for the contaminants either in terms of contaminant concentrations (e.g., mg/l) or total mass limits (e.g., lbs/day).

SPDES permits commonly set total flow discharge limitations as well. Flow limitations are set to minimize impacts on the receiving water. Such discharge limitations would be used in designing the appropriate treatment system. The drainage ditches are on-site and both creeks are physically very close to the site. Therefore, a discharge system could be easily designed and would be relatively inexpensive to install and control.

Discharge to surface water is feasible for this site due to the existence of the on-site drainage ditches and the proximity to off-site drainage ditches and creeks. For costing purposes it is assumed that treated groundwater would be discharged to on-site drainage ditches. Treatment systems can be designed to meet applicable regulations and required flow rates.

Based on currently available data the capital cost for this alternative is estimated to be $2,600. The annual operation and maintenance costs associated with this alternative is estimated to be $2,700.

This technology will be incorporated into the remedial alternatives that will be retained for detailed analysis.

6.4 CAPPING

A multimedia cap consisting of several different layers of materials (e.g., clay, sand, synthetic lines and asphalt) and a leachate detection system could be placed over the entire site or over hot spots at the site, to prevent rainfall and run-on from percolating through contaminated site media and leaching contaminants into site groundwater.

The effectiveness of a cap for controlling further groundwater contamination would be quite low. While it would reduce the amount of surface water percolating through the contaminated media somewhat, it would not reduce the mobility or volume of contaminated groundwater. The cap would not prevent the contaminated groundwater from contacting the underlying contaminated soil therefore potential public health and environmental risks would remain.

Services and materials for installing the cap are readily available. However, in order to maintain its effectiveness, the cap would require long-term maintenance and monitoring.

At this time, the area to be capped cannot be reasonably estimated because the site media potentially contributing to the groundwater contamination (e.g., soil and debris piles) require further characterization in the second Phase RI.

For reasons, of ineffectiveness in controlling migration of contaminants capping as a control measure for groundwater is eliminated from further consideration.

6.5 SUMMARY, DISCUSSION AND CONCLUSION

This section presents a summary and discussion of the alternatives screened in the previous four subsections. Table 6-2 presents the combinations of appropriate alternatives which have been retained and will be further evaluated in the Phase III FS. These tables are discussed in the following pages.

Alternative 1 would gradually remove or degrade the contaminants in groundwater. Assuming the sources of contamination are removed this alternative over the long-

TABLE 6-2

COMBINATIONS OF APPROPRIATE ALTERNATIVES FOR GROUNDWATER BECKER ELECTRONICS SITE

Alternative 1	No Action
Alternative 2	Water Use Restrictions
Alternative 3A	Extraction/Precipitation/Air Stripping
3B	Extraction/Precipitation/Carbon Adsorption/Discharge
3C	Extraction/Ion Exchange/Air Stripping/Discharge
3D	Extraction/Ion Exchange/Carbon Adsorption/Discharge

term would provide protection to human health and the environment upon completion of the remediation. The volume of contaminants in the groundwater would be reduced over time through natural attenuation and dilution. Currently identified receptors are now protected via an IRM (point of use treatment). This IRM would continue until contaminant levels are reduced to below state SCGs. This alternative would meet the remedial action objectives for the site in the future.

Alternative 2 would provide permanent protection to current and future residents using the groundwater for potable purposes. Currently identified receptors are now protected via an IRM (point of use treatment). This IRM would continue until contaminant levels are reduced to below state SCGs. This alternative would meet the remedial action objectives for the site in the future.

However, this alternative would not prevent the contaminated groundwater from further migrating and adversely impacting new receptors. Assuming the sources of contamination are removed, natural attenuation and dilution would gradually lessen these impacts. Therefore, it will be carried through to the detailed evaluation.

Alternatives 3A, 3B, 3C, and 3D would provide permanent protection to the public health and the environment. All of the alternatives would meet all of the remedial action objectives. They are all effective at removing and treating the contaminated groundwater. All of them are proven technologies and are available through several vendors. They would remediate the site much faster than Alternative 1 or 2. Therefore, for these reasons Alternatives 3A, 3B, 3C, and 3D will be carried through to detailed evaluation.

Alternative 4 would slightly reduce the amount of contaminants leaching into the groundwater. It would not prevent the contaminated groundwater form contacting the underlying contaminated soil, nor would it reduce the mobility or volume of contaminated groundwater. Therefore potential public health and environmental risks would remain. The cap would also require long-term maintenance and monitoring in order to maintain its effectiveness. For these reasons it will not be retained for further evaluation.

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REFERENCES

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