NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SUPERFUND STANDBY CONTRACT

BECKER ELECTRONICS MANUFACTURING SITE
EAST DURHAM, NEW YORK

WORK ASSIGNMENT NO. D002472-15

REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT
VOLUME I
REMEDIAL INVESTIGATION

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NYSDEC SUPERFUND STANDBY CONTRACT
WORK ASSIGNMENT NO. D002472-15

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
VOLUME IA
DRAFT FINAL PHASE II REMEDIAL INVESTIGATION REPORT

BECKER ELECTRONICS MANUFACTURING SITE
EAST DURHAM, NEW YORK

SITE NO. 4-20-007

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BECKER ELECTRONICS MANUFACTURING SITE
DRAFT FINAL PHASE II REMEDIAL INVESTIGATION REPORT

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EXECUTIVE SUMMARY

Phase II of the Remedial Investigation (RI) and Phase III of the Feasibility Study (FS) for the Becker Electronics Manufacturing (Becker) site was conducted by ABB Environmental Services (ABB-ES) for the New York State Department of Environmental Conservation (NYSDEC). The Becker site, located in the town of Durham, Greene County, New York, is listed as Site No. 4-20-007 in the Registry of *Inactive Hazardous Waste Disposal Sites in New York State* (NYSDEC, 1993a), and is a Class 2 inactive hazardous waste site. The Becker site is Class 2 because of the significant threat to public health created by solvents in private water supply wells surrounding the site, and hazardous waste deposition identified as the confirmed disposal of unknown quantities of F001 and F002-listed hazardous waste (chlorinated solvents) as set forth in 6 NYCRR Part 375. The Phase II RI completes the phased RI activities performed for NYSDEC, including the Phase I RI, interim remedial measures and subsurface investigations, and other environmental sampling.

The FS tasks included review and revision of the Phase I and Phase II FS based on results of the Phase II RI and completion of the Phase III FS (detailed analysis of alternatives and development of a conceptual plan).

The Becker site was an electrical components manufacturing facility producing high fidelity speakers and speaker components from at least as early as 1976 until declaring bankruptcy and closing in 1988. Since 1980, various studies have identified groundwater contamination at the Becker site, specifically industrial solvents (primarily 1,1,1-trichloroethane [1,1,1-TCA]) used in the company's manufacturing operations, which have been intercepted by downgradient and cross gradient private water supply wells. Area homes and businesses now use carbon filtration systems because of the solvent contamination in bedrock groundwater surrounding the site. The sources of solvent contamination in site media are discharges of solvent-contaminated wastewater to one or more on-site septic systems, and potential on-site disposal through accidental spills or poor waste management practices.

The purpose of the phased RI approach was to assess the nature and distribution of contamination associated with the Becker site and evaluate potential human and ecological risks associated with the site. Metcalf and Eddy of New York, Inc. (M&E) completed the Phase I RI between summer 1990 and spring 1992 (M&E, 1992a, 1992b, 1992c, 1992d, and 1992e). The Phase I RI was the basis of preliminary

groundwater remediation goals and remedial action objectives for the Becker site FS. The Phase I RI also recommended Interim Remedial Measures (IRMs) (drum removals and septic system clean-outs) which have been completed by NYSDEC. The Phase I RI, while confirming the nature of contamination and basic hydrogeologic characteristics of the site, could not identify specific sources of contamination or delineate the distribution of contamination in environmental media. This Phase II RI report compiles all previous Phase I RI data with results of additional environmental sampling to assess the distribution of contamination in media (primarily soil and groundwater) and the geologic and hydrogeologic characteristics of the site. The additional data are then used to complete qualitative ecological risk assessment, qualitatively revise the results of the Phase I RI human health risk assessment, and identify media-specific chemicals of potential concern (CPCs) as input to the FS.

Field activities completed during the Phase I RI included sampling of septic tanks, surface and subsurface soil, sediment, surface water, and groundwater. An aquifer pumping test was also performed to assess baseline hydrogeologic conditions for potential conceptual design of groundwater treatment systems in the FS. Based on recommendations in the Phase I RI, Environmental Products and Services, Inc. (EPS) cleaned out septic systems, removed underground storage tanks, disposed of drums of abandoned chemical products and wastes left on-site when Becker declared bankruptcy, and performed a limited subsurface investigation, including limited groundwater sampling (EPS, 1992). To address data gaps identified in the Phase I RI concerning surface soil, sediment, and surface water, additional environmental sampling of these media were performed by the NYSDEC from fall 1992 to winter 1993.

Based on the results of the Phase I investigation and other studies, the Becker site was subdivided into four source areas: (1) septic system no. 1; (2) the debris pile area/septic system no. 2; (3) septic system no. 3; and (4) the chemical storage building area. Between summer and fall 1994, ABB-ES conducted the Phase II RI field program to complete characterization of the operable units. Site-specific data to supplement the Phase I RI and other investigations were obtained from: (1) a fracture trace study; (2) field ecological inventories; (3) baseline air monitoring; (2) geophysical surveys; (4) samples of soil, surface debris, and subsurface (buried) debris collected from test pits and Geoprobe® borings; (5) samples of surface water and sediment from on-site drainages and downgradient seeps; (6) samples of groundwater

from newly installed and existing monitoring wells; (7) hydrogeologic testing; and (8) a location and elevation survey.

Based on results of RI and other sampling events, organic and inorganic contamination of soil, sediment, surface water, and groundwater have been identified. The primary source of volatile organic compound (VOC) groundwater contaminants (such as 1,1,1-TCA; trichloroethene [TCE]; and their degradation products) is believed to be soil contamination at the chemical storage building; other secondary sources appear to be isolated VOC contamination associated with the debris pile/ septic system no. 2. Semivolatile organic compounds (SVOCs) such as bis(2-ethyl-hexyl)phthalate, phenols, and polynuclear aromatic hydrocarbons [PAHs] originating from disposal of debris and wastewater have been identified as soil and sediment contaminants at the debris pile/septic system no. 2, septic system no. 3, and chemical storage building. Inorganic soil/sediment contaminants including cadmium, lead, and zinc are due to disposal of debris (solid waste), wastewater, and other anthropogenic sources; it is unclear from site data if these inorganics are also groundwater contaminants, although concentrations of some inorganics exceed New York State (NYS) and federal standards or guidance.

The hydrogeologic investigation completed in the Phase II RI shows that shallow groundwater is present in overburden/weathered bedrock and that deep groundwater is present in bedrock. Vertical hydraulic gradients are downward beneath the site, indicating that shallow groundwater recharges bedrock. Groundwater flow directions in overburden and bedrock are toward Catskill Creek and Thorp Creek, east of the Becker site. Upward hydraulic gradients between groundwater and the creeks, and the presence of seeps contaminated by VOCs along Catskill Creek, show that the groundwater contamination from the site is discharging to these surface water bodies.

A chemical fate and transport evaluation used analytical, topographical, piezometric, and geologic data to conclude: (1) VOCs in debris and soil may migrate by leaching to shallow groundwater, discharge to surface water, degrade or volatilize; (2) shallow groundwater (overburden/weathered bedrock) VOC contamination discharges downward into bedrock where it migrates in the direction of groundwater flow to discharge to Catskill or Thorp Creeks downgradient of the Becker site; (3) SVOCs may remain adsorbed to debris and may slowly attenuate by remobilization through leaching to subsurface soil or migrate as particulates to surface soil/sediment; and (4) inorganics may leach from the debris or other sources, migrate to shallow groundwater, precipitate out of solution, and concentrate in soil and sediment.

The analytical database from the RI and other studies, fate and transport assessment, site-specific and regional references, and the field inventory of biota were used to qualitatively assess the baseline human health risk assessment and complete a qualitative habitat-based ecological risk assessments. Groundwater, surface soil, sediment, and surface water exposure scenarios were developed in the Phase I RI. Subsurface soil was not evaluated in the Phase I RI due to a lack of data. To assess potential risks to public health, carcinogenic and non-carcinogenic risks calculated in the Phase I RI were compared to the U.S. Environmental Protection Agency (USEPA) and the NYS Department of Health risk range and hazard indices (HIs). In the Phase II RI, these results are evaluated by comparison to the revised data set (including Phase II RI data) to identify whether risks are likely under- or over-estimated, and by comparison to applicable NYS and federal soil, sediment, surface water, and groundwater standards, guidance, or cleanup criteria. Exposure of children and adults to groundwater contamination was identified in the Phase I RI as having an unacceptable carcinogenic risk (a carcinogenic risk value exceeding $1x10^{-4}$ compared to the USEPA acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$); exposure to groundwater was also identified as the source of unacceptable non-carcinogenic risks (HIs of slightly greater than the USEPA criteria of 1 were calculated for adults and children exposure scenarios). It is noted that all contaminated private water supply wells where groundwater exposures might occur utilize well head treatment to remove VOC contaminants from groundwater; SVOCs have not been detected in private water supply wells and inorganics (except isolated occurrences of barium) in private water supply wells do not exceed background.

Assessment of these results by comparison to the Phase II RI environmental data show that all scenarios in the Phase I RI underestimate risk; comparison of the available data to NYS and federal standards, guidance, and cleanup criteria show exceedances for VOCs (including 1,1,1-TCA; TCE; chloroethane; and vinyl chloride), SVOCs (including phthalates, phenols, and PAHs), and inorganics in one or more environmental media evaluated.

The Habitat-based Ecological Assessment identified several different ecological habitats including upland woodlands, open fields, and surface water bodies such as drainage ditches and the fire retention pond. Also identified were Class C trout streams, Catskill Creek and Thorp Creek, considered downgradient from the site. The maximum concentrations of chemicals of potential concern, identified in the Phase II RI were qualitatively compared to media-appropriate criteria. The results of the evaluation indicate potential risks to ecological receptors. Although direct

exposure of ecological receptors to groundwater is not expected, discharge of groundwater to the surface or surface water bodies (at seeps along the creeks and on-site drainage ditches) may pose potential ecological risks.

After the RI was completed, ABB-ES reviewed and revised previously identified remedial technologies for contaminated media at the Becker site, conducted a detailed analysis of alternatives, selected recommended remedies and developed a conceptual plan.

The FS Report identified the objectives of remedial actions to address contaminated media and the remediation goals (RGs) to achieve those objectives. Media identified as requiring remediation include soil, groundwater, and potable water. RGs were established for the media using applicable and appropriate or relevant requirements (ARARs) and NYS Standards, Criteria, and Guidelines (SCGs). In the FS, the CPCs identified in the risk assessment were further evaluated; a final list of contaminants of concern (COCs) was established as based on concentrations exceeding ARARs and SCGs, and their presence as hazardous waste constituents. Based on this evaluation, VOCs in groundwater and soil were identified as COCs.

Once the objectives and RGs for VOCs in soil, groundwater, and potable water were established, the FS identified and screened a range of remedial technologies capable of monitoring, containing, treating, and extracting/removing contaminated media. Those technologies considered feasible were assembled into alternatives for detailed analysis. The alternatives evaluated include the following:

Soil

Alternative S-1	No Action
Alternative S-2	Ex-Situ Source Soil Treatment
Alternative S-3	Off-Site Incineration and Disposal

Groundwater

Alternative GW-1	No Action

Alternative GW-2 Plume Control

Potable Water

Alternative WS-1 No Action

Alternative WS-2 Wellhead Treatment

Alternative WS-3 Alternative Water Supply

Criteria used to evaluate and compare the remedial alternatives for the COCs included protection of human health and the environment; compliance with ARARs and NYS SCGs; long term effectiveness and permanence; short-term impacts and effectiveness; reduction of contaminant mobility, toxicity, or volume; implementation; and cost.

For soil, Alternative S-2 Ex-situ Source Soil Treatment was selected as the preferred alternative for remediation of VOC contaminated soil at the chemical storage building and the leachfield for septic system no. 2. For groundwater, Alternative GW-2 Plume Control was selected as the preferred alternative, and for potable water, Alternative WS-2 Wellhead Treatment was selected as the preferred alternative. These alternatives were selected because they best meet the evaluation criteria. Off-site disposal of solid waste (primarily wood debris) to mitigate SVOC (phthalate) contaminant sources and abatement of on-site drainage ditches and off-site seeps receiving shallow VOC contaminated groundwater were included as a component of the FS.

The last step in the RI/FS process is to develop a conceptual plan. The conceptual plan combines the preferred alternatives into a comprehensive site response action. The conceptual plan includes a site plan, a proposed implementation schedule and flow chart. The conceptual plan consists of on-site extraction and treatment of contaminated groundwater, off-site reinjection of treated groundwater, excavation and on-site treatment of contaminated soil, on-site burial of treated soil, off-site disposal of surface wood debris as solid waste, and continued well head treatment of affected potable water supplies.

1.0 INTRODUCTION

ABB Environmental Services (ABB-ES), under contract to New York State Department of Environmental Conservation (NYSDEC) Division of Hazardous Waste Remediation (DHWR), is submitting this Phase II Remedial Investigation (RI) Report for the Becker Electronics Manufacturing site (hereinafter, the Becker site) in East Durham, Greene County, New York. The Becker site is listed as a Class 2 hazardous waste site, Number (No.) 4-20-007, in the *Registry of Inactive Hazardous Waste Sites in New York State* (NYSDEC, 1993a). This RI Report has been prepared in accordance with the requirements of NYSDEC as identified in Work Assignment (WA) No. D002472-15, dated November 24, 1993, under the New York State Superfund Standby Contract Supplemental Agreement No. One.

The RI and Feasibility Study (FS) for the Becker site are being conducted using a phased approach in accordance with the guidelines in the Superfund Amendment and Reauthorization Act (SARA) and New York State regulations (United States Environmental Protection Agency [USEPA], 1988 and NYSDEC, 1990). This approach integrates the RI and other field investigations and risk assessment (RA) with the screening and evaluation of alternatives performed during the FS. In particular, the Phase I RI and the Phase I and Phase II FS activities have been completed to date (Metcalf and Eddy of New York, Inc. [M&E], 1992a, 1992b, 1992c, and 1992d). This Phase II RI Report incorporates data from the Phase I RI and concurrent remedial activities and sampling performed by NYSDEC with results of the Phase II RI to assess the nature and distribution of contamination at the site.

The objectives of this Phase II RI are to determine the nature and distribution of contamination associated with site source areas and groundwater, and to reassess assessment of potential threats to human health and the environment posed by the release of hazardous substances from the Becker site as presented in the Phase I RI. The objectives of the FS are to evaluate potential remedial alternatives from an engineering, environmental, public health, and economic perspective and to develop a preferred alternative based on that evaluation. Review of the existing Phase I and Phase II FS was completed in 1994. The Phase III FS is presented in Volume II of the RI/FS document set.

1.1 REPORT ORGANIZATION

This RI Report is structured in general accordance with NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-89-4025 (NYSDEC, 1989a) and the USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01 (USEPA, 1988). The RI Report is contained within Volume IA and Appendices to the RI are in Volume IB. The FS for the site is contained in Volume II.

The purpose and scope of work are presented with a brief site history and summary of remedial actions undertaken by NYSDEC concurrent with the RI/FS in Section 1.0. In Section 2.0, the technical approach and structure of the Phase I and Phase II RI field programs are discussed, as are Applicable or Relevant and Appropriate Requirements (ARARs), Standard Criteria, and Guidelines (SCGs), aspects of the analytical program, and results of data validation. The general physical setting and characteristics of the area surrounding the site, such as population, land use characteristics, natural resources, and climate are presented in Section 3.0. Section 4.0 describes the regional and site geology and hydrogeology as interpreted from RI data and other sources of information. Section 5.0 summarizes the nature and distribution of contamination encountered, including the identification of site contaminants. An evaluation of fate and transport mechanisms at the site is in Section 6.0. Section 7.0 presents a summary and evaluation of the baseline habitat-based public health assessment performed during the Phase I RI and presents the baseline ecological assessment performed during the Phase II RI. Section 8.0 summarizes the RI and presents conclusions.

1.2 PURPOSE

The objectives of the Becker site Phase II RI were to:

- provide necessary data to characterize the nature and distribution of contamination in soil, groundwater, surface water, and sediment at the site;

- provide physical data sufficient to interpret the geologic and hydrogeologic characteristics of the site;
- assess the contaminant transport pathways and contaminant fate;
- provide the technical data to reassess public health and ecological risks; and
- provide data for detailed analysis in the FS.

The baseline public health RA performed during Phase I of the RI identified a preliminary list of contaminants of concern and assessed risks associated with contamination encountered in the study area as a result of past site activities. An expanded list of contaminants of concern has been developed based on results of the Phase II RI. These will be used to develop preliminary remediation goals (PRGs) in the FS.

1.3 SCOPE OF WORK

The scope of work required to fulfill the objectives of the RI/FS is presented in the site-specific Work Plan (ABB-ES, 1994b) and consist of the following major tasks:

- Detailed RI/FS Work Plan Preparation (Task 1)
- Phase I and Phase II FS Review (Task 2)
- Phase II (Post-Screening) RI Activities (Task 3)
- Phase III FS Report Preparation (Detailed Analysis of Alternatives (Task 4)
- Community Relations Support (Task 5)
- Final RI/FS Report Preparation (Task 6)

This Phase II RI Report completes Task 3 of the scope of work. When final, this report (Volume IA), its Appendices (Volume IB), and the Final FS Report (Volume II), will complete Task 6.

1.4 Reviews of Existing Documents and Data

The Becker site is located on Route 145 in East Durham, Greene County, New York (Figure 1-1), and produced high fidelity speakers and speaker components before declaring bankruptcy and closing in 1988. Since 1980, various studies have identified groundwater contamination at the Becker site, specifically industrial solvents (primarily 1,1,1-trichloroethane [TCA]) used in the company's manufacturing operations. 1,1,1-TCA was used as a solvent at the site from 1976 to 1982. Affected area homes and businesses now use carbon filtration systems because of contaminated private water supplies.

1.4.1 Previous Investigations

NYSDEC and the New York State Department of Health (NYSDOH) and private consultants previously investigated the Becker site. NYSDEC and its contractors performed RI/FS and Interim Remedial Measure (IRM) activities. Subsection 1.4.1 presents a chronological summary of the activities completed to date. ABB-ES obtained the existing documents and data forming the basis of this section during a review of the NYSDEC and NYSDOH files on December 8, 1993. In the Registry of Inactive Hazardous Waste Sites in New York, NYSDEC listed the Becker site as Class 2 inactive waste site due to significant threat established by occurrence of solvents in private water supply wells surrounding the site, and hazardous waste deposition identified as confirmed disposal of unknown quantities of F001 and F002-listed hazardous waste (1,1,1-TCA) (NYSDEC, 1993a). In addition, F003 and F005-listed hazardous waste constituents (non-halogenated solvents ethylbenzene, toluene, and methyl ethyl ketone [MEK or 2-butanone]) are also believed to have been disposed of on-site based on site history and results of environmental sampling. Disposal of solvents occurred through discharge of solvent-contaminated wastewater through site septic systems, accidental spills, and waste management practices.

The following chronology summarizes previous investigations and other historical information related to the Becker site. ABB-ES personnel reviewed these documents

and information to prepare a scope of work in response to the Phase II RI/FS work assignment. Locations of existing site features and previous sampling locations are shown on Figures 1-2 and 1-3, respectively.

Industrial Waste Study for Becker Electronics Manufacturing Corporation (Brinnier and Larios, 1981). Documents the source and disposal of industrial wastewater at the site, and summarizes environmental sampling results from 1980 and 1981. Recommends improvements to the industrial wastewater treatment process and cleanup of contamination.

Spiral Notebook Marked "Chemicals". Notebook found on-site by NYSDEC documenting shipments of chemical products received by the Becker Electronics Manufacturing Corporation for use between October 21, 1986 and June 10, 1987. Notes indicate receipt of various quantities of contact cement, lacquers, thinners, MEK, mineral spirits, and unidentified chemicals listed by quantity received and with the following reference numbers: 222, 332, 777, 3035B, 345, 511, 129, 6050, and 300AH.

NYSDOH Water Supply Well File Data from Vicinity of Becker Electronics Site - 1981 to Present. Documents concentrations of groundwater contaminants at water supply well/receptor locations from 1981 to the present in the vicinity of the Becker site. Maximum concentrations of the volatile organic compounds (VOCs) reported in the data compiled from 1981 to 1989 is summarized as follows:

VOLATILE ORGANIC COMPOUND (micrograms per liter [µg/L])	1981 TO 1982	1984 TO 1985	1986 TO 1989
1,1-DCE	63	10	65
1,1-DCA	240	200	580
trans-1,2-DCE	3	5	8
1,1,1-TCA	280	100	310
TCE	4	14	18
Chloroform	8	11	41
Chloroethane	10	ND	ND
Chloromethane	37	6	ND

VOLATILE ORGANIC COMPOUND (micrograms per liter [µg/L])	1981 TO 1982	1984 TO 1985	1986 TO 1989
(Continued)			
Dibromochloromethane	2	4	ND
Bromodichloromethane	34	1	15

Map Titled "Location of Proposed Monitoring Wells" (Dunn Geoscience, 1982a). Shows proposed locations for monitoring wells, locations of existing Becker Electronics Manufacturing Corporation water supply wells (WSWs) No. 1, No. 2, and No. 3, and approximate locations of leachfields (see Figure 1-2).

Map Titled "Approximate Location of 1,1,1-TCA Sources" (Dunn Geoscience, 1982b). Shows locations of Becker WSWs, septic tanks, and leachfields.

Map Titled "Selected Water Sampling Points and Concentrations of 1,1,1-TCA" (Dunn Geoscience, 1982c). Shows results of 1,1,1-TCA analysis of leachfield, septic tank, and Becker WSW samples.

Interim Report - Hydrogeologic Investigation Preliminary Findings For Becker Electronics (Dunn Geoscience, 1983). Documents results of preliminary sampling and geologic characterization performed by Dunn Geoscience. Indicates on-site bedrock fracture sets trend North 40 degrees East and North 95 degrees East, and illustrates the interpreted extent of groundwater contamination exceeding 50 µg/L of 1,1,1-TCA. Indicates spilling and burning of wastes occurred on the ground surface on the north side of the Becker manufacturing building and via the industrial leachfield. Includes a summary of detected 1,1,1-TCA concentrations from on- and off-site sampling points.

NYSDEC State Pollutant Discharge Elimination System Permit - Becker Electronics Manufacturing Site (NYSDEC, 1984). Presents sanitary and industrial waste leachfields discharge permit requirements and accompanying site detail map.

Proposal for Groundwater Contamination Assessment and Remediation Program for Becker Electronics Manufacturing Corporation (Bagdon Environmental Associates, 1986). Prepared for Becker Electronics Manufacturing Corporation. Summarizes the

existing groundwater problem, and notes that fluctuations in 1,1,1-TCA and dichloroethane (DCA) concentrations occur seasonally, with the highest concentrations in WSWs occurring in the winter when usage is lowest. Recommends a pump test of the Becker WSW No. 2, installation of a pump-and-treat system, and remediation of the septic systems and soil.

Becker Electronics Manufacturing Corporation - Well No. 2 Pump Test Report (Bagdon Environmental Associates, 1987). Details step-drawdown and three-day constant-rate pump test results for the Becker WSW No. 2 performed in 1987. Estimates a transmissivity of between 2,000 and 5,000 gallons per day (gpd)/foot with a maximum pumping rate of 20 to 30 gallons per minute (gpm). Predicts the cone of depression created by pumping this well to be elongated preferential to one of the joint sets identified by Dunn Geoscience.

Hydrogeologic Evaluation of Proposed Remedial Options at the Becker Electronics Site as Related to Human Exposure to a Contaminated Drinking Water Supply (P.A. Rubin, 1987). Provides a detailed review of the Bagdon Associates pump test. Concludes that the pump test was poorly designed and did not provide representative data from which to assess the aquifer characteristics, and recommends another pump test.

Affidavit in Support of Motion for Summary Judgment (State of New York against Becker Electronics Manufacturing Corporation, 1990 - draft). Details a summary of the studies performed to date, with evidence that contamination at the adjacent Weldon House (a resort hotel) originated from the industrial leachfield. Concludes that groundwater contamination will continue as long as sources remain. Recommends an RI/FS to assess the areal extent of contamination. Includes a summary of groundwater data from 1980 to 1988, a summary of on-site surface water and septic system data from 1981 to 1987, and private water supply well data from 1980 to 1989.

Citizen Participation Plan for Becker Electronics Manufacturing Site (NYSDEC Division of Hazardous Waste Remediation, 1992a). Encourages communication between the NYSDEC and the community during the RI/FS process for the site. Summarizes the site history, noting that Becker Electronics Manufacturing Corporation declared bankruptcy in 1988, and outlines the RI/FS process for the site to be performed by a NYSDEC Superfund standby consultant.

Interim Remedial Measure - Evaluation of Water Treatment Systems for Weldon House (M&E, 1992b). Details assessment of the water treatment system used at the Weldon House and recommends changes to the system.

Subsurface Investigation (Environmental Products and Services, Inc. [EPS], 1992). Documents a post-IRM investigation of shallow groundwater at the location of a former aboveground waste oil tank where surface spills occurred. Identifies shallow groundwater solvent contamination throughout the vicinity of the truck loading docks and chemical storage building, but no significant groundwater contamination associated with the former tank location. IRM activities completed at the site are summarized in Subsection 1.4.2.

Analytical Report for Becker Site (NYSDEC, 1992b; unpublished). Documents results of the NYSDEC background soil sampling (samples SS-1DEC to SS-6DEC) performed in September 1992. Background soil sample locations are shown in Figure 1-3. Soil samples were collected for laboratory analysis for the Target Compound List (TCL) metals barium, beryllium, cadmium, cobalt, lead, manganese, nickel, and zinc. Background soil sampling results are as follows:

TCL METAL (MILLIGRAMS PER KILOGRAM [mg/kg])	SS-1DEC	SS-2DEC	SS-3DEC	SS-4DEC	SS-5DEC	SS-6DEC	MAXIMUM
Barium	420	360	440	450	350	300	450
Beryllium	1.6	1.5	1	1.5	1.8	1.4	1.8
Cadmium	0.7	0.8	0.7	0.2 J	0.4 J	0.3 J	0.8
Cobalt	6	7	2	6	6	5	7
Lead	27	25	27	23	14	22	27
Manganese	970	2100	171	570	424	580	2100
Nickel	15	17	11	19	27	22	27
Zinc	80	78	69	72	68	60	80

Note: J indicates estimated concentrations.

Mobile Laboratory Submission (NYSDEC, 1993b; unpublished). Documents results of surface soil polychlorinated biphenyl (PCB) field screening and TCL VOC and selected TCL metals off-site laboratory analyses of sediment and surface water samples collected in December 1992 (samples SD/SW-201DEC to SD/SW-211DEC)

and for surface soil samples collected in January 1993 (samples SS-212DEC to SS-220DEC). TCL metals for which samples were analyzed were beryllium, cadmium, chromium, copper, lead, nickel, and zinc. Sample locations are shown in Figure 1-3. Samples SD/SW-207DEC were collected from Thorp Creek at a location believed upgradient of potential influence of the Becker site.

Surface soil results are shown in Figure 1-4. PCBs were not detected. TCL VOCs were not detected. TCL metals detected above background (as defined in NYSDEC, 1992b and NYSDOH, 1995-see also Table 2-12) are cadmium (99 mg/kg) and lead (up to 584 mg/kg) in sample SS-220DEC, and zinc (up to 420 mg/kg). All of the samples were of site surface soil except sample SS-220DEC which is a sample from a pile of dark-colored soil-like material located near the sawdust storage building. This sample (S-220DEC) contained the highest concentrations of cadmium, copper, and lead.

Sediment results are shown in Figure 1-5. PCBs were not detected. The TCL VOC 1,1,1-TCA (7 micrograms per kilogram [μg/kg]) was detected in sample SD-202DEC. The only TCL metal in the sediment samples at concentrations exceeding soil background is zinc (861 mg/kg) in sample SD-203DEC. Sample SD-202DEC containing the TCL VOCs is located near the former location of the septic tank for septic system no. 2.

Surface water results are shown in Figure 1-6. The TCL VOC 1,1,1-TCA was detected in sample SW-202DEC (4 μg/L), SW-204DEC (4 μg/L) and SW-206DEC (20 μg/L); chloroethane was detected in sample SW-206DEC (2 μg/L); all other VOCs were nondetect. TCL metals detected were chromium (up to 13 μg/L), copper (up to 31 μg/L), lead (up to 14 μg/L) and zinc (up to 705 μg/L). The highest concentrations of metals were generally in samples SW-202DEC and SW-203DEC, located along the drainage ditch in the vicinity of the septic system no. 2 septic tank. Comparison of surface water data to sample SW-207DEC (see Figure 1-6) shows similar concentrations of metals are present in all Catskill Creek and Thorp Creek samples (SW-207DEC to SW-210DEC). Inorganics detected in the NYSDEC surface water samples at concentrations greater than those detected in SW-207DEC are chromium (in samples SW-202DEC and SW-203DEC), copper (SW-202DEC and SW-203DEC), lead (SW-202DEC and SW-203DEC), and zinc (SW-202DEC, SW-203DEC, SW-206DEC, and SW-211DEC).

1993 Private Water Supply Well Data Submission (M&E, 1993; unpublished). Analytical results of water samples from private water supply wells affected by the Becker site; samples collected before carbon treatment units, in between carbon cylinders, and at the tap after treatment. Samples were collected in October of 1993. Results for the four private wells are summarized as follows (USEPA Method 524.2):

Volatile Organic Compound (µg/L)	Range of Detections		
	Pre-treatment	Mid-treatment	Tap
Methylene chloride	2-5	0.7-1	0.8-2
1,1-DCA	2-7	ND	ND
1,1,1-TCA	ND-9	ND-1	ND-0.9
1,1-DCE	ND-1	ND	ND
1,2-DCE (cis)	ND-0.7	ND	ND
TCE	ND-2	ND	ND

Of the private water supply wells sampled in this deliverable, all are located north of the Becker site and do not include wells located east of the site which historically have contained the highest concentrations of VOCs.

1994 Private Water Supply Well Data Submission (M&E, 1994). Analytical results of water samples from private water supply wells affected by the Becker site. Samples collected in May-June 1994. Results for the six private wells are summarized as follows (USEPA Method 524.2):

Volatile Organic Compound (µg/L)	Range of Detections		
	Pre-treatment	Mid-treatment	Tap
Vinyl chloride	ND-0.711	ND-0.990	ND
Chloroethane	ND-3.11	ND-2.52	ND-1.62
1,1-DCE	ND-6.4	ND	ND
1,1-DCA	1.07-167	ND-7.07	ND

Volatile Organic Compound (µg/L)	Range of Detections		
	Pre-treatment	Mid-treatment	Tap
(Continued)			
1,1,1-TCA	ND-50.2	ND-21.5	ND-19.9
Ethylbenzene	ND-0.6	ND	ND
m-xylene	ND-073	ND	ND
TCE	ND-3.25	ND	ND
1,2-DCE(cis)	ND-1.61	ND	ND

NYSDOH Soil and Groundwater Background Data (NYSDOH, 1995). Analytical results of water samples from private water supply wells in Greene County and background soil samples provided to NYSDEC to use as background from the Becker RI. Results for the six soil samples and 13 groundwater samples are as follows:

Inorganic Parameter	Range of Detections	
	Background Soil (mg/kg)	Background Groundwater (µg/L)
Barium	85.5-3,500	24-307
Beryllium	0.1-40	ND-3
Cadmium	ND-7	NA
Calcium	ND-400,000	8,100-785,000
Chromium	5-3,000	NA
Cobalt	1-40	NA
Copper	2-484	ND-86
Iron	7,000-550,000	ND-49,700
Lead	2-200	ND-22
Magnesium	600-6,000	1,000-48,900
Manganese	100-5,810	5-1,610
Mercury	ND-0.2	ND
Nickel	5-1,000	NA

Inorganic Parameter	Range of Detections	
	Background Soil (mg/kg)	Background Groundwater (µg/L)
(Continued)		
Sodium	NA	4,700-170,000
Zinc	10-300	ND-2,150

1995 Private Water Supply Well Inorganics Data (NYSDOH, 1995). Analytical results of water samples from private water supply wells affected by the Becker site; samples collected January-February 1995. Data set includes three samples collected before treatment and six samples collected after treatment and analyzed for selected inorganics. Results for the samples are summarized as follows:

Inorganic Parameter	Range of Detections	
	Pre-Treatment (µg/L)	TAP (µg/L)
Barium	387-650	195-657
Beryllium	ND	ND
Calcium	57,700-674,000	55,200-66,700
Copper	6-53	ND-38
Iron	14-75	ND-107
Lead	ND	ND
Magnesium	9,300-11,500	6,500-11,500
Manganese	106-258	ND-263
Mercury	ND	ND
Sodium	16,400-25,500	6,300-31,100
Zinc	ND-61	ND-77

Comparison of the results above to site background (see Table 2-13) shows barium to be the only inorganic detected at concentrations exceeding background in the private water supply wells.

1.4.2 Concurrent Remedial Actions

IRMs completed at the site by NYSDEC have included the following source control actions:

- Five underground structures (septic tanks and pump stations) associated with all three site septic systems were pumped out and steam cleaned. The structures were either backfilled with soil or removed.

- Soil from leach field no. 1 was excavated and placed on plastic sheeting adjacent to the gravel parking area near the site gate. The soil (sample ST-2-IRM on Figure 1-3) was tested for disposal parameters (e.g., Toxicity Characteristic Leaching Procedure [TCLP] metals, VOCs, and SVOCs; PCBs; pH; cyanide; flashpoint; sulfide and cyanide reactivity analyses). As the laboratory results were non-detect or did not identify the material as hazardous waste, the soil was spread out at that location. In addition, a sample of the material in the septic tank nearest the leachfield (sample ST-1-IRM), a sample from a septic tank near the building (SS-4-IRM), and a boiler drain believed to discharge to this system (SS-3-IRM) were also analyzed; results were below regulatory limits (RLs) that would define the materials as hazardous waste.

- At the oil/water separator (septic tank) for the industrial waste septic system, the tank and some soil was excavated. The tank and soil remain on-site. The soil surrounding the tank was sampled for disposal parameters (samples SS-5-IRM and SS-6-IRM on Figure 1-3); laboratory results did not identify the soil as hazardous waste. The soil remains piled on-site on plastic sheeting.

- An above ground waste oil tank and contaminated soil were removed from the back of the warehouse/truck maintenance building. The soil from beneath this tank was excavated and placed on plastic; a sample (SS-8-IRM) was collected for laboratory analysis for hazardous waste characteristics; results of TCLP analyses were below RLs and other

parameters did not define the material as hazardous waste. The excavated soil was spread on-site.

- A 5,000-gallon underground storage tank (UST) (fuel oil) was removed from the south side of the manufacturing building. Soil from beneath this tank (SS-7-IRM) was collected for laboratory analysis for hazardous waste characteristics; results were below RLs; other parameters did not define the soil as hazardous waste.

- A 5,000-gallon UST (fuel oil) was identified beneath the northeast portion of the manufacturing building foundation. The UST was cleaned in place and backfilled with cement grout.

- Approximately 90 drums of various containers of flammable and corrosive hazardous waste (including MEK, hydrofluoric acid, ether, chlorine and oxygen gas cylinders, sodium hydroxide, phosphoric acid, waste liquid containing toluene and xylene, potassium hydroxide, isobutane/isopropane gas, and 1,1,1-TCA) were removed from the chemical storage building and other portions of the site for disposal.

- A chain link fence was erected across the east side of the Becker site facing Route 145 to restrict access. At a later time, a chain and posts were placed at a dirt access road on the west side of the site. Some building doors have been nailed or bolted shut. These security actions were performed due to evidence of building break-ins and vandalism.

As part of the IRMs, NYSDEC contracted EPS to perform a subsurface investigation to assess the presence of subsurface contamination at the chemical storage building area. The subsurface investigation consisted of the following activities (EPS, 1992):

- Drilling five soil borings (MW-1EPS, TB-2EPS, MW-3EPS, MW-4EPS, and MW-5EPS) and screening of soil samples with a photoionization detector (PID) for the presence of contaminants;

- Installing four water table monitoring wells and groundwater sampling from the four monitoring wells (MW-1EPS, MW-3EPS, MW-4EPS, and MW-5EPS) and one recovery well installed at the location of the

former above ground waste oil tank (MW-SPILL), analyzing groundwater samples for VOCs by USEPA method 503.1 and method 624 and for metals;

- Installing three other 6-inch inside diameter (ID) wells to aid in observing water levels and potential future extraction of groundwater: MW-STS-3 in the remains of septic tank no. 3; MW-Tank at the location of a former 5,000-gallon UST; and MW-BOX in the remains of a former septic tank formerly part of septic system no. 1.

Monitoring wells installed by EPS are shown in Figure 1-3. An elevated PID reading of 3.8 parts per million (ppm) was detected in one soil sample from boring MW-4EPS located near the former waste oil tank location. All other PID readings for soil were at background concentrations (0 ppm). Bedrock was encountered at the surface at TB-2EPS. Bedrock was encountered between 2 and 12.7 feet below ground surface (bgs) in the remaining borings. Groundwater analytical results for USEPA method 624 follow:

COMPOUND (µg/L)	MW-1EPS	MW-3EPS	MW-4EPS	MW-5EPS	MW-SPILL
Chloroethane	ND	13	ND	ND	ND
1,1-DCA	57	80	56	ND	ND
Methylene Chloride	ND	5	5	ND	ND
1,1-DCE	20	8	ND	ND	ND
1,1,1-TCA	260	35	58	36	ND
TCE	6	5	ND	ND	ND
PCE	ND	6	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	6

Groundwater analytical results for USEPA method 503.1 follow:

COMPOUND (µg/L)	MW-1EPS	MW-3EPS	MW-4EPS	MW-5EPS	MW-SPILL
PCE	ND	7	ND	ND	ND

Figure 1-1 Site Location Map

Figure 1-2 Site Layout Map (foldout in pocket)

Figure 1-3 Previous NYSDEC and IRM Sampling Locations

Figure 1-4 Previous NYSDEC Surface Soil Sampling Locations and Results

Figure 1-5 Previous NYSDEC Sediment Sampling Locations and Results

Figure 1-6 Previous NYSDEC Surface Water Sampling Locations and Results

2.0 REMEDIAL INVESTIGATION PROGRAM

This section describes the Becker site RI program. Subsection 2.1 summarizes the Phase I RI program. Subsection 2.2 presents the Phase II RI program objectives and approach developed by ABB-ES and Phase II RI field activities completed. ARARs are summarized in Subsection 2.3. The methodology to identify potential site contaminants is presented in Subsection 2.4.

2.1 PHASE I REMEDIAL INVESTIGATION SUMMARY

This subsection presents a summary of the Phase I RI exploration program completed by M&E. For details of the Phase I RI, see the Phase I RI Report and its Appendices (M&E, 1992c).

2.1.1 Surface Water and Sediment Sampling

Surface water and sediment samples were collected from the fire pond, on-site drainage ditches, and from Thorp Creek and Catskill Creek (see Figure 2-1). The surface water and sediment laboratory analytical program is summarized in Table 2-1.

2.1.1.1 Fire Pond Samples. The on-site fire pond was sampled to assess the nature and distribution of potential contamination. Characterization of the fire pond consisted of establishing a grid at the pond with a 25-foot grid spacing; collecting measurements of water column and sediment thickness using a weighted tape and hand auger; and collecting six water (three surface water [SW], and three basal water [BW]), and three sediment (SD) samples from the pond (e.g., samples FP-1 through FP-3).

Laboratory analytical samples were collected initially from the pond in November 1990. The surface water samples were collected by immersing the sample bottle into the fire pond at the appropriate sampling location on the grid. The basal water was collected by using a stainless steel bottom sampler lowered by a teflon coated wire to the bottom of the fire pond. Sediment samples were collected using a stainless steel bucket auger. All of the samples were analyzed for TCL VOCs, semivolatile

organic compounds (SVOCs), pesticides/PCBs, and metals. In addition, water temperature, pH, conductivity, turbidity, and dissolved oxygen were measured in the field. Due to Quality Control (QC) problems, locations were resampled and analyzed for VOCs, SVOCs, and pesticides/PCBs.

2.1.1.2 Drainage Ditch Sampling. Nine surface water/sediment sample pairs (samples DD-1 through DD-9) were collected from on-site drainage ditches for laboratory analysis to assess the nature and distribution of potential contamination migrating from site sources (see Figure 2-1). The samples were initially collected in November 1990 and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and metals (see Table 2-1). Surface water samples were collected for laboratory analysis by immersing the sample bottles below the surface water in the drainage ditch. Sediment samples were then collected using a stainless steel bucket auger. Due to QC problems, locations were later resampled and analyzed as required for TCL SVOCs and pesticides/PCBs, including two additional samples (DD-10 and DD-11).

2.1.1.3 Catskill Creek and Thorp Creek Sampling. Four surface water/sediment pairs were collected from Catskill Creek and Thorp Creek located east and downhill of the Becker site (samples DD-TC-1, DD-TC-2, DD-CC-1, and DD-CC-2) (see Figure 2-1) to assess the nature and distribution of potential contamination migrating to these water bodies from the site via either surface water transport or groundwater discharge. The samples were collected initially in November 1990 and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and metals (see Table 2-1). Surface water samples were collected for laboratory analysis by immersing the sample bottles below the surface of the water in the creeks. Sediment samples were then collected using a stainless steel bucket auger. Due to QC problems, locations were later resampled and analyzed as required for TCL VOCs, SVOCs and pesticides/PCBs.

2.1.2 Surface and Subsurface Soil Sampling

The Phase I RI soil investigation was initially conducted in the fall of 1990, and resampling was performed in the spring of 1991. Surface and subsurface soil sampling locations are shown in Figure 2-1. Sample depths and laboratory analyses performed are summarized in Table 2-1. Subsurface soil samples were collected from soil borings and test pits; surface soil samples were comprised usually of the first 0.5 feet of soil encountered at a selected sampling location.

2.1.2.1 Surface Soil Sampling. Surface soil sampling was performed at suspected spill locations to characterize soil and assess the nature of potential contamination present. Nineteen surface soil samples (SS-1 through SS-19) were collected in the Phase I RI for laboratory analysis for TCL VOCs, SVOCs, pesticides/PCBs and metals. Due to laboratory QC problems associated with the original sampling program, 13 of the locations were resampled and analyzed for TCL VOCs and SVOCs.

2.1.2.2 Subsurface Soil Sampling. Subsurface soil sampling was performed to characterize subsurface soil in the vicinity of potential spill locations and assess the thickness of overburden. Four subsurface soil samples were collected from one test pit (BL-1) and three soil borings completed at the site (BL-2, BL-3 and BL-4) (see Figure 2-1) at depths from the ground surface to 6 feet bgs. Samples were collected for laboratory analysis for TCL VOCs, SVOCs, pesticides/PCBs, and metals. Due to laboratory QC problems, all four locations were resampled and analyzed for TCL VOCs and SVOCs.

2.1.3 Septic System Sampling

The three on-site septic systems were located and sampled in the Phase I RI. Septic system no. 1, referenced as having State Pollution Discharge Elimination System (SPDES) Permit #2 (M&E, 1992c; NYSDEC, 1984), was excavated in November 1990 and uncovered a leachfield distribution box and lateral. Three samples were collected from septic system no. 1 (see Figure 2-1). A water/sediment pair (designated as ST-1-SW and ST-1-SD) were collected from the distribution box, and a soil sample (ST-1-TP) was collected beneath a perforated 4-inch ID polyvinyl chloride (PVC) lateral pipe. Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and metals.

Septic system no. 3, referenced as having SPDES Permit #1 (M&E, 1992c; NYSDEC, 1984) was excavated in November 1990 and uncovered a septic tank and leachfield. Three samples were collected from septic system no. 3 (see Figure 2-1). A water/sediment pair (designated as ST-3-SW and ST-3-SD) were collected from the septic tank, and a soil sample (ST-3-TP) was collected at the outfall of a 4-inch ID PVC pipe in a nearby drainage ditch (believed initially to be an overflow pipe for the leachfield). Further excavation defined this pipe as discharging directly from the

septic tank. Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and metals.

Septic System No. 2, referenced as the industrial waste septic system and having SPDES Permit #3 (M&E, 1992c; NYSDEC, 1984), was excavated November 1990 and uncovered a septic tank (possibly designed as an oil/water separator) and piping from the tank to the building. Four samples were collected from septic system no. 2 (see Figure 2-1). Samples of sediment and soil (designated as ST-2-SD and ST-2-TP) were collected from the septic tank and from soil beneath a pipe discharging to the septic tank from the building, respectively. A water sample (PP-1) was collected from a PVC pipe inside the building which appeared to be part of the piping discharging to ST-2. Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and metals. Due to QC problems, all septic system locations in the Phase I RI were resampled and analyzed for VOCs, SVOCs, and pesticides/PCBs. During the resampling, water in the discharge piping exiting the septic tank at ST-2 was sampled (sample ST-2-DWP).

2.1.4 Monitoring Wells

One overburden monitoring well (MW-2S) and three bedrock monitoring wells (MW-4, MW-5, and MW-6) were installed at the site during the Phase I RI to assess the nature of groundwater contamination at the site (see Figure 2-1).

2.1.4.1 Monitoring Well Locations. MW-2S was installed as a water table monitoring well in overburden near the abandoned Becker No. 2 water supply well. MW-2S was installed in a boring advanced with 4.25-inch ID hollow stem augers (HSA) to 7.5 feet bgs.

Bedrock wells MW-4, MW-5, and MW-6 were installed in borings advanced into bedrock with rock coring. Coreholes were advanced to reach a siltstone marker bed located approximately 65 feet bgs. Rock core retrieved was logged and rock quality designation (RQD) was determined. Prior to monitoring well installation, the bedrock coreholes were packer tested to assess hydraulic conductivity (see Subsection 2.1.5.1).

2.1.4.2 Monitoring Well Construction. The bedrock wells were installed using open hole well construction. The monitoring wells were constructed of 2-inch ID stainless

steel well screen and riser. The well screens were located at the bottom depth of the bedrock boreholes, with no sand filter pack, seal, or backfill material. MW-4, MW-5, and MW-6 were completed to 64, 70, and 74.7 feet bgs, respectively. Shallow monitoring well MW-2S was constructed of 2-inch ID PVC well screen and riser. All monitoring wells were developed in accordance with the Phase I Work Plan; stabilization of physical parameters (pH, temperature, and conductivity) and turbidity levels less than 50 NTUs were achieved.

2.1.5 Hydrogeologic Testing

Hydrogeologic testing performed in the Phase I RI included packer testing, measurement of water levels, and an aquifer pumping test.

2.1.5.1 Packer Testing. Packer (pressure) testing of bedrock boreholes drilled to install MW-4, MW-5, and MW-6 was performed to assess bedrock hydraulic conductivity. An assembly consisting of two inflatable packers spaced five feet apart with 3.4-inch ID steel riser was used. The water injection rate was controlled by a pump pressure valve and gate valve attached to the riser pipe at the surface; a flow gauge recorded the total amount and rate of water injected during a particular test interval. Packer inflation was controlled using compressed nitrogen at 100 pounds per square inch (psi). Each five-foot interval was tested at 5 psi, 10 psi, and 15 psi water injection pressure above ambient pressure and than stepped back to 5 psi to determine any increase in permeability resulting from the test itself. This procedure was followed for all bedrock monitoring wells with the exception of MW-6, which could not be tested from 17.2 to 42 feet bgs due to the width of the borehole over this interval.

2.1.5.2 Water Level Measurements. Groundwater levels were measured at each monitoring well, and at abandoned Becker WSW-2 and Becker WSW-3, during November 1990 to January 1991. Levels were recorded to the nearest 0.01 foot with an electronic water level meter. Results are detailed in the Phase I RI Report (M&E, 1992c).

2.1.5.3 Aquifer Pumping Test. A pumping test was performed during the Phase I RI from December 15-17, 1990 to characterize hydraulic conditions at the site and to provide the necessary data for any future groundwater pumping and treatment system design. Becker WSW-2 was used as the pumping well; Becker WSW-3 and

monitoring wells MW-2S, MW-4, MW-5, and MW-6 were used as observation wells in the test. Test equipment consisted of an Aquistar DL4-16 digital water level recorder with corresponding transducers placed in each of the six wells.

Step-drawdown tests were conducted in the Becker WSW-2 to estimate a sustainable pumping rate for the constant rate pumping test. BSW-2 was tested in three steps with pumping rates increased at 10 gpm intervals from 40 gpm to 60 gpm to estimate a sustainable pumping rate for the constant rate pumping test.

A constant rate pumping test was conducted in the Becker WSW-2 at a rate of 50 gpm for 24.5 hours. The remaining on-site monitoring wells were continuously monitored during the test and drawdown data was analyzed using the following standard methods:

- Theis Method
- Jacob Method
- Hantush-Jacob semi-log drawdown method
- Hantush-Jacob semi-log recovery method

2.1.6 Groundwater Sampling

Six groundwater samples were collected during the Phase I RI for analysis for TCL VOCs, SVOCs, pesticides/PCBs, and metals (see Figure 2-1 and Table 2-1). Becker WSW-2 and WSW-3 were purged using submersible pumps and dedicated tubing. Monitoring wells MW-2S, MW-4, MW-5, and MW-6 were purged with centrifugal pumps and dedicated tubing. Wells were purged to remove three well volumes; turbidity values were reportedly less than 50 NTUs and physical parameters of temperature, pH, and conductivity were stabilized (M&E, 1992c). Samples were collected using a teflon bailer with a teflon coated steel leader. Due to QC problems, all of the wells were resampled and analyzed for VOCs, SVOC, and pesticides/PCBs.

2.1.7 Topographic Survey and Mapping

A topographic survey was conducted at the Becker site as part of the Phase I RI by YEC, Inc., subcontracted to M&E. The objectives of the survey were to standardize

maps, drawings, and other information pertinent to the RI/FS. The surveying program included the following:

- topographic survey of existing site features;
- establishing a grid for fire pond sampling;
- establishing surface water elevations of the fire pond;
- establishing well locations and elevations; and
- locating sampling locations and elevations.

The surveyor used a datum spot elevation of 484.0 feet at the intersection of New York State Route 145 and County Road 67A as a vertical control point. This datum spot elevation is based on the U.S. Geological Survey (USGS) 7.5 minute Freehold quadrangle map and the National Geodetic Survey of 1929. Elevations were obtained to the nearest 0.01 foot and were used to create the base map for the site. The topographic survey was performed with a contour interval of 1.0 foot.

2.1.8 Phase I RI Laboratory Analytical Program

Phase I RI samples were collected from November 11, 1990 through May 8, 1991 (M&E, 1992c). The samples were submitted to Pace Incorporated, the laboratory subcontracted to M&E for analysis for TCL VOCs, SVOCs, pesticides/PCBs, and metals in accordance with NYSDEC analytical services protocol (ASP) methodology. Results of validation of these data are detailed in the Phase I RI report, and summarized in this subsection.

Data validation was performed on the Phase I RI low level soil, sediment, surface water, septic tank, and groundwater samples collected by M&E at the Becker site (M&E, 1992c). Data validation was performed by NYTEST Environmental, Inc. (NYTEST), subcontracted to M&E. Numerous QC problems were identified during initial validation efforts by NYTEST for almost all samples collected in November and December 1990. To attain useable data, resampling occurred in April and May 1991. Data presented in the Phase I RI report (acceptable 1990 results and all 1991 results) are considered useable (except rejected antimony and silver results, and approximately half of all lead results) with validation qualifiers as necessary.

2.2 PHASE II REMEDIAL INVESTIGATION

The following technical objectives of the Phase II RI were identified by ABB-ES and NYSDEC to address data gaps from the Phase I RI.

- The extent of contamination at the debris pile area, and the leachfield and septic tank for septic system no. 2 needed to be assessed through laboratory analysis of debris, subsurface soil, and groundwater samples, and through direct measurements of the aereal extent and thickness (of debris). Phase I RI data were not sufficient to consider the scope of potential remedial alternatives for these areas, although they are suspected to have been the dominant source of groundwater contamination migrating from the site.

- Shallow groundwater at the locations of septic system no. 2 and septic system no. 3 needed to be characterized, due to detection of solvents in the septic tanks during the Phase I RI. If evidence of significant shallow groundwater contamination is detected, test pitting in the leachfields would be warranted to assess the extent of soil (source) contamination.

- The extent of soil and groundwater contamination at the chemical storage building area needed to be determined. Phase I RI soil data was insufficient to assess potential remedial alternatives.

- The extent of groundwater contamination migrating from the site required further definition to evaluate potential remedial alternatives in detail. In addition, groundwater flow directions and gradients associated with septic system no. 2 (the industrial septic system) towards Catskill Creek needed to be evaluated, and water treatment parameters [hardness, total organic carbon (TOC), total suspended solids (TSS), chemical oxygen demand (COD), biological oxygen demand (BOD), alkalinity, and metals content] needed to be measured in bedrock monitoring wells.

- Because shallow groundwater contamination has been shown to discharge to surface water at the site, resampling of surface water for VOCs was necessary. In response to NYSDEC comments on the Phase I RI, an additional surface water/sediment pair was requested

to characterize a small wetland area north of the site receiving surface water from the site, and additional on-site surface water/sediment pairs were needed to complete assessment of the nature and distribution of contamination in on-site drainages and the fire pond.

The primary objective of the Phase II RI field activities was to provide data supporting an evaluation of the site-related problems and the selection of potentially feasible remedial alternatives for the Becker site. Phase II RI field activities includes investigation of air, debris, subsurface soil, surface water and sediment, and groundwater on-site and in the vicinity of the site. All Phase II RI explorations are presented in Figure 2-1. The Phase II RI laboratory analytical program is summarized in Table 2-2; sample data records and exploration logs are included in Appendix A (see Volume IB). Specific activities were as follows:

- Baseline Air Monitoring (Subsection 2.2.1)
- Surface Geophysical Survey (Subsection 2.2.2)
- Fracture Trace Analysis (Subsection 2.2.3)
- Surface Water/Sediment Sampling (Subsection 2.2.4)
- Subsurface Soil Sampling (Subsection 2.2.5)
- Water Table Monitoring Well/Piezometer Installation (Subsection 2.2.6)
- Bedrock Borings and Borehole Geophysical Survey (Subsection 2.2.7)
- Bedrock Monitoring Well Installation and Existing Bedrock Well Reconstruction (Subsection 2.2.8)
- Monitoring Well Development (Subsection 2.2.9)
- Groundwater Sampling (Subsection 2.2.10)
- Hydrogeologic Characterization (Subsection 2.2.11)

- Exploration Location and Elevation Survey (Subsection 2.2.12)
- Ecological Characterization (Subsection 2.2.13)

2.2.1 Baseline Air Monitoring

The objective of the baseline air monitoring program in the Phase II RI was to: (1) assess atmospheric migration as a potential contamination pathway; (2) assess the risk to potential receptors from airborne contaminants; and (3) assess site conditions for health and safety purposes. The air monitoring program included both qualitative and quantitative analysis of USEPA Method TO-14 VOCs plus the tentative identification of 10 additional compounds. In addition, the air monitoring program includes screening evaluation of SVOCs at the site, consisting of quantitative analysis of 17 polynuclear aromatic compounds using National Institute of Occupational Safety and Health (NIOSH) Method 5506.

2.2.1.1 Procedures. To meet the project objectives, one sampling event, eight hours in duration, was conducted. Four sampling stations were established for the event: one station upwind (background designated as LG-101) and three stations at or downwind of source areas (designated as LG-102, LG-103, and LG-104) at the site (i.e., the waste pile/septic system no. 2; septic system no. 3; and the chemical storage building area).

Station placement was determined based on information from a portable meteorological monitoring station (met station) set up at the site as well as information from the local weather station.

Monitoring for both VOCs and SVOCs was conducted over an 8-hour period at each sampling location. Sampling for VOCs was conducted using passivated stainless steel SUMMA canisters in accordance with USEPA Method TO-14 as found in: *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (USEPA, 1989a). Sampling for SVOCs was performed using XAD-2 polymer sorbent tubes with a pre-filters and personal sampling pumps in accordance with NIOSH Method 5506: *Determination of Polynuclear Aromatic Hydrocarbons (PAHs) in Ambient Air Using Sorbent Tube Sampling and HPLC* analysis as specified in NIOSH Manual of Analytical Methods, Third Edition (U.S. Department of Health and Human Services, 1984).

Procedures for selecting monitoring locations, air monitoring methodologies for VOCs and SVOCs, and a discussion of the field program are discussed in the following subsections. Field data sheets from the baseline air monitoring program are included in Appendix A-4.

2.2.1.2 Selection of Monitoring Locations. A portable met station was set up on site. The meteorological tower was erected approximately 15 feet above ground on a pole located along the fence near the entrance gate to the site. The location was free of obstructions and interferences, and accessible to the on-site ABB-ES scientist. The met station was used for the evaluation of wind speed and wind direction during sampling. The meteorological tower provided a running hard copy of the data for future use. Prior to its operation, the met station's sensors were aligned and calibrated, using a compass.

The sampling event occurred on June 30, 1994. Selection of the monitoring station locations was performed prior to sampling. A PID with an 11.7 electron volt (eV) bulb (sensitive to 1,1,1-TCA) was used to screen potential station locations to determine if any "hot spots" exist. There were no PID detections above background (0 ppm) anywhere at the site.

Weather the previous day (June 29, 1994) consisted of overcast skies, gusty winds, and intermittent showers. Therefore, meteorological information from that day was not useful in locating monitoring stations for the June 30 event. Weather June 30 began clear with very light and variable winds. Based on information from the local weather station and from observations of the met tower that morning, it was determined that, though variable, winds were predominantly out of the north. The upwind station (LG-101) was therefore located initially on the north end of the site.

Following were the initial locations of the air monitoring stations: station LG-102 was located at septic system no. 3; station LG-103 was located at the debris pile/ septic system no. 2; and stations LG-104 and LG-104D (duplicate) were located at the chemical storage building. Air sample collection stations are included on Figure 2-1.

VOC sampling was initiated at about 0830, and SVOC sampling at about 1000. Winds were very light and variable until about 1000 when they seemed to stabilize out of the southeast. At 1100, after about an hour of relatively stable winds out of

the southeast, the upwind station (LG-101) was stopped and moved to a new "upwind" location in the east/southeast end of the site (see Figure 2-1). After about 1300, winds became more variable, so the upwind sample location was not relocated again. VOC sampling was completed around 1630, and SVOC sampling completed around 1700.

2.2.1.3 VOC Sampling Procedures. Sampling and analysis for VOCs was conducted in accordance with USEPA Method TO-14. Whole air samples were collected in evacuated SUMMA, passivated stainless steel canisters. The SUMMA canisters arrived from Coast-to-Coast Analytical Services, Inc. (CCAS) in Camarillo, California pre-evacuated to a pressure of approximately 30 inches of mercury (in. Hg). Flow controllers provided by CCAS were used to regulate the flow of air into the SUMMA canister to enable the collection of samples integrated over a period of 8-hours. The flow controllers arrived pre-calibrated to a flow rate of approximately 8 milliliters per minute (mL/min) to allow for a target volume of 4 liters to be collected per test over the 8-hour period.

A pressure/vacuum gauge provided by CCAS was used on site to verify and record the initial vacuum on each canister prior to use. At each sampling location, a SUMMA canister equipped with a flow controller was secured either to the top of a stake or to a structure (e.g., fence) approximately five feet above the ground. At the start of the sampling period, the valve to the canister was opened. At the completion of the 8-hour test period, the valve to the canister was closed and the canister was removed from the stake. The final vacuum on the canisters was checked and recorded after completion of the sampling event.

After the completion of sampling, the canisters were shipped under chain of custody documentation to CCAS for analysis. The canisters were then analyzed by gas chromatography/mass spectrometry (GC/MS) for the USEPA Method TO-14 target compound list of VOCs. In addition to the target compound list, tentative identification of 10 unknown peaks were conducted on two VOC canisters collected (LG-104D and LG-101).

2.2.1.4 SVOC Sampling Procedures. Screening of SVOCs at the site was conducted by quantitative analysis of 17 polynuclear aromatic hydrocarbons (PAHs) using NIOSH Method 5506. This method involves the collection of gaseous and particulate SVOC samples using an XAD-2 polymer sorbent tube with a pre-filter and a

personal sampling pump manufactured by DuPont. A Gilibrator® electronic soap film flow meter was used to calibrate each pump before and after each sampling event. Calibrations were performed using a "dummy" XAD-2 tube and prefilter. The flow rate of the pumps was set to approximately two liters per minute; exact flow rates were obtained from the calibration data. With the sampling period of 8 hours, each sample volume was approximately 1,000 liters.

Each pump was calibrated immediately prior to use. At each sampling location, a pump was secured to the sampling location used for the SUMMA canister. A XAD-2 tube was opened by snipping the glass ball off each end. The tube and prefilter were then attached to the pump using Tygon tubing. The personal pump was turned on and run for an 8 hour test. At the completion of the 8 hour test period, the pump was shut off. The XAD-2 tube and the pre-filter were removed from the pump, capped at each end, wrapped in aluminum foil, and placed in a cooler on ice. Each pump was post-calibrated immediately following each sampling event.

The XAD-2 tubes and pre-filters were shipped under chain of custody documentation to Environmental Science and Engineering Laboratories (ESE) in Gainesville, Florida for analysis. The laboratory then analyzed for 17 target PAHs by high performance liquid chromatograph (HPLC), Fluorescence/ultraviolet (UV) Detection.

2.2.1.5 Analytical Results. Raw data obtained from CCAS and ESE are presented in Appendix B-8. VOC results were provided by the laboratory in parts per billion by volume (ppbv). SVOC results were provided by the laboratory in total micrograms. SVOC results were converted to a concentration (micrograms per cubic meter) by dividing by the total volume of sample collected.

Data in Appendix B-8 show VOCs were detected in the baseline air monitoring samples. The VOC acetone was detected in every sample; it is believed that acetone detected is a laboratory artifact and does not reflect site conditions. The "upwind" sample (LG-101) contained detectable concentrations of benzene (1.1 ppbv), 2-butanone (0.7 ppbv), chloromethane (1.5 ppbv), toluene (6.9 ppbv), and xylenes (4.2 ppbv). These are the highest concentrations of the VOCs detected. Chloromethane was detected in LG-102; toluene was detected in LG-104 and LG-104D. Overall, none of the VOCs detected were present at concentrations

exceeding NYSDEC Air Guide-1 standards. The presence of VOCs in the LG-101 and LG-104 sample is believed to be due either to the proximity of Route 145, or possibly shallow soil contamination in the vicinity of the chemical storage building (see Section 5.0).

SVOCs were not detected in the air samples. No tentatively identified compounds (TICs) were detected for LG-101 and LG-104D, the two locations which had TIC analyses performed.

2.2.2 Surface Geophysical Survey

Magnetometry, terrain conductivity, and ground-penetrating radar (GPR) surveys were performed during the Phase II RI to investigate the debris pile area portion of the site (see Figure 2-1). Table 2-3 provides a listing of these techniques and a summary of the data collection activities performed.

2.2.2.1 Magnetometry and Terrain Conductivity. The magnetometer survey was performed to evaluate whether the debris piles contain buried metallic debris or waste containers, and to assess the extent of buried debris. The magnetometer survey used a vertical gradiometer capable of vertical gradient and total field measurements.

The terrain conductivity survey was performed to attempt to map the location of the septic system no. 2 leachfield, which received industrial wastewater; characterize the debris pile area in general; and characterize the location of a soil pile located near the septic system no. 2 septic tank. Wastewater discharged through septic system no. 2 is reported to have contained potentially significant concentrations of phosphate salts, caustic soda and waste solvents (Brinnier and Larios, 1981). The terrain conductivity survey was conducted with a data logger capable of collecting in-phase and quadrature terrain conductivity measurements.

Magnetometer and terrain conductivity data were collected at nodal points on a 10-by-10-foot grid covering the investigated areas (see Figure 2-1 and Appendix A-2). Deliverables for these surveys consist of contour maps annotated with the interpretation of any pertinent information (i.e., potential buried debris, leachfield boundaries, debris pile, or surface metal locations), and electronic data records. Color interpretive contour maps are included in Appendix A-2.

Magnetic and terrain conductivity data were used to select the locations of test pits used to characterize the nature of geophysical anomalies identified during the survey.

2.2.2.2 Ground Penetrating Radar. An optional geophysical task was to perform a limited GPR survey at the waste pile area to further investigate (1) subsurface anomalies detected during the magnetic and electromagnetic surveys at the debris pile/septic system no. 2 area, and (2) at the chemical storage building to explore for potential USTs. The location of the optional GPR activities at the chemical storage building is indicated on Figure 2-1. Due to the voluminous nature of GPR strip chart recordings, and inconclusive nature of the data (see Subsection 2.2.2.3) raw data results are not be presented in this deliverable.

2.2.2.3 Interpretation of Surface Geophysical Surveys. Table 2-4 provides a listing of surficial techniques employed at the four site areas investigated and a brief summary of results. Figure 2-1 illustrates the lateral extent and location of surficial geophysical surveys performed at the site.

Four areas at the Becker site were the subject of geophysical surveying (see Figure 2-1). Data collection activities focused primarily on the debris pile area/ septic system no. 2 and the chemical storage building. Terrain conductivity surveying at the soil pile adjacent to septic tank no. 2 at the manufacturing building and magnetometer and terrain conductivity surveying over an area of bare ground (located in woods in the northwest corner of the site) did not identify anomalies potentially indicative of waste or buried debris.

Magnetic and terrain conductivity survey contour maps for the debris pile area/septic system no. 2 are presented in Appendix A-2. Magnetic and terrain conductivity results indicated the presence of buried ferrous objects or structures within and adjacent (northeast) to the debris pile area. Total magnetic field, vertical magnetic gradient, and in-phase terrain conductivity results show corresponding signatures indicating the presence of buried ferrous objects. In-phase terrain conductivity results indicate a laterally extensive anomalous area in the central portion of the survey area. This anomaly is interpreted to result from both the presence of buried conductive debris and the septic system no. 2 leachfield. Magnetic field anomalies in the northern portion of the survey area represent surface debris, including pipe and possibly speaker magnets. Magnetic field anomalies in the central and eastern

portion of the survey area represent both surface and buried ferrous debris. Quadrature terrain conductivity results show anomalies mimicking the footprint of the surface debris piles which may reflect the increased moisture content of the sawdust and particle board comprising the debris piles.

GPR results were for the most part, inconclusive. GPR data suggests that the nature of the overburden soils at the time of the survey was not conducive for the collection of high quality data. Weather may have been an important factor in poor data quality at the site. Overburden soils appeared to be saturated over much of the site due to rainy weather prior to and over the course of the survey. Lack of penetration was observed primarily in the area of the chemical storage area. Chaotic signatures and apparent energy attenuation were also observed in limited GPR traverses in the debris pile area.

2.2.3 Fracture Trace Analysis

Fracture trace analysis was performed prior to drilling activities. Fracture trace analysis activities performed consisted of the following:

- Existing aerial photos of the site were reviewed in stereo to identify lineaments and other geomorphological features that may represent surficial expressions of major subsurface fracture systems or faults. This information was transferred onto a regional map showing the location of the site.

- Existing geologic reference material (reports and maps) were reviewed for information relating to faults or fracture orientations near the site.

- An ABB-ES geologist visited the site to collect geologic data. The data collection performed consisted of mapping the locations of bedrock exposures, and using a Brunton® compass to collect fracture and bedding plane strike and dip measurements, and to describe the bedrock encountered. Work extended from uphill of the site down to Catskill Creek, and along Catskill Creek.

- Upon completion of the bedrock mapping, the data collected was entered into an IBM-computer format ASCII data file and evaluated

using the Rose-PC 1.0 and Stereo 3.0 applications in the Rockworks® software package.

Results of the aerial photograph survey, bedrock mapping, and fracture data analysis are summarized onto a site base map indicating potential major-fracture locations in the vicinity of the site. This informational map was used to locate bedrock monitoring well locations at and downgradient of the site. Fracture trace data are included in Appendix A-3. Results are discussed in Section 4.0.

2.2.4 Surface Water/Sediment Sampling

Surface water and sediment in ditches and the fire pond on-site were sampled at five locations (designated as SW/SD-101 to SW/SD-105) and analyzed at the off-site laboratory for TCL VOCs, SVOCs, and metals (see Figure 2-1). The purpose was to verify NYSDEC 1992 site sampling data which shows that metals exceed background at some areas on-site (see Section 1.0) and to confirm the concentrations of VOCs, PAHs, and phthalates found in the drainage ditches and soils during the Phase I RI. To fill a data gap in the ecological assessment, an additional surface water/sediment sample pair (SW/SD-106) was collected from a low wetland area off the northern corner of the property near septic system no. 3, and analyzed for TCL VOCs, TCL SVOCs, and metals. The six total sediment samples were also analyzed for TOC. Three additional seep samples (SW-107, SW-108, and SW-109) were added to the scope of work during Phase II RI field work and sampled for TCL VOCs; these seeps are located along the base of a rock outcropping along Thorp Creek and Catskill Creek (see Figure 2-1). Surface water/sediment field sample data records are included in Appendix A-11.

During sample collection, surface water pH, temperature, conductivity, and turbidity were measured. Field parameter results are presented and discussed in Section 5.0. PID screening of the water and sediment samples were performed; PID readings for all samples were background (0 ppm).

2.2.5 Subsurface Soil Sampling

Subsurface samples of debris and soil were collected during the Phase II RI from test pit excavations and Geoprobe® soil borings.

2.2.5.1 Test Pitting. The test pit exploration program consisted of excavations in the debris pile (TP-101 to TP-110), the septic system no. 2 leachfield (TP-111 to TP-117), and chemical storage building areas (TP-118 to TP-122), and an additional test pit excavated near existing water table well MW-2S (TP-125) (see Figure 2-1). Test pitting was be performed to: (1) assess the thickness of, and sample any, debris or visually contaminated soil horizons; (2) assess the thickness of overburden; and (3) allow for detailed observation of geologic materials or buried debris or objects (such as USTs or drums) that might be encountered. Test pit logs are included in Appendix A-5.

Tri-State Drilling and Boring, subcontracted to ABB-ES, performed the excavations under the direction of ABB-ES. Excavations were typically 10 to 15 feet in length and as deep as could be excavated with a backhoe. One sample per test pit was collected for TCL VOCs, SVOCs, and metals analysis. Two debris composite samples were collected for TCLP laboratory analysis from the waste pile area to characterize wood debris; however, the laboratory did not perform the required analyses (TCL VOC, SVOC, and metals analysis were performed by the laboratory instead).

All materials encountered in the test pits were screened with a PID. The highest PID readings were measured from TP-119 soil.

Additional unsampled test pits were excavated at the direction of NYSDEC to explore for reported USTs, septic tanks, or contaminated soil in the vicinity of the chemical storage building, at septic system no. 2, and in the drainage ditch near septic system no. 3 (test pits TP-126, TP-127, and TP-128); none were encountered and these excavations were backfilled without significant logging.

Based on results of test pitting and the site survey (see Subsection 2.2.12), a contour map of the surface wood debris at the debris pile area was generated. Using these data and ground topography, the wood debris is estimated to represent an estimated 6,130 cubic yards of solid waste (e.g., 165,476 cubic feet, see Figure 2-2).

2.2.5.2 Geoprobe® Borings. Additional subsurface soil sampling was performed with the approval of NYSDEC to characterize subsurface soils: (1) beneath a loading dock area where older site maps for the Becker site indicated the location of an oil/water separator; (2) in the vicinity of the inlet pipe for septic system no. 2 adjacent to the

Becker manufacturing building; and (3) in the vicinity of the chemical storage building near where test pitting identified soil contamination (see above). Aquifer Drilling and Testing performed the Geoprobe® borings at the direction of ABB-ES. A total of nine borings (GP-1 through GP-9) were advanced to bedrock through overburden, with soil samples collected at two-foot or continuous intervals with a two-foot long, 1-inch ID sample tube fitted with an acetate liner. One sample per boring, estimated from visual or PID screening to represent the most contaminated interval, or from the deepest sample from the boring, were selected for laboratory analysis for TCL VOCs only. Geoprobe® boring notes and logs (including PID screening results) are included in Appendix A-1. Locations are shown in Figure 2-1. The highest PID readings were measured from GP-8 soil.

2.2.6 Water Table Monitoring Well/Piezometer Installation

Six water table monitoring wells in overburden or weathered bedrock were installed in site source areas (the waste pile [MW-102S], septic system no. 2 [MW-103], septic system no. 3 [MW-104 and MW-105S], and chemical storage building [MW-106S and MW-107] areas) to assess the nature and distribution of groundwater contamination (see Figure 2-1). One additional upgradient water table monitoring well (MW-101S) was planned to be installed, but was not because conditions encountered during drilling of deep bedrock well MW-101D indicated that significant overburden and a shallow water table were not present at that location. Two downgradient on-site water table piezometers (PZ-4 and PZ-6), and one downgradient off-site water table piezometer (PZ-110) were also installed. Another downgradient water table piezometer (PZ-112) was not installed due to access constraints. The piezometers were installed to collect vertical hydraulic gradient data to assist in evaluation of groundwater flow conditions. Piezometers were constructed with the same materials and specifications as water table monitoring wells.

Where possible, the water table installations (wells and piezometers) were paired with new or existing bedrock monitoring wells to assist in interpreting site hydrogeology (interpreting vertical flow gradients and shallow groundwater flow directions). This was determined to be necessary because the shallow groundwater system in overburden at the site is perched (not hydraulically connected to the bedrock groundwater system), and the Phase I RI demonstrated that shallow groundwater contains VOCs. An understanding of the hydrologic connection

between shallow groundwater and bedrock groundwater was needed to assess effective groundwater remedial alternatives in the FS.

Shallow monitoring wells/piezometers were constructed of 2-inch PVC well construction material in the borings by Tri-State Drilling and Boring under the direction of ABB-ES. The borings were drilled using 4-inch ID spun casing to a depth eight feet into the static water table. The wells and piezometers have 10-foot long, 0.006-inch or 0.010-inch slotted, schedule 40 PVC screens and schedule 40 PVC riser. A fine-graded filter pack (#00 Morie filter sand) was installed from a minimum of 2 inches below the screen to two feet above the top of the screen. Above the sandpack, the remaining annulus was backfilled with bentonite pellets and a cement/bentonite grout. The installations were completed with a locking, protective casing cemented in place over the riser stickup. Boring logs and monitoring wells construction diagrams are included in Appendices A-6 and A-7.

2.2.7 Bedrock Borings and Borehole Geophysical Survey

Ten bedrock borings were drilled for the installation of monitoring wells (see Figure 2-1). One bedrock boring was installed upgradient of the site (MW-101D); five were installed at site source areas (MW-102D, MW-105D, MW-106D, MW-108, and MW-109); and four were installed downgradient of the site (MW-110D, MW-111, MW-112, and MW-113) to assess the nature and distribution of bedrock groundwater contamination. As noted in Subsection 2.2.6, some bedrock monitoring wells were collocated with water table monitoring wells (MW-2S, MW-102S, MW-105S, and MW-106S) and piezometers (PZ-4, PZ-6, and PZ-110), to aid in assessing the vertical extent of contamination and vertical hydraulic gradients in the vicinity of the site. The final locations of all bedrock borings were chosen based on results of a field fracture trace analysis during the week of mobilization (see Subsection 2.2.3).

2.2.7.1 Bedrock Borehole Installations. Bedrock borings were drilled by Tri-State Drilling and Boring under the direction of ABB-ES. The borings were drilled by the following method:

- At each bedrock boring location, a 6-inch ID casing was advanced through the overburden and seated into unweathered bedrock (typically encountered between 2 and 15 feet bgs.

- Bedrock boring advanced through the temporary casing using 5-inch air hammer drilling to a completion depth of 65 feet bgs or greater.

- Upon completion of the 5-inch ID boring, the driller developed the borehole by pumping and surging until development water quality parameters (pH, temperature, conductivity, and turbidity) stabilized.

2.2.7.2 Borehole Geophysical Logging. Borehole geophysical logging was conducted in open boreholes (1) to determine the presence of fractures which may bear water and (2) to determine stratigraphy or bedrock structure to the extent possible. Logging techniques were chosen specifically to meet the objectives set forth in the Work Plan. Logging suites were conducted in the following sequence.

1) Fluid temperature and fluid resistivity
2) Three arm caliper
3) Single point resistance (SPR) and spontaneous potential (SP)
4) Sixteen-inch normal resistivity (16N)

Borehole geophysical data were collected with a Mt. Sopris data logger and associated logging tools. Data were saved to a field computer and interpreted in the field. Field interpretation focused primarily on the identification of water-bearing fractures. Individual well log results and interpretation are presented in Appendix A-9. These data were used in conjunction with packer testing data to guide the location of monitoring well screen intervals. The borehole geophysical tools, applications, and general interpretation guidelines are summarized further in Table 2-5.

Geophysical logging was performed in 11 open boreholes Logging an existing borehole (MW-04) allowed for direct correlation of existing rock core, packer test results, and geophysical logs, and interpretation of data from air hammered boreholes. Existing borehole MW-5 could not be logged as planned due to the presence of a drilling tool jammed in the borehole (and later retrieved) by the drilling subcontractor. MW-6 was not logged because the protective casing may not have been seated properly and may have allowed shallow bedrock fragments to partially bridge the borehole.

2.2.7.3 Interpretation of Borehole Geophysical Logging Results. The interpretation discussion is two fold and is presented with regards to fracture identification and stratigraphic correlation.

Fracture Identification. Geophysical logging identified water-bearing fractures in each borehole. Borehole deviations profiled with the caliper tool were contemporaneous with changes in fluid temperature. Fractures which are collocated with the presence of temperature breaks or anomalies indicate fluid movement within the borehole. Some electrical anomalies were collocated with the presence of larger borehole breakouts. Identified fractures or fracture zones were targeted for packer testing (see Subsection 2.2.7.4). Table 2-6 provides a summary of findings for each logged borehole. A qualitative correlation between Phase I data and interpretation of Phase II logging results for existing borehole MW-4 is presented in Table 2-7.

Stratigraphic Correlation. From a site-wide perspective, two marker beds were profiled throughout the stratigraphic column penetrated by subsurface explorations. These marker beds were used to determine subsurface stratigraphy and are observed consistently throughout the borehole geophysics data set and are the primary focus of the stratigraphic discussion.

Natural gamma and SPR logs are shown superimposed on cross sections A-A' and B-B' discussed in Section 4.0 (see Figure 4-2). These logs are the primary logs used in stratigraphic correlation. Marker beds were denoted M1 and M2 and most likely correspond to lithologic changes in the subsurface. Markers were defined by significant deflections in the SPR logs and natural gamma highs, which may represent contact between laterally continuous siltstone and shale sequences throughout the stratigraphic column. Inspection of outcrop in the vicinity of Catskill Creek and outcrop located to the east of the debris pile area indicate the presence of interbedded shaley deposits to siltstones which dip to the southwest by 7 to 9 degrees. Evidence exists for the presence of a fault located between MW-06 and the easternmost exploration, MW-113. A fault or slump feature may also exist between MW-108 and MW-106. Approximately 8 to 10 feet of vertical displacement may exist.

Natural gamma data strongly suggest the presence of several transgressive (fining upward) sedimentary sequences. These are observed as increases in natural gamma readings with increasing elevation in distinct (10 foot or greater thickness) marker

beds (for example, results in borehole MW-112 from 558 to 568 feet mean sea level [MSL]).

2.2.7.4 Borehole Packer Testing. After a boring had been logged with the geophysical tools, it was packer tested by the drilling subcontractor at 10-foot intervals to characterize fracture zones. The packer test (PT) results were evaluated in the field by ABB-ES to select depths in the boreholes for well screen placement. Packer test logs are included in Appendix A-10. Results are discussed in Section 4.0.

2.2.8 Bedrock Monitoring Well Installation and Existing Bedrock Well Reconstruction

Bedrock monitoring wells (MW-101D, MW-102D, MW-105D, MW-106D, MW-108, MW-109, MW-110, MW-111, and MW-113) were constructed in the nine 5-inch ID bedrock borings using 2-inch ID schedule 40 PVC well screen (10 feet long, 0.010-inch slot) and riser. MW-112 was constructed in the 5-inch ID bedrock boring using 4-inch ID schedule 80 well screen (10 feet long, 0.010-inch slot) and riser as requested by NYSDEC via the property owner. Bedrock well construction logs are included in Appendix A-7.

If the well screen was installed above the bottom of the borehole, a cement/ bentonite grout was used to backfill the borehole up to the selected screen depth. At the selected well screen depth, a medium graded silica sand filter pack was installed, extending a minimum of two inches below the well screen to two feet above the well screen. Above the sand filter pack, a 2-foot or larger bentonite pellet or slurry seal was installed. The remaining annulus of the borehole was backfilled with cement/bentonite grout. The well riser extends 2 feet above the ground surface at each bedrock well location (except MW-110 completed flush with the ground surface).

Three existing Phase I bedrock monitoring wells (MW-4, MW-5, and MW-6) at the site were reconstructed to address concerns that the "open hole" constructions did not provide representative groundwater samples and may behave as vertical contaminant migration pathways. ABB-ES redesigned the monitoring wells to sample discrete fractured intervals based on the packer test results in the Phase I RI and on borehole geophysical logging results from MW-4.

Reconstruction began by removal of the existing stainless well materials from the boreholes by the drilling subcontractor. During removal of the well materials from MW-5, the drilling subcontractor jammed a downhole hammer in the boring; this tool precluded later geophysical logging but was later retrieved and well reconstruction completed.

Upon removal of the well materials, the open boreholes for MW-4 and MW-6 were redeveloped, and then allowed to reequilibrate for a minimum of 72 hours. At that time, the MW-4 borehole was logged using the geophysical tools described in Subsection 2.2.7.2. MW-6 was not logged because during borehole redevelopment it was discovered that the surface casing at MW-6 did not extend downward into competent bedrock, and rock and overburden material was observed to collapse into the borehole.

Based on results of the Phase I PT results (for MW-4, MW-5, and MW-6) and the Phase II RI geophysical logging (for MW-4), ABB-ES selected depths for well screens. The reconstructed wells were completed as detailed above for new bedrock monitoring wells. Well construction logs for MW-4, MW-5, and MW-6 are included in Appendix A-7 and replace Phase I RI well construction logs.

2.2.9 Monitoring Well Development

The 10 new bedrock monitoring wells, three reconstructed bedrock monitoring wells, and six new shallow monitoring wells were developed by the drilling subcontractor under the supervision of ABB-ES or by ABB-ES personnel by pumping and surging or air-lift techniques no sooner than 24 hours after grout placement. Well development was complete when (1) turbidity was 50 NTUs or stabilized; (2) other parameters (temperature, conductivity, and pH) stabilized; and (3) a minimum of 1.5 times the volume of water estimated to have been lost during spun-casing drilling was recovered. Well development logs are included in Appendix A-8.

2.2.10 Groundwater Sampling

ABB-ES purged and sampled for laboratory analysis the new and existing monitoring wells at the site between August 22 and August 26, 1994. Inactive Becker WSWs which were planned to be sampled were approved for no further sampling by NYSDEC due to the large volumes of purge water that would have been generated.

During purging, field measurements of pH, temperature, dissolved oxygen, conductivity, salinity, and turbidity were performed. The groundwater samples were analyzed for TCL VOCs. All new shallow wells were also sampled for TCL SVOCs; all bedrock wells were sampled for metals; and three selected source area bedrock wells (MW-105D, MW-106D, and MW-108) were analyzed for alkalinity, TSS, BOD, COD, and TOC. Hardness was calculated from metals results. Groundwater field sample data records are included in Appendix A-12. Results of groundwater sampling are presented and discussed in Section 5.0.

2.2.11 Hydrogeologic Characterization

After the wells were developed and sampled, rising and falling head hydraulic conductivity tests were conducted for each well installed after the Phase I RI. Tests were performed with a In-Situ 20 psi pressure transducer, a 5-foot long weighted PVC slug, and a Hermit 1000-C® data logger. An ABB-ES hydrogeologist interpreted the data using Aqtesolv® software. Slug testing is discussed in Section 4.0; slug test data records and Aqtesolv® printouts are included in Appendix A-13.

In addition to the initial round of water level measurements obtained during the well sampling effort, two subsequent rounds of measurements, taken monthly, were performed to assess fluctuations in groundwater flow directions and gradients.

2.2.12 Exploration Location and Elevation Survey

Om Popli, PC, LS, subcontractor to ABB-ES, conducted the exploration survey after all Phase II RI sampling activities had been completed. Locations of all new monitoring wells, stream gauges, piezometers, test pits, and surface water and sediment samples were surveyed. The exploration locations were surveyed to the nearest 0.01 foot. Ground elevations were surveyed to the nearest 0.1 foot. The horizontal positions were tied to a relative coordinate system initiated during the Phase I RI; vertical positions are tied to MSL as determined by the 1929 General Adjustment. The Phase II survey report is included in Appendix A-14.

2.2.13 Ecological Characterization

A characterization of the ecological receptors that may be affected by contamination associated with the Becker site was conducted. This characterization provided a description of the different biological habitats that comprise the Becker site, and of the wildlife species expected to be found associated with these habitats. This characterization included required elements of the "Step 1 - Site Description" component of the *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (NYSDEC, 1991a), including the development of a map of the potentially affected habitat and a description of the potentially impacted ecological receptors.

The ecological characterization was based on a site reconnaissance, background information available for the site, literature information on the range and distribution of wildlife species, and interviews with local, state, and/or federal wildlife officials. The site reconnaissance was performed by ABB-ES ecological assessment personnel during mobilization. The results of the ecological characterization is used in the RI/RA report to prepare a cover map and a qualitative assessment of site contaminants (see Subsection 7.2). In addition, major vegetative communities, aquatic communities, and their associated fish and wildlife communities were identified. This characterization provides a baseline description of the site. The NYSDEC TAGM *Habitat-Based Assessment Guidance Document for Conducting Environmental Risk Assessments at Hazardous Waste Sites* was followed in performing the ecological characterization (NYSDEC, 1989b) (see Subsection 7.2).

Aquatic and terrestrial habitats within at least 0.5 miles of the site were described in terms of habitat type (e.g., shrub swamp, forested upland, stream) and species composition. This description included identification of typical plant species composition and density in each habitat type and, within aquatic habitats, measurement of chemical and physical parameters (e.g., dissolved oxygen, specific conductance, pH, temperature, stream width, depth, and flow rate, and substrate characteristics).

2.2.14 Phase II RI Laboratory Analytical Program

Laboratory analyses of soil, sediment, surface water, groundwater, and air samples were performed by E3I, a NYSDOH Environmental Laboratory Approval Program-certified laboratory subcontractor for Contract Laboratory Program (CLP) categories.

This laboratory adhered to all NYSDEC laboratory requirements, and was monitored for compliance by an ABB-ES chemist. The completed laboratory analytical program is summarized in Table 2-2.

Upon receipt of the laboratory analytical data, ABB-ES validated the data using applicable NYSDEC and USEPA guidelines. The validated data and data useability report prepared by an ABB-ES chemist was submitted to the NYSDEC for review in November 1994, and is included in Appendix B. Phase II RI analytical data are summarized into a tabular format and included by media in Appendix B.

2.3 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND STANDARDS, CRITERIA, AND GUIDELINES

ARARs and SCGs are federal and state public health and environmental requirements used to (1) evaluate the appropriate extent of site cleanup, (2) define and formulate remedial action alternatives, and (3) govern implementation and operation of the selected action. To properly consider ARARs and SCGs and to clarify the function of these requirements in the RI/FS and remedial response process, the National Contingency Plan (NCP) (USEPA, 1990) (40 CFR Part 300) defines two ARAR components: (1) applicable requirements, and (2) relevant and appropriate requirements. These definitions are discussed in the following paragraphs.

Applicable requirements are those federal and state requirements that would be legally applicable, either directly or as incorporated by a federally authorized state program. Requirements that specifically address and have jurisdiction over a given situation are considered "applicable requirements." An example of an applicable requirement is the use of Maximum Contaminant Levels (MCLs) for a site where groundwater contamination enters a public water supply.

Relevant and appropriate requirements are those federal and state requirements that, while not legally "applicable," can be applied to a site if it is determined that site circumstances are sufficiently similar to those situations that are covered and use of the requirement makes good sense. Relevant and appropriate requirements are intended to have the same weight and consideration as applicable requirements.

The term "relevant" was included so that a requirement initially screened as nonapplicable because of jurisdictional restrictions would be reconsidered and, if appropriate, be included as an ARAR for the site. For example, MCLs would be relevant and appropriate requirements at a site where groundwater contamination could affect a potential, rather than actual, drinking water source.

Other requirements to be considered (TBCs) are federal and state nonpromulgated advisories or guidelines that are not legally binding and do not have the status of potential ARARs and SCGs. However, if there are no specific ARARs and SCGs for a chemical or site condition, or if existing ARARs and SCGs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure protection of public health and the environment.

Under the description of ARARs in the NCP, state and federal environmental requirements must be considered. These requirements include ARARs that are:

- location-specific (i.e., pertain to existing site features);
- chemical-specific (i.e., govern the level or extent of site remediation); and
- potential action-specific (i.e., pertain to proposed site remedies and govern implementation of the selected site remedy).

2.3.1 Location-Specific ARARs and SCGs

Location-specific ARARs and SCGs pertain to natural site features (e.g., wetlands, floodplains, and sensitive ecosystems) and man-made features (e.g., existing landfills, disposal areas, and places of historical or archeological significance). These ARARs and SCGs generally restrict the concentration of hazardous substances or the conduct of activities based on a site's particular characteristics or location. Table 2-8 is a list and synopsis of potential location-specific standards that apply to the site.

Because wood debris, particle board, and other solid non-hazardous wastes were generated during the manufacturing operation at the Becker site and were disposed of on-site in debris piles, New York State Solid Waste Management facilities regulations (6 NYCRR Subparts 360-1 and 360-2) are applicable. Because no

protected wetlands, floodplains or hazard zones, endangered species, wild or scenic rivers, or historical or archeological areas are found on the Becker site, no further location-specific ARARs apply.

2.3.2 Chemical-Specific ARARs and SCGs

Chemical-specific ARARs and SCGs are usually health- or risk-based standards limiting the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual clean-up levels, or the basis for calculating such levels. For example, drinking water and/or groundwater standards may provide necessary cleanup goals for sites with contaminated groundwater. Chemical-specific ARARs and SCGs for the site may also be used to indicate acceptable levels of discharge in determining treatment and disposal requirements, and to assess the effectiveness of future remedial alternatives. Table 2-9 lists and summarizes the potential chemical-specific ARARs and SCGs that apply to the Becker site.

Groundwater in the vicinity of the Becker site is used by area residents who depend on private wells as a source of drinking water. Therefore, drinking water standards, promulgated under the Safe Drinking Water Act (SDWA) MCLs (40 CFR 141.11-141.16) and SDWA Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50-141.51), New York Water Quality Regulations for Groundwater (6 NYCRR Parts 701 - 705), and NYSDOH Public Water Supplies Drinking Water Standards (10 NYCRR Subpart 5-1) are applicable and are used during the RI/FS to compare to the concentrations of contaminants detected in the groundwater (Table 2-10).

Surface water quality is regulated under the Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC) and NYSDEC Water Quality Regulations for Surface Water (6 NYCRR Parts 701 - 703). NYSDEC Water Quality Regulations set state standards for the classification of surface waters. The CWA AWQC are nonenforceable guidance values developed under the CWA and are used by the state to establish water quality standards for designated uses of surface water bodies. NYSDEC identifies guidance values that are to be used where a value for a water substance has not been established. At the Becker site, nearby Catskill Creek and Thorp Creek are designated as NYS Class C surface water bodies. NYS Class C surface water standards and guidance are included in Table 2-10.

Soil criteria to be considered include NYSDEC's Soil Cleanup Criteria based on Partitioning Theory, which assesses the potential of contaminants leaching from soils into groundwater.

In sediment, the Toxic Substances Control Act (TSCA), 40 CFR 702-799 is to be considered to address PCB contamination in ditch sediment at the Becker site. NYSDEC's Division of Fish and Wildlife Sediment Criteria Guidance are to be considered to address organic compounds and metals in ditch sediment. Where sediment criteria do not exist, the Soil Cleanup Criteria using the Partitioning Theory are used for comparison.

2.3.3 Action-Specific ARARs and SCGs

Action-specific ARARs are technology- or activity-based limitations controlling actions at hazardous waste sites. Potential action-specific ARARs for the Becker site are identified in Table 2-11, and further action-specific ARARs, as appropriate, will be identified in the FS.

2.4 Identification of Site Contaminants and Contaminants of Potential Concern

A site contaminant is a chemical detected in environmental samples from the site at concentrations exceeding appropriate background levels. A contaminant of potential concern (CPC) is a subset of site contaminants identified in the risk assessment as potentially present at concentrations posing an adverse risk or impact to human or ecological receptors. To evaluate which chemicals are site contaminants, validated analytical results are compared to site background concentrations. The decision steps used to evaluate the Becker site laboratory analytical data are described in the following paragraphs.

For soil and sediment samples, chemicals were considered site contaminants (see the contamination assessment in Section 5.0) if:

(1) organic chemicals were detected and could not be attributed to laboratory or sampling contamination; or

(2) inorganic chemicals were detected and their concentrations exceeded the maximum concentration in the background data sets (NYSDOH background data for Greene County [NYSDOH, 1995] and NYS regional background soil concentrations [McGovern, no date] is summarized in Table 2-12).

For groundwater samples, chemicals were considered site contaminants if both:

(1) the concentrations of inorganic chemicals exceeded background concentrations detected in the upgradient well (MW-101D) or exceeded the background range for Greene County (NYSDOH, 1995) (background for groundwater is summarized in Table 2-13); and

(2) the concentrations of organic and inorganic chemicals detected exceeded NYS Class GA standards, USEPA MCLs, or USEPA MCLGs (see Table 2-10).

For surface water samples chemicals were considered site contaminants if:

(1) the concentration of inorganic chemicals exceeded background concentrations detected in the upgradient surface water sample (SW-207DEC; see Table 2-13); and

(2) the concentration of organic and inorganic chemicals exceeded the appropriate NYS Class C standard (see Table 2-10).

The baseline RA (see Section 7.0) identifies CPCs as a subset of site contaminants whose average concentrations exceed background and exceed potential chemical-specific ARARs and SCGs. The CPCs presented in the baseline RA (see Section 7.0) are further evaluated in the FS (see Volume II).

Figure 2-1 Exploration Locations

Figure 2-2 Debris Pile Survey Contours

TABLE 2-1
PHASE I RI LABORATORY ANALYTICAL PROGRAM SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Location	Depth	Sample Type	Sample Date	Media Type	TCL VOA	TCL SVOA	TCL PEST/PCB	TCL Inorganics
GROUNDWATER SAMPLES								
BECKER-2	344.62	N	12/4/90	groundwater	X	X		X
BECKER-2	344.62	N	11/12/90	groundwater	X	X		X
BECKER-2	344.62	N	5/3/91	groundwater	X	X	X	
BECKER-3	231.66	N	12/27/90	groundwater	X	X		X
BECKER-3	231.66	N	5/7/91	groundwater	X	X	X	
MW-2S	7.35	N	12/6/90	groundwater	X	X		X
MW-2S	7.35	N	5/2/91	groundwater	X	X	X	X
MW-4	64.16	N	5/3/91	groundwater	X	X	X	
MW-4	64.16	N	12/6/90	groundwater	X	X		X
MW-5	70.08	N	5/2/91	groundwater	X	X	X	
MW-5	70.08	N	12/6/90	groundwater	X	X		X
MW-6	75	N	5/3/91	groundwater		X	X	
MW-6	75	N	12/6/90	groundwater	X	X		X
MW-6	75	D	5/3/91	groundwater		X	X	
MW-6	75	D	12/6/90	groundwater	X	X		X
PIPING SAMPLES								
PP-1		N	11/19/90	pipe liquid	X	X	X	X
PP-1		N	5/7/91	pipe liquid		X		
SEDIMENT SAMPLES								
CC-1-SED	0-0.5	N	4/26/91	sediment	X	X	X	
CC-1-SED	0-0.5	N	11/19/90	sediment	X	X	X	X
CC-2-SED	0-0.5	N	11/19/90	sediment	X	X	X	X
CC-2-SED	0-0.5	N	4/26/91	sediment	X	X	X	
DD-1-SED	0-0.5	N	11/16/90	sediment	X	X	X	X
DD-2-SED	0-0.5	N	11/15/90	sediment	X	X	X	X
DD-2-SED	0-0.5	N	4/24/91	sediment		X		
DD-3-SED	0-0.5	N	11/15/90	sediment	X	X	X	X
DD-3-SED	0-0.5	N	4/24/91	sediment		X		
DD-3-SED	0-0.5	N	4/25/91	sediment			X	
DD-4-SED	0-0.5	N	11/13/90	sediment	X	X	X	X
DD-5-SED	0-0.5	N	11/15/90	sediment	X	X	X	X
DD-5-SED	0-0.5	N	4/24/91	sediment		X		
DD-6-SED	0-0.5	N	11/15/90	sediment	X	X	X	X
DD-6-SED	0-0.5	D	4/24/91	sediment		X		
DD-6-SED	0-0.5	N	4/24/91	sediment		X		
DD-6-SED	0-0.5	D	11/15/90	sediment	X	X	X	X
DD-7-SED	0-0.5	N	11/15/90	sediment	X	X	X	X
DD-7-SED	0-0.5	N	4/24/91	sediment		X		
DD-8-SED	0-0.5	N	11/16/90	sediment	X	X	X	X
DD-8-SED	0-0.5	D	4/24/91	sediment		X		
DD-8-SED	0-0.5	D	11/16/90	sediment	X	X	X	X
DD-8-SED	0-0.5	N	4/24/91	sediment		X		
DD-9-SED	0-0.5	N	4/25/91	sediment			X	
DD-9-SED	0-0.5	N	11/13/90	sediment	X	X	X	X

TABLE 2-1
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Location	Depth	Sample Type	Sample Date	Media Type	TCL VOA	TCL SVOA	TCL PEST/PCB	TCL Inorganics
FP-1-SED	0-0.5	N	5/1/91	sediment	X	X		
FP-1-SED	0-0.5	N	11/14/90	sediment	X	X	X	X
FP-2-SED	0-0.5	N	5/1/91	sediment	X	X		
FP-2-SED	0-0.5	N	11/14/90	sediment	X	X	X	X
FP-3-SED	0-0.5	N	11/14/90	sediment	X	X	X	X
FP-3-SED	0-0.5	D	5/1/91	sediment	X	X		X
FP-3-SED	0-0.5	D	11/14/90	sediment	X	X	X	X
FP-3-SED	0-0.5	N	5/1/91	sediment	X	X		
TC-1-SED	0-0.5	N	11/19/90	sediment	X	X	X	X
TC-1-SED	0-0.5	N	4/26/91	sediment	X			
TC-2-SED	0-0.5	N	4/26/91	sediment	X	X	X	
TC-2-SED	0-0.5	D	4/26/91	sediment	X	X	X	
TC-2-SED	0-0.5	N	11/19/90	sediment	X	X	X	X
TC-2-SED	0-0.5	D	11/19/90	sediment	X	X	X	X
SEPTIC TANK LIQUID SAMPLES								
ST-1-SW		N	5/6/91	septic liquid		X		
ST-1-SW		N	11/7/90	septic liquid	X	X	X	X
ST-2-DPW		N	5/7/91	septic liquid	X	X		
ST-2-DPW		N	11/8/90	septic liquid	X	X		
ST-3-SW		N	11/8/90	septic liquid	X	X	X	X
ST-3-SW		N	5/7/91	septic liquid		X		
SEPTIC TANK SEDIMENT/SLUDGE SAMPLES								
ST-1-SD		N	5/6/91	septic sed.		X		
ST-1-SD		N	11/7/90	septic sed.	X	X	X	X
ST-2-SD		N	12/5/90	septic sed.	X	X	X	X
ST-2-SD		N	5/7/91	septic sed.	X	X		
ST-3-SD		N	5/7/91	septic sed.		X		
ST-3-SD		N	11/8/90	septic sed.	X	X	X	X
SOIL BORING/TEST PIT SAMPLES								
BL-1	3-5	N	5/6/91	soil		X		
BL-1	3-5	N	12/3/90	soil	X	X	X	X
BL-2	2-4	N	11/14/90	soil	X	X	X	X
BL-2	4-6	N	11/14/90	soil	X	X	X	X
BL-2	2-4	D	5/6/91	soil	X	X		
BL-2	4-6	N	5/6/91	soil	X	X		
BL-2	2-4	N	5/6/91	soil	X	X		
BL-3	0-2	N	11/14/90	soil	X	X	X	X
BL-3	0-2	N	5/1/91	soil	X	X		
BL-4	2-4	N	11/14/90	soil	X	X	X	X
BL-4	2-4	N	5/1/91	soil	X	X		

TABLE 2-1
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BECKER ELECTRONICS MANUFACTURING SITE
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Location	Depth	Sample Type	Sample Date	Media Type	TCL VOA	TCL SVOA	TCL PEST/PCB	TCL Inorganics
SURFACE SOIL SAMPLES								
SS-1	0-0.5	N	4/25/91	soil		X		
SS-1	0-0.5	N	11/12/90	soil	X	X	X	X
SS-10	0-0.5	N	11/13/90	soil	X	X	X	X
SS-11	0-0.5	N	11/13/90	soil	X	X	X	X
SS-11	0-0.5	N	4/25/91	soil		X		
SS-12	0-0.5	N	11/13/90	soil	X	X	X	X
SS-12	0-0.5	N	4/25/91	soil		X		
SS-12	0-0.5	N	4/25/91	soil	X			
SS-13	0-0.5	N	11/13/90	soil	X	X	X	X
SS-14	0-0.5	N	4/25/91	soil	X			
SS-14	0-0.5	N	11/13/90	soil	X	X	X	X
SS-15	0-0.5	N	11/12/90	soil	X	X	X	X
SS-15	0-0.5	N	4/25/91	soil		X		
SS-16	0-0.5	N	11/12/90	soil	X	X	X	X
SS-16	0-0.5	N	4/25/91	soil		X		
SS-17	0-0.5	N	11/13/90	soil	X	X	X	X
SS-18	0-0.5	N	11/12/90	soil	X	X	X	X
SS-18	0-0.5	N	4/25/91	soil		X		
SS-19	0-0.5	N	11/13/90	soil	X	X	X	X
SS-19	0-0.5	D	11/13/90	soil	X	X	X	X
SS-2	0-0.5	D	4/25/91	soil		X		
SS-2	0-0.5	N	11/12/90	soil	X	X	X	X
SS-2	0-0.5	N	4/25/91	soil		X		
SS-3	0-0.5	N	11/13/90	soil	X	X	X	X
SS-4	0-0.5	N	4/25/91	soil		X		
SS-4	0-0.5	N	11/13/90	soil	X	X	X	X
SS-5	0-0.5	N	11/13/90	soil	X	X	X	X
SS-5	0-0.5	N	4/25/91	soil		X		
SS-6	0-0.5	N	4/25/91	soil		X		
SS-6	0-0.5	N	11/13/90	soil	X	X	X	X
SS-7	0-0.5	D	11/13/90	soil	X	X	X	
SS-7	0-0.5	D	4/25/91	soil	X			
SS-7	0-0.5	N	11/13/90	soil	X	X	X	X
SS-7	0-0.5	N	4/25/91	soil	X			
SS-8	0-0.5	N	11/13/90	soil	X	X	X	X
SS-9	0-0.5	N	4/25/91	soil		X		
SS-9	0-0.5	N	11/13/90	soil	X	X	X	X
SEPTIC TANK SOIL/LEACHFIELD SOIL SAMPLES								
ST-1-SL	5	N	11/7/90	soil	X	X	X	X
ST-1-SL	5	N	5/6/91	soil		X		
ST-2-SL	3	N	5/7/90	soil	X	X		
ST-2-SL	3	N	12/5/90	soil	X	X	X	X
ST-3-SL	3.5	D	5/7/91	soil		X		
ST-3-SL	3.5	N	11/8/90	soil	X	X	X	X
ST-3-SL	3.5	N	5/7/91	soil		X		
ST-3-SL	3.5	D	11/8/90	soil	X	X	X	X

TABLE 2-1
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Location	Depth	Sample Type	Sample Date	Media Type	TCL VOA	TCL SVOA	TCL PEST/PCB	TCL Inorganics
SURFACE WATER SAMPLES								
CC-1-SW		N	11/19/90	water	X	X		X
CC-1-SW		N	4/26/91	water		X	X	
CC-2-SW		N	11/19/90	water	X	X		X
CC-2-SW		N	4/26/91	water			X	
DD-1-SW		N	4/24/91	water		X		
DD-1-SW		N	4/25/91	water			X	
DD-1-SW		N	11/16/90	water	X	X		X
DD-2-SW		N	4/24/91	water		X		
DD-2-SW		N	11/15/90	water	X	X		X
DD-2-SW		N	4/25/91	water			X	
DD-3-SW		N	4/25/91	water			X	
DD-3-SW		N	11/15/90	water	X	X		X
DD-3-SW		N	4/24/91	water		X		
DD-4-SW		N	11/13/90	water	X	X		X
DD-4-SW		N	4/25/91	water			X	
DD-5-SW		N	4/24/91	water		X		
DD-5-SW		N	4/25/91	water			X	
DD-5-SW		N	11/15/90	water	X	X		X
DD-6-SW		D	4/25/91	water			X	
DD-6-SW		N	11/15/90	water	X	X		X
DD-6-SW		D	11/15/90	water	X	X		X
DD-6-SW		N	4/25/91	water			X	
DD-6-SW		D	4/24/91	water		X		
DD-6-SW		N	4/24/91	water		X		
DD-7-SW		N	4/25/91	water			X	
DD-7-SW		N	4/24/91	water		X		
DD-7-SW		N	11/15/90	water	X	X		X
DD-8-SW		D	11/16/90	water	X	X		X
DD-8-SW		D	4/25/91	water			X	
DD-8-SW		N	4/24/91	water		X		
DD-8-SW		N	11/16/90	water	X	X		X
DD-8-SW		N	4/25/91	water			X	
DD-8-SW		D	4/24/91	water		X		
DD-9-SW		N	4/25/91	water			X	
DD-9-SW		N	11/13/90	water	X	X		X
FP-1-BW		N	11/14/90	water	X	X		X
FP-1-SW		N	4/30/91	water			X	
FP-1-SW		N	11/14/90	water	X	X		X
FP-2-BW		N	11/14/90	water	X	X		X
FP-2-BW		D	11/14/90	water	X	X		X
FP-2-BW		N	4/30/91	water		X		
FP-2-SW		D	11/14/90	water	X	X		X
FP-2-SW		N	11/14/90	water	X	X		X
FP-2-SW		N	4/30/91	water			X	
FP-3-BW		N	4/30/91	water		X		
FP-3-BW		N	11/14/90	water	X	X		X

TABLE 2-1
PHASE I RI LABORATORY ANALYTICAL PROGRAM SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Location	Depth	Sample Type	Sample Date	Media Type	TCL VOA	TCL SVOA	TCL PEST/PCB	TCL Inorganics
FP-3-SW		D	4/30/91	water		X	X	
FP-3-SW		N	11/14/90	water	X	X		X
FP-3-SW		N	4/30/91	water		X	X	
TC-1-SW		N	11/19/90	water	X	X		X
TC-1-SW		N	4/26/91	water		X	X	
TC-2-SW		N	4/26/91	water			X	
TC-2-SW		D	4/26/91	water			X	
TC-2-SW		D	11/19/90	water	X	X		X
TC-2-SW		N	11/19/90	water	X	X		X

Notes:
N - Normal Sample
D - Duplicate Sample

TABLE 2–2
PHASE II RI LABORATORY ANALYTICAL PROGRAM SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SAMPLE ISIS ID	SAMPLE DEPTH	SAMPLE TYPE	TCL VOC	TCL SVOC	TCL METALS	TOC	BOD/COD/ TSS/ALK
TEST PIT SAMPLES (SOIL)							
BETP101XX194XX	1	N	X	X	X		
BETP101XX194XD	1	D	X	X	X		
BETP102XX494XX	4	N	X	X	X		
BETP103XX794XX	7	N	X	X	X		
BETP125XX394XX	3	N	X	X	X		
BETP104XX494XX	4	N	X	X	X		
BETP105XX794XX	7	N	X	X	X		
BETP106XX294XX	2	N	X	X	X		
BETP107XX794XX	7	N	X	X	X		
BETP108XX694XX	6	N	X	X	X		
BETP109X1194XX	11	N	X	X	X		
BETPCOMP#194XX		C	NR	NR	NR		
BETP110XX294XX	2	N	X	X	X		
BETP110XX294XD	2	N	X	X	X		
BETPCOMP#294XX		C	NR	NR	NR		
BETP111XX494XX	4	N	X	X	X		
BETP111XX394XX	3	N	X	X	X		
BETP112XX394XX	3	N	X	X	X		
BETP113XX494XX	4	N	X	X	X		
BETP114XX494XX	4	N	X	X	X		
BETP120XX194XX	1	N	X	X	X		
BETP119XX194XX	1	N	X	X	X		
BETP122XX294XX	2	N	X	X	X		
BETP122XX294XD	2	D	X	X	X		
BETP121XX194XX	1	N	X	X	X		
BETP115XX294XX	2	N	X	X	X		
BETP116XX994XX	9	N	X	X	X		
BETP117XX594XX	5	N	X	X	X		
GROUNDWATER SAMPLES							
BEMW105DXX94XX		N	X		X	X	X
BEMW106DXX94XX		N	X		X	X	X
BEMW108XXX94XX		N	X		X	X	X
BEMW108XXX94XD		D	X		X	X	X
BEMW4XXXXX94XX		N	X		X		
BEMW5XXXXX94XX		N	X		X		
BEMW5XXXXX94XD		N	X		X		
BEMW6XXXXX94XX		N	X		X		
BEMW2SXXXX94XX		N	X	X			
BEMW107XXX94XX		N	X	X			
BEMW107XXX94XD		D	X	X			

TABLE 2-2
PHASE II RI LABORATORY ANALYTICAL PROGRAM SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SAMPLE ISIS ID	SAMPLE DEPTH	SAMPLE TYPE	TCL VOC	TCL SVOC	TCL METALS	TOC	BOD/COD/ TSS/ALK
BEMW104XXX94XX		N	X	X			
BEMW105SXX94XX		N	X	X			
BEMW106SXX94XX		N	X	X			
BEMW101DXX94XX		N	X		X		
BEMW102SXX94XX		N	X	X			
BEMW102DXX94XX		N	X				
BEMW103XXX94XX		N	X	X			
BEMW112XXX94XX		N	X		X		
BEMW113XXX94XX		N	X		X		
BEMW110XXX94XX		N	X		X		
BEMW111XXX94XX		N	X		X		
BEMW1EPSXX94XX		N	X				
BEMW3EPSXX94XX		N	X				
BEMW4EPSXX94XX		N	X				
BEMW5EPSXX94XX		N	X				
BEMWBOXXXX94XX		N	X				
BEMWSPILLXX94XX		N	X				
SURFACE WATER SAMPLES							
BESW101XXX94XX		N	X	X	X		
BESW101XXX94XD		D	X	X	X		
BESW103XXX94XX		N	X	X	X		
BESW104XXX94XX		N	X	X	X		
BESW105XXX94XX		N	X	X	X		
BESW106XXX94XX		N	X	X	X		
BESW102XXX94XX		N	X	X	X		
BESW107XXX94XX		N	X				
BESW108XXX94XX		N	X				
BESW109XXX94XX		N	X				
PIPING SAMPLES		N					
BEPPXX1XXX94XX		N	X				
SEDIMENT SAMPLES		N					
BESD101XXX94XX	0-0.5	N	X	X	X	X	
BESD101XXX94XD	0-0.5	D	X	X	X	X	
BESD103XXX94XX	0-0.5	N	X	X	X	X	
BESD104XXX94XX	0-0.5	N	X	X	X	X	
BESD105XXX94XX	0-0.5	N	X	X	X	X	
BESD106XXX94XX	0-0.5	N	X	X	X	X	
BESD102XXX94XX	0-0.5	N	X	X	X	X	

TABLE 2–2
PHASE II RI LABORATORY ANALYTICAL PROGRAM SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SAMPLE ISIS ID	SAMPLE DEPTH	SAMPLE TYPE	TCL VOC	TCL SVOC	TCL METALS	TOC	BOD/COD/ TSS/ALK
GEOPROBE SAMPLES							
BEGPXX1X1094XX	10	N	X				
BEGPXX2X1094XX	10	N	X				
BEGPXX3XX694XX	6	N	X				
BEGPXX4XX894XX	8	N	X				
BEGPXX5XX694XX	6	N	X				
BEGPXX6XX794XX	7	N	X				
BEGPXX7XX794XX	7	N	X				
BEGPXX8XX694XX	6	N	X				
BEGPXX9XX494XX	4	N	X				

Notes:

(1) Composite samples were requested to be analyzed for TCLP parameters and waste characteristics; this was not performed by the laboratory. Instead, TCL analyses were performed

N – normal sample
D – duplicate sample
C – composite sample
TCL – Target Compounds List
VOC – volatile organic compound
SVOC – semivolatile organic compound
TOC – total organic carbon
BOD – biochemical oxygen demand
COD – chemical oxygen demand
TSS – total suspended solids
Alk – alkalinity

TABLE 2-3
SURFACE GEOPHYSICAL SURVEY SUMMARY
APPLICATIONS AND DATA COLLECTION ACTIVITIES

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

GEOPHYSICAL TECHNIQUE	APPLICATION(S) PERTAINING TO SITE	DATA COLLECTION SUMMARY
GEM Gradiometer (Magnetometry)	Locating the lateral extent of buried ferrous objects and possibly abandoned septic structures.	Approximately 1,100 magnetic data locations within a 10-foot by 10-foot grid at debris pile site. Approximately 50 data points in other areas of interest.
Geonics EM-31 (Electromagnetics)	Locating the extent of buried metallic objects and conductive wastes or materials.	Approximately 1,100 magnetic data locations within a 10-foot by 10-foot grid at debris pile site. Approximately 50 data points in other areas of interest.
GSSI System III Ground-penetrating Radar Unit	Locating underground structures such as septic systems and UST's	Approximately 800 lineal feet of GPR profiling was conducted in the debris pile area and in the vicinity of the chemical storage building.

TABLE 2-4
SURFACE GEOPHYSICAL SURVEY RESULTS SUMMARY
MAGNETICS, ELECTROMAGNETICS, AND GPR

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

AREA(S) OF INVESTIGATION	DATA RESULTS SUMMARY
Debris Pile Area	Total field, vertical gradient, and in-phase results indicate presence of buried ferrous objects in the central and eastern portions of the survey area. May partially indicate the presence of the abandoned leachfield and or metallic objects such as pipes or buried drums. Quadrature anomalies tend to mimic the footprint of the debris pile area which is most likely due to elevated moisture content in sawdust and particle board. Anomalous area also encompasses magnetically elevated area in the central portion of the survey. GPR data were inconclusive due to poor data quality within the debris pile area.
Chemical Storage Building Area	Magnetic and electromagnetic data were not collected due to the presence of metallic cultural features. GPR data were generally inconclusive, data considered of acceptable quality did not indicate the presence of buried USTs.
Soil Pile adjacent to Septic Tank No. 2	Electromagnetic data did not indicate the presence of conductive materials.
"Bare Ground" Area	Magnetic and electromagnetic data did not indicate the presence of buried ferrous objects or anomalously conductive materials. GPR data was not collected.

TABLE 2-5
BOREHOLE GEOPHYSICAL LOGGING APPLICATIONS LISTING AND INTERPRETATION GUIDELINES

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

TYPE OF BOREHOLE GEOPHYSICAL LOGGING	METHOD DESCRIPTION	APPLICATION(S) PERTAINING TO THE BEDROCK AQUIFER	GENERAL INTERPRETATION GUIDELINES (I.E., WHAT TO LOOK FOR)
Fluid Temperature	Measures temperature (degrees C) of borehole fluid(s)	Profiling of geothermal gradient, provides information to borehole flow regimes, may indicate presence of water bearing fractures	Temperature gradient changes or breaks, compare anomalies with caliper, single point, and fluid resistivity logs
Fluid Resistivity	Measures resistivity/conductivity (ohm-meters) of borehole fluid(s)	Provides information on borehole fluid quality and flow regimes indicating the presence of water bearing fractures and, in some extreme cases, contaminated groundwater	Fluid resistivity gradient changes or breaks, compare with fluid temperature, and caliper logs.
Natural Gamma Ray	Passively measures gamma radiation (counts/sec) of radioisotopes	Assists in lithologic correlation, may indicate presence of clay filled fractures and degree of bedrock weathering	Gamma ray peaks suggest the presence of clay minerals which may be indicative of silt/clay filled fractures or significant lithology changes.
16" Normal Resistivity (16N)	Measures resistivity (ohm-meters) of borehole effects (i.e., borehole wall and slightly into formation)	Lithology and fracture identification, stratigraphic correlation	Relative low resistivity values are indicative of the presence of fractured rock. Compare with SPR, SP, and caliper logs for fractures and compare with other 16N logs for stratigraphic determination.
Single Point Resistance (SPR)	Measures resistance (ohms) of borehole	Lithology and fracture determination, stratigraphic correlation	Relative low resistivity values are indicative of the presence of fractured rock. Compare with normal resistivity and caliper logs
Caliper	Measures borehole diameter (inches) with 3-arm probe	Fracture and void identification	Values greater than that of the drilled borehole diameter indicate the presence of fractures, voids, or breakout features

TABLE 2-6
SUMMARY OF BOREHOLE GEOPHYSICAL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

EXPLORATION LOCATION	SUMMARY OF BOREHOLE GEOPHYSICAL RESULTS
MW-04*	High angle fracture noted on core log extending from approximately 45 to 48 feet bgs. Subtle caliper anomaly profiled at 46 feet bgs.
MW-101D	Caliper anomaly at 81 feet bgs. Temperature breaks at 66 and 76 feet bgs.
MW-102D	Caliper deviations profiled throughout the borehole specifically from 19 to 25 feet bgs, 37 to 50 feet bgs, and at 56 feet bgs. Subtle deviations extend from 65 to 75 feet bgs. Temperature breaks at 25, 30, 41, 52.5, 61, and 66 feet bgs.
MW-105D	Borehole breakouts profiled throughout the 15 to 28-foot interval. Subtle caliper deviations at 43.5, 52, and 59 feet. Temperature breaks at 26, 30, 53, and 58 feet.
MW-106D	Caliper anomalies from 25 to 31 feet bgs, fractures at 49 feet bgs and from 53 to 56 feet bgs. Temperature breaks at 25, 30 and 58 feet bgs.
MW-108	Fractures profiled at 22 and 26 feet bgs, and from 56 to 62 feet bgs. Temperature anomalies at 23, 35, 41, and 56 feet bgs.
MW-109	Fractures extend from 21 to 24 feet and from 39 to 44 feet bgs; subtle fractures at 27, 48, 62, 68 feet bgs, and from 73 to 78 feet bgs. Temperature anomaly at 40, 49, and 51 feet bgs, corresponding fluid resistivity shifts.
MW-110D	Fractured interval from 22 to 28 feet; subtle caliper anomalies from 28 to 42 feet bgs and at 52 and 55 feet bgs. Temperature breaks at 21, 25, 30, 44, and 55 feet bgs.
MW-111	Caliper anomalies at 35 and 44 feet bgs, 54 to 63 feet bgs, 86 and 94 feet bgs. Temperature breaks at 39.5, 43, 57, 66, and 73 feet bgs.
MW-112	Subtle caliper anomalies throughout the 34 to 45-foot interval; fractures at 48, 64, and 80 feet bgs. Temperature breaks at 35, 47, 53.5, 64, 71, 81, and 93 feet bgs.
MW-113	Borehole deviations extend from 22 to 26 feet bgs; subtle fractures at 31, 49, and 64 feet bgs. Temperature breaks at 30, 37, and 50 feet bgs.

Notes:

* = Rock core exploration
bgs = below ground surface

TABLE 2-7
MW-4 BOREHOLE GEOPHYSICAL CORRELATION SUMMARY

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

ZONES OF INTEREST, FEET BGS	CORE OBSERVATIONS FROM MEI CORE LOG (NOV., 1990)	SUMMARY OF BOREHOLE GEOPHYSICAL RESULTS
24-32	Mottled reddish brown to light green shale; closely spaced high angle fractures with dark to yellow brown mineralization on fracture faces throughout interval; RQD's between 26% and 61%.	Subtle caliper deviation from 24 to 32 feet bgs; temperature breaks at 26, 29, and 32 feet bgs.
40-50	Light green shale to mottled reddish-brown to green laminated shale; close to moderately close fractures, large vertical fracture extending from 45 to 48 feet bgs; RQD's between 52% to 67%.	Subtle caliper deviation at 46 feet bgs; 16N low at 45 feet bgs; temperature breaks at 45 and 47 feet bgs.
50-60	Reddish brown shale from 50 to 56.5 feet. Greenish gray siltstone from 56.5 to 60 feet; close to moderately close fractures, some appear to be healed; RQD is 55%.	Slight caliper deviations at 52, 57, and 60 feet bgs; temperature break at 53 and 55 feet bgs.

Notes:

bgs = below ground surface
RQD = rock quality designation

TABLE 2-8
LOCATION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
State	New York State Solid Waste Management Facilities - General Provisions [6 NYCRR Subpart 360-1] and Landfills{Subpart 360-2]	Applicable	Part 360 of the New York Environmental Regulations outline the requirements for facilities handling the disposal of solid waste other than hazardous or radioactive materials. Subpart 360-1 presents definitions, general requirements and permitting information for the disposal and management of non-hazardous solid waste. Subpart 360-2 regulates the siting, design, construction, operation, closure, and post-closure activities all solid waste landfills.	Because wood debris and other solid wastes generated during the manufacturing process at Becker were disposed of in debris piles on-site, New York State solid waste regulations apply.

Notes:

ARARs = Applicable or Relevant and Appropriate Requirements
NYCRR = New York Code of Rules and Regulations
SCG = Standards, Criteria, Guidelines

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
Groundwater/ Surface Water				
Federal	SDWA - MCLs [40 CFR 141.11 - 141.16]	Applicable	MCLs have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water.	Because groundwater is used for drinking water in the vicinity of the Becker site, the SDWA is applicable.
	SDWA - MCLGs [40 CFR 141.50 - 141.51]	Applicable	MCLGs are standards at which there are no known or anticipated public health effects. These are guidance values.	The 1990 National Contingency Plan states that non-zero MCLGs are to be used as goals. Because groundwater is used as a drinking water source, the concentrations of contaminant detected in groundwater at Becker will be compared to their MCLGs.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
	Federal AWQC	Relevant and Appropriate	Federal AWQC include (1) health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds and (2) water quality parameters. AWQC, for the protection of human health, provide levels for exposure from drinking water and consuming aquatic organisms and from consuming fish. Remedial actions involving contaminated surface water or groundwater must consider the uses of the water and the circumstances of the release or threatened release; this determines whether AWQC are relevant and appropriate.	AWQC will be used, where appropriate, in the development of clean-up levels for surface water.
	RCRA - Subpart F Groundwater Protection Standards, Alternative Concentration Limits (40 CFR 264.94)	Relevant and Appropriate	This requirement outlines standards, in addition to background concentrations and MCLs, to be used in establishing clean-up levels for remediating groundwater contamination.	These requirements may be relevant and appropriate if certain conditions relating to transport and exposure are met.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
State	New York Water Classifications and Quality Standards [6 NYCRR Parts 701-705]	Applicable	New York State has classified surface water bodies and groundwater based on use. Water Quality Standards have been set to protect the designated uses of water.	Because groundwater in the vicinity of Becker is used as a drinking water supply, this regulation is applicable. Groundwater at Becker is designated as Class GA. Catskill Creek and Thorp Brook are classified as Class C and therefore applicable surface water quality standards apply.
	New York Department of Public Health Public Water Systems [Subpart 5-1]	Relevant and Appropriate	This requirement outlines MCLs that are not to be exceeded in public water supplies. Where MCLs have been exceeded, action is required to comply with regulatory standards.	Because groundwater is used for drinking water in the vicinity of the Becker site, these standards will be reviewed and evaluated in developing target cleanup levels.
Federal Guidance and Criteria To Be Considered	USEPA Reference Doses (RfDs) and Risk Reference Concentrations (RfCs)	To Be Considered	RfDs/RfCs are estimates of a daily exposure level for the human population without an appreciable risk of deleterious effects during a lifetime.	USEPA RfDs/RfCs are used to characterize risks due to noncarcinogens in various media.
	USEPA Human Health Carcinogen Assessment Group Cancer Slope Factors (CSFs)	To Be Considered	Carcinogenic effects present the most up-to-date information on cancer risk potency derived from USEPA's Human Health Carcinogen Assessment Group.	USEPA CSFs are used to compute the individual incremental cancer risk resulting from exposure to certain compounds.

TABLE 2-9
CHEMICAL-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
Groundwater/ Surface Water				
Federal	SDWA - MCLs [40 CFR 141.11 - 141.16]	Applicable	MCLs have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water.	Because groundwater is used for drinking water in the vicinity of the Becker site, the SDWA is applicable.
	SDWA - MCLGs [40 CFR 141.50 - 141.51]	Applicable	MCLGs are standards at which there are no known or anticipated public health effects. These are guidance values.	The 1990 National Contingency Plan states that non-zero MCLGs are to be used as goals. Because groundwater is used as a drinking water source, the concentrations of contaminant detected in groundwater at Becker will be compared to their MCLGs.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
	Federal AWQC	Relevant and Appropriate	Federal AWQC include (1) health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds and (2) water quality parameters. AWQC, for the protection of human health, provide levels for exposure from drinking water and consuming aquatic organisms and from consuming fish. Remedial actions involving contaminated surface water or groundwater must consider the uses of the water and the circumstances of the release or threatened release; this determines whether AWQC are relevant and appropriate.	AWQC will be used, where appropriate, in the development of clean-up levels for surface water.
	RCRA - Subpart F Groundwater Protection Standards, Alternative Concentration Limits (40 CFR 264.94)	Relevant and Appropriate	This requirement outlines standards, in addition to background concentrations and MCLs, to be used in establishing clean-up levels for remediating groundwater contamination.	These requirements may be relevant and appropriate if certain conditions relating to transport and exposure are met.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
State	New York Water Classifications and Quality Standards [6 NYCRR Parts 701-705]	Applicable	New York State has classified surface water bodies and groundwater based on use. Water Quality Standards have been set to protect the designated uses of water.	Because groundwater in the vicinity of Becker is used as a drinking water supply, this regulation is applicable. Groundwater at Becker is designated as Class GA. Catskill Creek and Thorp Brook are classified as Class C and therefore applicable surface water quality standards apply.
	New York Department of Public Health Public Water Systems [Subpart 5-1]	Relevant and Appropriate	This requirement outlines MCLs that are not to be exceeded in public water supplies. Where MCLs have been exceeded, action is required to comply with regulatory standards.	Because groundwater is used for drinking water in the vicinity of the Becker site, these standards will be reviewed and evaluated in developing target cleanup levels.
Federal Guidance and Criteria To Be Considered	USEPA Reference Doses (RfDs) and Risk Reference Concentrations (RfCs)	To Be Considered	RfDs/RfCs are estimates of a daily exposure level for the human population without an appreciable risk of deleterious effects during a lifetime.	USEPA RfDs/RfCs are used to characterize risks due to noncarcinogens in various media.
	USEPA Human Health Carcinogen Assessment Group Cancer Slope Factors (CSFs)	To Be Considered	Carcinogenic effects present the most up-to-date information on cancer risk potency derived from USEPA's Human Health Carcinogen Assessment Group.	USEPA CSFs are used to compute the individual incremental cancer risk resulting from exposure to certain compounds.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
	USEPA Health Advisories (HAs)	To Be Considered	HAs are issued as nonregulatory guidance. HA values represent the concentration of contaminants in drinking water at which adverse health effects would not be expected to occur. HAs are established for one-day and ten-day exposure durations.	USEPA HAs are used to evaluate noncarcinogenic effects for oral exposures of short durations.
State Guidance and Criteria To Be Considered	New York State Department of Health (NYSDOH) PWS 69 - Organic Chemical Action Steps for Drinking Water	To Be Considered	This technical document outlines concentrations of certain organic chemicals that are to be used in evaluating appropriate response for chemicals without MCLs.	Action levels provide a decision-making mechanism as to whether steps are required to protect public health if organic chemicals contaminate a drinking water supply.
	New York State Cleanup Criteria for Sediments	To Be Considered	This guidance document sets forth the numeric criteria for the cleanup of organic and inorganic contaminants in sediments. The criteria reflect contaminant concentrations that would be protective of aquatic life and/or prevent bioaccumulation.	Sediment criteria for organics and inorganics will be evaluated in establishing preliminary remediation goals for contaminated sediments.
	New York State Soil Cleanup Objectives and Cleanup Levels	To Be Considered	This guidance document sets forth the numeric criteria for the cleanup of organic and inorganic contaminants in soil. The criteria reflect contaminant concentrations that would be protective of groundwater quality and human health through exposure.	Soil criteria for organics and inorganics will be evaluated in establishing preliminary remediation goals for contaminated soil.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
Air				
Federal	Clean Air Act - National Applicable Primary and Secondary Ambient Air Quality Standards (40 CFR 50)	Applicable	Primary ambient air quality standards define levels of air quality to protect public health. Secondary ambient air quality standards protect public welfare from known or anticipated adverse effects from pollutants.	Particulate standard for matter less than 10 microns is 150 $\mu g/m^3$, 24-hour average concentration.
State	New York Air Pollution Control Regulations - General Provisions (Part 200.6)	Applicable	An air contamination source may not emit air contaminants in quantities that would exceed ambient air quality standards.	Activities conducted at the Becker site should not result in the release of regulated contaminants in concentrations that exceed ambient air quality standards.
	New York Air Pollution Control Regulations - General Prohibitions (Part 211.2)	Relevant and Appropriate	Air quality standards are designed to provide protection from adverse health effects from air contaminants.	Particulate standards for matter less than 10 microns is 250 $\mu g/m^3$, 24-hour average concentration.

(continued)

TABLE 2-9
CHEMICAL-SPECIFIC ARARs AND SCGs

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

SITE FEATURE	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
	New York State Air Guide-1: Guidelines for the Control of Toxic Ambient Air Contaminants.	Applicable	This guide outlines Ambient Guideline Concentrations (AGCs). AGCs are numerical values to be used as a screening mechanism for permit applications and determining the needs for additional air quality controls.	AGCs can be used in determining potential impacts of emissions of toxic contaminants and evaluating the needs for air quality controls.

Notes:

AGCs	=	Ambient Guideline Concentrations
ARARs	=	Applicable or Relevant and Appropriate Requirements
AWQC	=	Ambient Water Quality Criteria
CFR	=	Code of Federal Regulations
CSF	=	Cancer Slope Factor
MCL	=	Maximum Contaminant Level
MCLG	=	Maximum Contaminant Level Goal
mg/L	=	milligrams per liter
NYCRR	=	New York Code of Rules and Regulations
ppm	=	parts per million
RCRA	=	Resource Conservation and Recovery Act
RfC	=	Risk Reference Concentration
RfD	=	Risk Reference Dose
RI/FS	=	Remedial Investigation/Feasibility Study
SCG	=	Standards, Criteria, and Guidelines
SDWA	=	Safe Drinking Water Act
μg/L	=	micrograms per liter
$\mu g/m^3$	=	micrograms per cubic meter
USEPA	=	U.S. Environmental Protection Agency

TABLE 2-10
SUMMARY OF GROUNDWATER AND SURFACE WATER STANDARDS AND GUIDANCE

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Compound	NY STATE Groundwater Quality Class GA (µg/L)	FEDERAL MCL (µg/L)	FEDERAL MCLG (µg/L)	FEDERAL WQC Water & Organisms (µg/L)	NY STATE Surface Water Quality Class D (µg/L)	NY STATE Surface Water Quality Class C (µg/L)
VOLATILE ORGANIC COMPOUNDS						
Chloromethane	5			0(0.19)		
Bromomethane				0(0.19)		
Vinyl Chloride	2	2	0	0(2.0)		
Chloroethane				IND		
Methylene chloride	5	(5)	(0)			
Acetone						
Carbon disulfide						
1,1-Dichloroethene	5	7	7	0(33ng/L)		
1,1-Dichloroethane	5					
1,1,1-Trichloroethane	5	200	200	18400		
1,2-Dichloroethene (total)	5	70/100	70/100	IND		
Chloroform	7	100	0	0(0.19)		
1,2-Dichloroethane	5	5	0	0(0.94)		
2-Butanone						
1,1,1-Trichloroethane	5	200	200			
Carbon tetrachloride	5	5	0	0(0.42ng/L)		
Vinyl Acetate						
Bromodichloromethane	50 G	100				
1,2-Dichloropropane	5	5	0	IND		
cis-1,3-Dichloropropene	5			87		
Trichloroethene	5	5	0	0(2.8)	11 G	11 G
Dibromochloromethane	50 G	100		0(0.19)		
1,1,2-Trichloroethane	5	5	3	0(0.6)		
Benzene	0.7	5	0	0(0.66)	6 G	6 G
trans-1,3-Dichloropropene	5			87		
Bromoform	50 G	100	0			
4-Methyl-2-Pentanone						
2-Hexanone	50 G					
Tetrachloroethene	5	5	0	0(0.88)	1 G	1 G
1,1,2,2-Tetrachloroethane	5			0(0.17)		
Toluene	5	1000	1000	14300		
Chlorobenzene	5	100	100	488	50	5
Ethylbenzene	5	700	700	2400		
Styrene	5	100	100			
Xylenes (Total)	5	10000	10000			
SEMIVOLATILE ORGANIC COMPOUNDS						
Phenol	1			3500	1	1
bis(2-Chloroethyl)ether	1.0			0(30ng/L)		
2-Chlorophenol	+			0.1 (01)		
1,3-Dichlorobenzene	5	600	600	470	50	5
1,4-Dichlorobenzene	4.7	75	75	470	50	5
Benzyl alcohol						
1,2-Dichlorobenzene	4.7	600	600	470	50	5
2-Methylphenol	+					
bis(2-Chloroisopropyl)ether				34.7		
4-Methylphenol	+					
N-Nitroso-di-n-propylamine						
Hexachloroethane				0 (2.4)		
Nitrobenzene	5			19800		
Isophorone	50 G			5200		
2-Nitrophenol	+					
2,4-Dimethylphenol	+			400 (01)		

TABLE 2-10 (cont'd)
SUMMARY OF GROUNDWATER AND SURFACE WATER STANDARDS AND GUIDANCE

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Compound	NY STATE Groundwater Quality Class GA (µg/L)	FEDERAL MCL (µg/L)	FEDERAL MCLG (µg/L)	FEDERAL WQC Water & Organisms (µg/L)	NY STATE Surface Water Quality Class D (µg/L)	NY STATE Surface Water Quality Class C (µg/L)
Benzoic Acid						
bis(2-Chloroethoxy)methane						
2,4-Dichlorophenol	+			3090	1	1
1,2,4-Trichlorobenzene	5	70	70	IND	50	5
Naphthalene	10 G			IND		
4-Chloroanaline						
Hexachlorobutadiene	5		1	0 (0.45)	10	1
4-Chloro-3-methylphenol	+			3000		
2-Methylnaphthalene				0 (3.1 ng/L)		
Hexachlorocyclopentadiene	5	50	50	206	4.5	0.45
2,4,6-Trichlorophenol	+			0 (1.8)		
2,4,5-Trichlorophenol	+			2600		
2-Chloronaphthalene	10			IND		
2-Nitroanaline						
Dimethylphthalate	50 G			350000		
2,6-Dinitrotoluene	5					
3-Nitroanaline						
Acenaphthene	20 G			0 (3.1 ng/L)		
2,4-Dinitrophenol	+			70		
4-Nitrophenol	+					
Dibenzofuran						
2,4-Dinitrotoluene				0 (0.11)		
Diethylphthalate	50 G			434000		
4-Chlorophenyl-phenylether						
Fluorene	50 G			0 (2.8 ng/L)		
4-Nitroanaline						
4,6-Dinitro-2-methylphenol	+					
N-Nitrosodiphenylamine	50 G			0 (7.0)		
4-Bromophenyl-phenylether						
Hexachlorobenzene	0.35	1	0	0 (21 ng/L)		
Pentachlorophenol	+	1	0	200	1	0.4
Phenanthrene	50 G			0 (3.1 ng/L)		
Anthracene	50 G			0 (3.1 ng/L)		
Di-n-butylphthalate	50			44000		
Fluoranthene	50 G			188		
Pyrene	50 G			0 (3.1 ng/L)		
Butylbenzylphthalate	50 G	(100)	(0)			
3,3-Dichlorobenzidene				470		
Benzo(a)anthracene	0.002 G	(0.1)	(0)	0 (3.1 ng/L)		
Chrysene	0.002 G	(0.2)	(0)	0 (3.1 ng/L)		
bis(2-Ethylhexyl)phthalate	50					0.6
Di-n-octylphthalate	50 G					
Benzo(b)fluoranthene	0.002 G	(0.2)	(0)	0 (3.1 ng/L)		
Benzo(k)fluoranthene	0.002 G	(0.2)	(0)	0 (3.1 ng/L)		
Benzo(a)pyrene	ND	(0.2)	(0)	0 (3.1 ng/L)	0.0012 G	0.0012 G
Indeno(1,2,3-cd)Pyrene	0.002 G	(0.4)	(0)	0 (3.1 ng/L)		
Dibenz(a,h)Anthracene		(0.3)	(0)	0 (3.1 ng/L)		
Benzo(g,h,i)perylene				0 (3.1 ng/L)		

TABLE 2–10 (cont'd)
SUMMARY OF GROUNDWATER AND SURFACE WATER STANDARDS AND GUIDANCE

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Compound	NY STATE Groundwater Quality Class GA (µg/L)	FEDERAL MCL (µg/L)	FEDERAL MCLG (µg/L)	FEDERAL WQC Water & Organisms (µg/L)	NY STATE Surface Water Quality Class D (µg/L)	NY STATE Surface Water Quality Class C (µg/L)
PESTICIDE/PCBs						
alpha–BHC	ND	0.2	0.2	0 (73 ng/L)	2	0.01
beta–BHC	ND	0.2	0.2	0 (23.3 ng/L)	2	0.01
delta–BHC	ND	0.2	0.2	IND	2	0.01
gamma–BHC (Lindane)	ND	4	0.2	0 (17.4 ng/L)	2	0.01
Heptachlor	ND	0.4	0	0 (11 ng/L)	0.001	0.001
Aldrin	ND				0.001	0.001
Heptachlor epoxide	ND	0.2	0		0.001	0.001
Endosulfan I				138	0.22	0.009
Dieldrin***	ND			0.000071	0.001	0.001
4,4'–DDE	ND				0.001	0.001
Endrin	ND	2	2	1		
Endosulfan II						
4,4'–DDD	ND				0.001	0.001
Endosulfan sulfate						
4,4'–DDT	ND			0.000024		0.001
Methoxychlor	35	40	40			0.03
Endrin ketone						
alpha–Chlordane	0.1	2	0		0.002	0.002
gamma–Chlordane	0.1	2	0		0.002	0.002
Toxaphene	ND	3	0	0 (26 ng/L)	1.6	0.005
Aroclor–1016	0.1	0.5	0		0.001	0.001
Aroclor–1221	0.1	0.5	0		0.001	0.001
Aroclor–1232	0.1	0.5	0		0.001	0.001
Aroclor–1242	0.1	0.5	0		0.001	0.001
Aroclor–1248	0.1	0.5	0		0.001	0.001
Aroclor–1254	0.1	0.5	0		0.001	0.001
Aroclor–1260	0.1	0.5	0		0.001	0.001
INORGANICS						
Aluminum						100
Antimony	3 G	6	6	146		
Arsenic	25	50		0.0022	360	190
Barium	2000	2000	(5000)	1		
Beryllium	3 G	4	4	0.0037		11/1100H
Cadmium	10	5	5	10	*	@
Calcium						
Chromium	50	100	100		@@@	@@
Cobalt					110 G	5
Copper	200	1300	TT	1000 (01)	**	@@@@
Cyanide	100	(200)	(200)	200	22	5.2
Iron	300			300	300	300
Lead	25	TT 15	0	50	***	@@@@@
Magnesium	35000 G					
Manganese	300			50		
Mercury	2	2	2	0.144	0.2 G	0.2 G
Nickel		100	100	13.4	****	@@@@@@
Potassium						
Selenium	10	50	50	10		1
Silver	50			50	*****	1
Sodium	20000					
Thallium	4 G	2	0.5	17.8	20	8
Vanadium					190	14
Zinc	300			5000 (01)	******	30

TABLE 2–10 (cont'd)
SUMMARY OF GROUNDWATER AND SURFACE WATER STANDARDS AND GUIDANCE

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

Compound	NY STATE Groundwater Quality Class GA (µg/L)	FEDERAL MCL (µg/L)	FEDERAL MCLG (µg/L)	FEDERAL WQC Water & Organisms (µg/L)	NY STATE Surface Water Quality Class D (µg/L)	NY STATE Surface Water Quality Class C (µg/L)
WATER QUALITY PARAMETERS						
pH					6.0< X <9.5	6.5< X <8.5
Dissolved solids	500 mg/L					
DO					> 3 mg/L	> 4 mg/L (T)

Sources:
Federal MCLs and MCLGs from 40 CFR 141.
Federal MCLs and MCLGs in parentheses are proposed (from 54FR22062, 55FR30370, and 56FR3521).
Federal Ambient Water Quality Criteria, May 1, 1991

New York State Groundwater Quality standards taken from 6NYCRR 703 (September 1, 1991) and Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values (November 15, 1991). New York State Public Water Supply MCLs taken from 10 NYCRR 5–1 (March 11, 1992).

Notes:

G	= Guidance values taken from New York State Division of Water Technical and Operational Guidance Series (Ambient Water Quality Standards and Guidance Values, November 15, 1991).
IND	= Insufficient data
TT	= Treatment Technique Action Level
MCL	= Maximum Contaminant Level
MCLG	= Maximum Contaminant Level Goal
WQC	= Water Quality Criteria (for the protection of human health).
ND	= Not detectable
*	= exp (1.128[ln (ppm hardness) – 3.828)
**	= exp(0.9422 [ln (ppm hardness)] – 1.464)
***	= exp(1.266 [ln (ppm hardness)] – 1.416)
****	= exp(0.76 [ln (ppm hardness)] + 4.02)
*****	= exp(1.72 [ln (ppm hardness)] –6.52)
******	= exp(0.83 [ln (ppm hardness)] + 1.95)
@	= exp(.7852 [ln (ppm harness)] – 3.490)
@@	= exp(0.819 [ln (ppm hardness)] – 1.561)
@@@	= exp(0.819 [ln (ppm hardness)]–3.688)
@@@@	= exp(0.8545 [ln(ppm hardness)] – 1.465)
@@@@@	= exp(1.286 [ln (ppm hardness)]–4.861)
@@@@@@	= exp(0.76 [ln (ppm hardness)]–1.06)
+	= total phenols limit of 1.0 ug/L
$	= Not included in 100 ug/L organic total
T	= May also depend on presence of trout habitat. See regulations for limits.
ol	= organoleptic, criteria based on odor and taste, not health. No health–based criteria available
( )	= MCLs and MCLGs in parenthesis are proposed
H	= NYS Surface Water Standard for beryllium in 11 ug/L when hardness is less than or equal to 75 ppm; 1100 ug/L when hardness is greater than 75 ppm

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
Federal		
Clean Water Act (CWA) - National Pollution Discharge Elimination System (NPDES) (40 CFR Parts 122, 125)	This requirement implements the NPDES program that specifies the applicable effluent standards, monitoring requirements, and special conditions for direct discharge to surface water bodies.	CWA NPDES requirements, including discharge limitations, monitoring requirements, and best management practices would apply to alternatives proposing direct discharge of treated groundwater to Catskill and/or Thorp Creeks. Discharges would require NPDES compliance and a NPDES permit.
OSHA - General Industry Standards [29 CFR Part 1910]	These regulations specify the 8-hour time-weighted average concentration for various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the required concentrations. Workers performing activities would be required to have completed specific training requirements prior to site work.
OSHA - Safety and Health Standards [29 CFR Part 1926]	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site. In addition, safety procedures would be followed during on-site activities.
OSHA - Recordkeeping, Reporting, and Related Regulations [29 CFR Part 1904]	This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	These requirements apply to all site contractors and subcontractors, and must be followed during all site work.
CAA - National Ambient Air Quality Standards [40 CFR Part 50]	This regulation specifies maximum concentrations for particulate matter, ozone, and other hazardous air pollutants.	Emissions from treatment units would be required to comply with this regulation.
DOT - Rules for Transportation of Hazardous Materials [49 CFR Parts 107, 171.1-172.558]	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting hazardous materials.	These rules apply to waste that would be transported off-site for treatment and/or disposal.

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
RCRA - General Facility Standards (40 CFR 264.10-264.18)	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	
RCRA - Preparedness and Prevention (40 CFR 264.30-264.37)	This regulation outlines requirements for safety equipment and spill-control requirements for hazardous waste facilities. Part of the regulation includes a requirement that facilities be designed, maintained, constructed, and operated to minimize the possibility of an unplanned release that could threaten human health or the environment.	
RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56)	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	
RCRA - Manifest System, Recordkeeping, and Reporting (40 CFR 264.70-264.77)	This regulation details the manifesting requirements for all waste transported off-site and for on-site treatment processes, storage locations, analyses records, contingency plan summary reports, and monitoring requirements.	

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
RCRA - Releases from Solid Waste Management Units (40 CFR 264.90-264.109)	This regulation details groundwater monitoring requirements for hazardous waste treatment facilities. The regulation outlines general groundwater monitoring standards, as well as standards for detection monitoring, compliance monitoring, and corrective action monitoring.	Groundwater monitoring programs are subject to this regulation.
RCRA - Closure and Post-closure (40 CFR 264.110-264.120)	This regulation details general requirements for closure and post-closure of hazardous waste facilities, including installation of a groundwater monitoring program.	Groundwater monitoring programs are subject to this regulation.
RCRA - Generators (40 CFR Part 262)	This requirement sets standards for generators of hazardous waste that address: (1) accumulating waste, (2) preparing hazardous waste for shipment, and (3) preparing the uniform hazardous waste manifest. These requirements are integrated with DOT regulations.	Generators of hazardous waste who ship that waste off-site must comply with these regulations.
RCRA - Waste Piles (40 CFR 264.110-264.120)	This regulation details procedures, operating requirements, closure, and post-closure for waste piles. If removal or decontamination of all contaminated subsoils is not possible, closure and post-closure requirements for landfills must be attained.	

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
RCRA - Incinerators (40 CFR 264.340-264.599)	This regulation specifies the performance standards, operating requirements, monitoring, inspection, and closure guidelines of any incinerator burning hazardous wastes.	This regulation applies to hazardous waste to be treated at an incinerator.
RCRA - Land Disposal Restrictions (40 CFR 268)	Land disposal of RCRA hazardous waste is restricted without specified treatment. It must be determined that the waste meets the definition of a hazardous waste and the remedial action constitutes "placement" for the LDRs to apply. For each hazardous waste, LDRs specify a treatment technology or concentration level required prior to disposal in a RCRA-permitted facility.	This regulation applies to hazardous waste that is land-disposed.
RCRA - Miscellaneous Units (40 CFR 264.600-264.999)	These standards are applicable to miscellaneous units not previously defined under existing RCRA regulations. Subpart X outlines performance requirements that miscellaneous units be designed, constructed, operated, and maintained to prevent releases to the subsurface, groundwater, surface water, and wetlands that may have adverse effects on human health or the environment.	

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
RCRA Transporters (40 CFR Part 263)	These regulations establish standards for persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262. These regulations cross-reference DOT regulations. Hazardous waste transporters are required to have a valid USEPA identification number and to comply with all manifest, recordkeeping, and reporting requirements. These regulations do not apply to on-site transportation.	Transporters of soil off-site will be subject to these regulations.
State		
New York State Solid Waste Management Facilities - General Provisions [6 NYCRR Subpart 360-1]	Part 360 of the New York Environmental Regulations outline the requirements for facilities handling the disposal of solid waste other than hazardous or radioactive materials. Subpart 360-1 presents definitions, general requirements, and permitting information for the disposal and management of non-hazardous solid waste.	If the waste material at Becker is determined to be, or treated so as to meet the definition of, a non-hazardous waste it may become subject to Solid Waste Regulations. This subpart would apply in clarifying the status of the waste or treated materials. Any on-site or off-site land disposal of treated/non-hazardous waste would need to be within a unit subject to the permitting and general operation requirements of this subpart.

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
New York State Solid Waste Management Facilities - Landfills [6 NYCRR Subpart 360-2]	This subpart sets forth design and performance requirements for landfills. Permit application requirements specific to general landfills are also outlined in this Subpart.	On-site or off-site land disposal of treated, non-hazardous materials from Becker would need to be in a unit complying with the requirements of this subpart. Construction of an on-site land disposal unit would be subject to the minimum siting, construction, and closure requirements.
NYSDEC - Siting of Industrial Hazardous Waste Facilities Regulations [NYCRR Chapter 361]	Under these regulations, a new hazardous waste TSDF must submit a permit application before construction. Population density, transportation, proximity to recreational areas, historical structures, incompatible structures and utilities, risk of groundwater, surface water, or air contamination, and threats to endangered species are considered in the application process.	

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
NYSDEC - Hazardous Waste Management and Facility Regulations [6 NYCRR Chapters 370-373-2]	These regulations are essentially equivalent to the federal RCRA regulations with the exception that portions of the NYSDEC regulations are more stringent. Regulations are broken down as follows: Chapter 371: Identification and Listing of Hazardous Waste Regulations Chapter 372: Hazardous Waste Manifest System Regulations Chapter 373-1: Hazardous Waste TSDF Permitting Requirements Chapter 373-2: Final Standards for Owners and Operators of Hazardous Waste TSDFs.	
New York State Regulations on State Pollutant Discharge Elimination System (SPDES)[6 NYCRR Parts 750-758]	Compliance with NYS SPDES is required for discharge of treatment process water. Under these regulations NYSDEC may impose treatment standards for discharge, monitoring, reporting, and recordkeeping requirements.	These regulations may be attained through compliance with the NPDES program under the CWA for alternatives proposing to discharge treated groundwater to Catskill or Thorp Creeks. Consideration of additional actions to meet NYS SPDES requirements may be necessary.
New York State Rules for Inactive Hazardous Waste Disposal Sites [6 NYCRR Part 375]	These rules apply to the development and implementation of remedial programs at inactive hazardous waste sites.	NYSDEC generally conforms to all federal requirements concerning site clean up. Remedial activities will follow the state policies.
New York State Rules on Collection and Transport of Industrial Wastes [6 NYCRR Part 364]	These rules govern the collection, transportation, and delivery of hazardous and regulated waste in the State of New York.	Off-site transport of contaminated waste or treatment process residuals will be performed by a state-permitted transporter.

(continued)

TABLE 2-11
POTENTIAL ACTION-SPECIFIC ARARS AND SCGS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

REQUIREMENT	REQUIREMENT SYNOPSIS	CONSIDERATION IN RI/FS
NYSDEC - Division of Air Resources Regulations [6 NYCRR Chapters 200-202, 257]	This regulation prohibits the emissions of air contaminants that exceed ambient air quality standards. It prohibits the construction and operation of an air contamination source without a valid permit. NYSDEC may require sampling and emissions testing under Chapter 202.	Emissions from treatment units must comply with this regulation.

Notes:

ARARs	=	Applicable or Relevant and Appropriate Requirements
CAA	=	Clean Air Act
CFR	=	Code of Federal Regulations
CWA	=	Clean Water Act
DEC	=	Department of Environmental Conservation
DOT	=	Department of Transportation
NPDES	=	National Pollutant Discharge Elimination System
NYCRR	=	New York Code of Rules and Regulations
NYS	=	New York State
OSHA	=	Occupational Safety and Health Act
ppm	=	parts per million
RCRA	=	Resource Conservation and Recovery Act
SCG	=	Standards, Criteria, and Guidelines
SPDES	=	State Pollutant Discharge Elimination System
TSDF	=	Treatment, Storage, an Disposal Facility
USEPA	=	U.S. Environmental Protection Agency

TABLE 2-12
BACKGROUND SOIL AND SEDIMENT CONCENTRATION RANGES

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

COMPOUND	NEW YORK REGION* (mg/kg)	SOIL BACKGROUND RANGE[1] (mg/kg)	SEDIMENT BACKGROUND[2] (mg/kg)	BACKGROUND EXCEEDANCE CRITERIA (mg/kg)
Aluminum	1,000 - 25,000	NA	NA	25,000
Antimony	NA	NA	NA	NA
Arsenic	3 - 12	NA	NA	12
Barium	15 - 600	85.5 - 3,500	NA	3,500
Beryllium	0 - 1.75	0.1 - 40	0.9	40
Cadmium	0.01 - 2	BDL - 7	BDL	7
Calcium	130 - 35,000	BDL - 400,000	NA	400,000
Chromium	1.5 - 40	5 - 3,000	BDL	3,000
Cobalt	2.5 - 60	1 - 40	NA	60
Copper	1 - 15	2 - 484	BDL	484
Iron	17,500 - 25,000	7,000 - 550,000	NA	550,000
Lead	10 - 37	2 - 200	13	200
Magnesium	17,500 - 6,000	600 - 6,000	NA	17,500
Manganese	50 - 5,000	100 - 5,810	NA	5,810
Mercury	0.042 - 0.066	BDL - 0.2	NA	0.2
Nickel	0.5 - 2.5	5 - 1,000	25	1,000
Potassium	8,500 - 43,000	NA	NA	43,000
Selenium	<0.1 - 0.125	NA	NA	0.125
Silver	NA	NA	NA	NA
Sodium	6,000 - 8,000	NA	NA	8,000
Vanadium	25 - 60	NA	NA	60
Zinc	37 - 60	10 - 300	72	300

Notes:

* Concentrations obtained from "Background Concentrations of 20 Elements in Soils with Special Regard for New York State". (no date) Paper prepared by E. Carol McGovern. NYSDEC Wildlife Resources Center.

NA = not available
BDL = not detected (below detection limits)

1 Concentrations obtained from site background surface soil samples (SS-1DEC to SS-6DEC) obtained by NYSDEC and analyzed for selected inorganics (NYSDEC, 1992b) and soil data from NYSDOH (NYSDOH, 1995).

2 Concentrations obtained from site background sediment sample SD-207DEC obtained by NYSDEC and analyzed for selected inorganics (NYSDEC, 1993b).

TABLE 2-13
BACKGROUND SURFACE WATER AND GROUNDWATER CONCENTRATION RANGES

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

COMPOUND	SURFACE WATER[1] SW-207DEC (µg/L)	GROUNDWATER[2] (µg/L)
Aluminum	NA	BDL
Antimony	N	BDL
Arsenic	NA	5.0J
Barium	NA	24 - 307
Beryllium	BDL	BDL - 3
Cadmium	BDL	BDL
Calcium	NA	785,000
Chromium	BDL	BDL
Cobalt	NA	BDL
Copper	BDL	BDL - 86
Iron	NA	BDL - 49,700
Lead	4J	BDL - 22
Magnesium	NA	1,000 - 48,900
Manganese	NA	5 - 1,610
Mercury	NA	BDL
Nickel	BDL	BDL
Potassium	NA	803J
Selenium	NA	BDL
Silver	NA	BDL
Sodium	NA	4,700 - 170,000
Thallium	NA	BDL
Vanadium	NA	BDL
Zinc	140	BDL - 2,150

Notes:

J = estimated concentration
NA = not available
BDL = not detected (below detection limits)

[1] Concentrations obtained from site background surface water sample SW-207DEC (NYSDEC, 1993b).
[2] Concentrations obtained from Phase II RI 1994 data for MW-101D and data from private water supply wells provided by NYSDOH (NYSDOH, 1995).

3.0 PHYSICAL SETTING

The Becker site is located in East Durham, within the town of Durham, Greene County, New York. East Durham is located approximately 40 miles southwest of Albany, and 12 miles west of Catskill, New York (see Figure 1-1). The Becker site is situated on the west side of NYS Route 145 on a parcel officially designated on the tax assessors map as Lot 1, Blocks 25 and 26. The property is presently owned by Becker Electronics Manufacturing Corporation. Access to the Becker site is via Route 145. Delineation of the site/study area boundary is shown in Figure 1-2. Several access roads and/or vehicle trails are located within the site boundaries.

3.1 SITE DESCRIPTION

The Becker site is approximately 13 acres in size, and is comprised of several buildings which once were used for the manufacturing of high fidelity speakers and components, shipping, and maintenance. Site operations ceased several years ago (approximately 1987) and the facilities are currently abandoned. Private residences and small business establishments (gift shops, a restaurant/pub, and a go-cart speedway/recreation area) are located north and east of the site. A private residence is located immediately adjacent to the northeast corner of the site. An abandoned resort, the Weldon House, lies adjacent to the site to the south. Immediately north of the site are athletic fields of the Irish Culture and Sports Center Land. West of the site is undeveloped land consisting of a grass field reportedly used for overflow parking for the adjacent athletic fields, and woods.

Figure 1-2 is a detailed site plan showing existing buildings and other site features. The existing facilities are comprised of approximately 96,000 square feet (sq. ft.) of manufacturing/office space with 13,850 sq. ft. of associated garage area, a 4,700 sq. ft. sawdust storage building and a water pumphouse. Other than the existing buildings/structures and several paved or gravel parking areas, the site is grass-covered and contains a wooded area in the northeast corner, a surface debris pile area, a fire pond, and drainage ditches.

3.2 POPULATION CHARACTERISTICS/LAND USE

East Durham is a rural community. The Becker site is located on census tract 0802.00 and block no. 238. This census block is approximately 1 square mile in size and includes the site and the lower portion of East Durham. The 1990 census showed 57 people living in Block no. 238. The dominant land uses in the vicinity of the Becker site are for recreational and agricultural purposes.

3.3 SURFACE WATER HYDROLOGY

Surface water runoff from the site either pools on the ground surface, or flows through drainage ditches and culverts (on-site to off-site) and ultimately to Thorp Creek and Catskill Creek located east and downhill of the site.

Thorp Creek, a tributary of Catskill Creek, is classified by the NYSDEC Division of Fish and Wildlife as a Class C(TS)-C trout stream. Catskill Creek is classified as a Class C(T)-C trout stream. The confluence of these surface water bodies is located approximately 800 feet northeast of the site (see Figure 1-1). Based on a review of the Federal Emergency Management Agency flood map of the area, the site does not lie within the 100-year floodplain of either Catskill Creek, Thorp Creek, or their tributaries. Catskill Creek ultimately discharges to the Hudson River.

Figure 1-3 in the Phase I RI report shows the NYSDEC designated freshwater wetlands in the vicinity of the Becker site (M&E, 1992c). There are two NYSDEC protected wetlands (GR-110, F-2) located within one mile of the site; however, both are considered upgradient of the site with respect to surface water drainage. A third NYSDEC regulated wetland, F-3, is located approximately one mile southeast of the site along Catskill Creek, considered downgradient of the site. Wetland F-3 is listed as a Class II wetland.

3.4 CLIMATE

Climatological data was obtained during the Phase I RI from the reporting station in Cairo, New York, which is located approximately 2.5 miles southeast of the Becker site (M&E, 1992c). The average annual precipitation for the area in the vicinity of

the site was approximately 39.13 inches during the 10-year period from 1980 through 1990. In general, precipitation is rather evenly distributed throughout the year, with winter being the drier season. The average annual temperature for the vicinity of the site over the same time period of 1980 to 1990 was 47.3 degrees fahrenheit. July is the warmest month and January is the coldest month, with average temperatures of 70.6 and 21.5 degrees Fahrenheit, respectively.

4.0 SITE GEOLOGY AND HYDROGEOLOGY

Regional and site hydrogeology descriptions are based upon review of available scientific literature, the Phase I RI report (M&E, 1992c), and results of explorations conducted during the Phase II RI program.

4.1 REGIONAL GEOLOGY

Setting. Geologic formations encountered in Greene County are of two types: consolidated or bedrock, and unconsolidated deposits. Bedrock within Greene County is composed of Ordovician through Devonian Age sedimentary formations. The sediments which formed these bedrock formations were deposited in marine and subaerial environments in response to transgressional and recessional sea levels and regional structural uplift. The formational sequence of the existing bedrock material may be best characterized as a series of cycles which included periods of sediment deposition followed by regional uplift and erosion. For the past 450 million years, this area had experienced the erosional portion of the cycle which has resulted in the modern landform (M&E, 1992c).

In general, unconsolidated deposits cover the bedrock in most places within Greene County. These unconsolidated deposits are primarily Pleistocene in age and are stratified and/or unstratified till, gravel, sand, and clay of varying thicknesses. Thin layers comprising less than 20 feet of Quaternary alluvium gravel, sand, and silt deposits can be found locally in stream bed channels.

Stratigraphy. The Deepkill Shale of lower Ordovician Age is the oldest unit present, and consists of a green siliceous shale, black shale and thin-bedded limestone and chert. Gray sandstone with chert and dark-gray shale make up the younger Normanskill Formation. Subsequent to the deposition which formed the Deepkill and Normanskill formations, the region underwent uplift and deformation. Throughout the late Ordovician and Middle Silurian ages, erosion reduced the formations to a shallow plain. The total thickness of the Deepkill and Normanskill units in the county is reported to be approximately 1,200 feet along the Hudson River.

In the late Silurian to the Middle Devonian, the region was transgressed by the sea. Deposits of thick muds and sands accumulated on top of the eroded Ordovician formation. These deposits formed the massive dark gray folliliferous limestone, overlying these units known as the Devonian Helderberg Group and the Devonian Onondaga and Ulster Groups. The Helderberg group is a highly fossiliferous shaley or cherty limestone interspersed with massive crystalline limestone beds.

The thickness of the Rondout and Manlius limestone ranges from 40 to 50 feet and the Helderberg Group is approximately 300 feet thick. The thickness of the Ulster Group ranges from 7 to 250 feet and the Onondaga limestone approximately 80 feet. A nearly complete sequence of highly deformed Ordovician through Devonian units can be observed at a road cut along Route 23 between Cairo and Catskill in the area of Route 87, approximately ten miles east of the site.

During the Middle Devonian, the landmass to the northeast of the region was uplifted. A thick sequence of alluvial sands and gravels were deposited on the lower Devonian formations. These deposits formed a wedge of material from the uplifted and eroding landmass to the northeast. In the southern part of the county, the Middle Devonian Ashokan Formation was deposited over the Mount Marion formation, and ranges in thickness from 250 to 350 feet. In the northern region of the county, the Mount Marion Formation is thicker (up to 1,100 feet) due to continued deposition.

The Catskill formation was formed during the middle to late Devonian Age from continued subaerial deposition of sand, silts, and muds. Occasional examples of crossbedding are evident in sandstone beds. Mud cracks have also been observed in exposed bedrock outcrops along the Catskill Creek. This formation underlies approximately five sixths of the county and makes up the foothills of the Catskill mountains on which the Becker Electronics site is located. This formation consists of red and gray sandstone along with red, gray and green shales. The Catskill formation attains a maximum thickness of 5,500 feet.

West along Route 23 near Cairo, undeformed Middle Devonian red and green shales and sandstones can be observed. The beds at this location dip generally to the northwest.

Pleistocene glacial alluvial and fluvial deposits of sand and gravel are found in valleys throughout the county. Glacial lakes formed in some valleys. Lacustrine silt and clay deposits are found at the sites of these former lakes. Sporadic deposits of till are found in the upland areas.

Structure. Several formations in Greene County have developed faults and folds as a result of two primary periods of deformation during the Ordovician and Devonian Ages. The Deepkill and Normanskill Shales show the greatest amount of deformation, resulting from at least two major episodes of folding and faulting. These formations may be part of a thrust block to the west.

In the southern part of the county (from the town of Catskill and further south), extensive thrust faulting and folding occurred. The faulting and folding occurred most notably in the Helderberg and Onondaga Groups. The folding and faulting decreases to the north of the town of Climax. Paralleling the strike of the beds in this region are several normal faults. The dip of the lower limestone formations is generally to the northwest. They dip southwest in some northern areas.

The younger Middle Devonian Bakoven Shale is highly deformed in local areas. The overlying younger formations are significantly less deformed. These younger formations (Mount Marion, Ashoken and Catskill Formations) have dips ranging from 7 degrees in the northwest to 0 degrees in the western part of the county.

The subtle faulting of the broad syncline of the Catskill formation is not readily detectable with the exception of some noted keystone or splay faulting along closely spaced joints. The joint orientation in the northwest ranges from N 42 degrees to N 55 degrees W. In the northeast part of the county, the joint sets are roughly between 58 degrees W to N 74 degrees W.

4.2 SITE GEOLOGY

Overburden. Based on information in the Phase I RI and the IRM report (M&E, 1992c; EPS, 1992), a thin layer of overburden or fill overlays bedrock. The overburden is composed of brown to red silt and fine to coarse sand with varying amounts of gravel. Natural overburden at the site is mapped as a till (USGS, 1987).

Overburden/fill is as much as 17 feet thick. Up to several feet of weathered bedrock overlies competent bedrock.

Bedrock. Bedrock encountered in rock core in the Phase I RI is identified as shale and siltstone of the Catskill formation (M&E, 1992c). Shale encountered was reddish brown to green or grey in color. A bed of dark green-grey siltstone was encountered during bedrock coring at MW-4, MW-5, and MW-6. The upper contact of this siltstone was gradational with a reddish-brown mottled shale. The lower contact consisted of a sharp contact, possibly erosional, with the underlying reddish brown shale.

Fracture trace analysis performed during the Phase II RI included Brunton® measurements of bedding strike/dip and joint trend/plunge. Locations of bedrock outcrops and Brunton® compass data are shown in Figure 4-1. Bedrock outcrop observations noted bedding plane fractures (i.e., fractures approximately parallel to bedding dip) were common in shale and almost non-existent in siltstone. Vertical joints were also observed to be more frequent in shale than siltstone. Joints were observed to trend in two directions. Results as follows:

- Bedding at the site strikes N 70 degrees W, dips 9 degrees SW (away from river)

- Joints trend (a) N 60 degrees E and (b) N 40 degrees W, plunging an average of 82 degrees from horizontal. (Note: the joint sets in the shale were measured in Phase I to trend North 30 degrees East and North 60 degrees West [M&E, 1992d], no data are provided).

Fracture trace analysis included review of available topographic maps and aerial photographs to identify lineaments (large scale linear features) suggestive of vertical fracture zones or faults (see Figure 4-1). This analysis identified an estimated five lineaments (denoted L-1 through L-5 on Figure 4-1), including two that are interpreted to cross portions of the site (L-1 and L-4). Lineaments are observed to be roughly parallel to the directions of vertical joints measured in the outcrop compass measurements in the southern and eastern portions of the site and do not appear to be reflected in joint measurements to the north of the site. As lineaments were interpreted from the locations of linear patterns of streams and topography, no apparent width of these features or their interrelationship with other lineaments can

be determined. In addition, lineaments could not be observed to have expression in the outcrops mapped in the fracture trace analysis (e.g., no discernable significant vertical fracture zones or bedding offsets were observed).

Based on the results of bedrock core descriptions from the Phase I RI and results of fracture trace analysis and borehole geophysical logging performed in the Phase II RI (see Subsection 2.2.7.3), two interpretive geologic cross sections (denoted A-A' and B-B') have been prepared (see Figure 4-2). Cross section A-A' is oriented from upgradient well MW-1-1 to MW-112 and Catskill Creek, approximately along the direction of groundwater flow. Cross section B-B' is oriented approximately perpendicular to A-A', paralleling Route 145.

The cross sections in Figure 4-2 show that bedrock is composed of several stacked shale and siltstone units, with some apparent vertical offsets or faults. The locations of the offsets or faults are interpreted from borehole geophysical logging results. Siltstone units form the steep changes in local topography such as the bluff above Catskill Creek. Although the fracture trace attempted to identify the location of fault zones, and some boreholes were sited specifically along interpreted lineaments, packer test and borehole logging data do not show that borings were successfully placed. It is believed that these zones would be significant pathways for groundwater flow beneath the site. The interpreted bedrock offsets observed in cross section A-A' (between MW-108D and MW-106D) and cross section B-B' (between MW-6 and MW-113) may represent an unmapped lineament or L-1 in cross section A-A' and L-2 in cross section B-B'.

4.3 REGIONAL HYDROGEOLOGY

Groundwater in Greene County occurs in both consolidated bedrock and unconsolidated deposits. Bedrock in Greene County can be categorized, with respect to hydrogeologic conditions, into three principal groups (Berdan, 1954). The first is comprised of shales and sandstones of the Deepkill and Normanskill formations found in a north-south belt from the Hudson River westward to a point several miles beyond U.S. Route 9W. Although these units have been highly deformed, their water bearing properties are relatively poor, with wells situated within these units yielding from 0.5 to 32 gpm and an average yield of 10 gpm (no borehole lengths are specified). The second group is comprised of water-bearing units ranging in age from

late Silurian to middle Devonian including the Rondout and Manlius Limestones, Helderberg Group, Onondaga limestone and Bakoven shale. These units consist of alternating limestones and shales occurring in a narrow north-south belt 1 to 2 miles wide, parallel to the Hudson Valley. The beds have been moderately deformed creating joints and openings along bedding planes in the limestones which are commonly enlarged by solution. In the shales, groundwater occurs chiefly in joints and zones of fracture cleavage. In general, this second group yields small to moderate supplies to wells on the order of 1 to 30 gpm. The third group comprises the Mount Marion, Ashokan and Catskill formations. The rocks of this group underlie the remaining 90 percent of the area in the county. The Catskill formation is the most important of the three members of this group as it underlies the Becker site. Although the Catskill formation is relatively undeformed, it contains numerous joints which are the primary source of groundwater in this formation. Joints commonly extend to considerable depths. In addition, many of the sandstones have substantial primary porosity. Well yields are found to range from 14 to 20 gpm with an average of 17 gpm.

Pleistocene stratified sand and gravel deposits are a variable source of water within the unconsolidated materials in Greene County. The alluvial sand, silt, and gravel beds yield little water and are located primarily along the stream valleys in Greene County. These deposits are significant to Vly and West Kill Creeks.

Glacial drift deposits are up to 200 feet thick in some locations in the county. Deposits of sand and gravel were formed from deltas at the margin of glacial lakes and glacial outwash. The beds of fine to coarse sand with lenses of gravel are the most productive source of water in the unconsolidated units.

The glacial till deposits found extensively in Durham, Greenville, and western Cairo Townships are of little substance as a source of water. Wells in the till overburden obtain water from lenses of sand but are not generally good sources of water.

There are several lacustrine deposits of clay and silt throughout the county. These are also poor sources of water except where there are lenses of sand present.

4.4 SITE HYDROGEOLOGY

Site hydrogeologic characteristics are interpreted from results of the Phase I RI (M&E, 1992c) and results of the Phase II RI hydrogeologic investigations.

4.4.1 Packer Testing Results

Results of packer testing of boreholes MW-4, MW-5, and MW-6 from the Phase I RI are presented in Table 3-1 in the Phase I report (M&E, 1992c). Phase II RI packer testing results from boreholes MW-101, MW-102D, MW-105D, MW-106D, MW-108, MW-109, MW-110D, MW-111, MW-112, and MW-113 are summarized in Table 4-1. Phase I RI results were evaluated as detailed in Phase I Report (M&E, 1992c). The Phase II hydraulic conductivity values were calculated using the following equation (ABB-ES, 1994a):

$$K = Cx(Q/2x3.14xLxH)xln(L/r)$$

where:

K	=	hydraulic conductivity
Q	=	flow rate
L	=	length of test section
H_T	=	differential head on the test section
r	=	radius of borehole
C	=	conversion factor

Results of packer testing are given in centimeters per second (cm/sec) in Table 4-1. The average hydraulic conductivity values obtained from the bedrock boreholes tested during the Phase II RI range from $1.53x10^{-3}$ cm/sec to less than $1x10^{-6}$ cm/sec. This is within the range identified in the Phase I RI and concurs with literature for hydraulic conductivities of fractured sedimentary and metamorphic rock units (Freeze and Cherry, 1979). Results show some boreholes have almost no flow (MW-102D), and others are highly variable with depth (MW-105D). Results of packer testing provide only approximate values of K since they are based on several simplifying assumptions and do not take into account the flow of water from the test section back to the borehole (U.S. Bureau of Reclamation, 1968). Because of the

heterogeneous and anisotropic nature of water-bearing rock formations, K value is referred to a apparent gross hydraulic conductivity.

4.4.2 Slug Test Results

Rising and falling head slug test were performed in 18 wells and piezometers during the Phase II RI. Results are summarized in Table 4-2. Data was collected using a 10 psi pressure transducer and Hermit data logger (see Section 2.2.11) and analyzed using Aqtesolv™ software and the Bouwer and Rice slug test solution for unconfined aquifers (Bouwer and Rice, 1976).

Eleven bedrock wells were tested. Bedrock K values ranged from $3.4x10^{-7}$ to $9.7x10^{-3}$ cm/sec, with an arithmetic average of $1.4x10^{-3}$ cm/sec and a geometric mean of $1.8x10^{-4}$ cm/sec. Bedrock wells with the highest K values are MW-5 and MW-108.

The overburden/shallow bedrock K values were measured in seven wells/ piezometers. Of the seven shallow wells and piezometers tested (see Table 4-1) only MW-103 is screened totally in fill material and native soil; all others are screened in native soil and weathered bedrock (PZ-4, PZ-6, MW-102D, MW-104, MW-105S, MW-106S, MW-107 and PZ-110). The range of K values for these deposits ranged from $1.5x10^{-7}$ to $7.6x10^{-3}$ cm/sec with an arithmetic average of $1.1x10^{-3}$ cm/sec and a geometric mean of $6.7x10^{-5}$ cm/sec. The shallow well with the highest K is MW-107.

Results of the hydraulic conductivity testing show (by comparison of geometric means) that bedrock is roughly one order of magnitude more permeable than overburden deposits. The Bouwer and Rice solution for unconfined aquifers is believed to be appropriate for the bedrock aquifer because artesian condition were not encountered, and on-site bedrock/overburden well pairs showed downward gradients, which is discussed in Subsection 4.4.4.

4.4.3 Pumping Test Results

An aquifer pumping test was performed in bedrock as part of the Phase I RI (M&E, 1992c). The test included a step drawdown test and a constant rate pumping test. The step drawdown test obtained a 50 gpm discharge rate selected for the constant rate pumping test. The constant rate pumping test was performed for 25.5 hours; results are summarized as follows:

- The constant withdrawal of water from Becker WSW-2 during the test formed an elliptical cone of depression whose long axis is oriented NE-SW. This elliptical cone is defined from observations from bedrock wells MW-4, MW-5, MW-6, and Becker WSW-3 (ABB-ES notes that at the time of the pumping test MW-6 was receiving significant recharge from overburden and this biased the results).

- The only overburden well installed at the site during the Phase I RI, water table well MW-2S (located near Becker WSW-2), did not exhibit any drawdown during the test. This indicates that the overburden is not hydraulically similar or connected directly with the bedrock aquifer.

- Transmissivity (T) values were obtained using the Theiss nonequilibrium equation for Becker WSW-3 and MW-5. Their respective T values of 4,900 and 4,500 gpd/ft, when used to calculate the storage coefficients (S) of each well, produces S values of $3.6x10^{-5}$ and $8.9x10^{-5}$.

- Based on the results of S and T, K values were estimated at Becker WSW-3 and MW-5. Using an estimated aquifer thickness based on the static water level in Becker WSW-2 prior to the pumping test, Becker WSW-3 and MW-5 K values are estimated to be $6.5x10^{-4}$ and $7.2x10^{-4}$ cm/sec, which concur with the average hydraulic conductivity values obtained from Phase I RI bedrock packer testing, and are within an order of magnitude of the bedrock geometric mean hydraulic conductivity from Phase II RI slug testing.

4.4.4 Groundwater Flow Conditions

Groundwater exists at the site generally as two aquifer systems; a shallow perched aquifer in fill/overburden/shallow bedrock, and a deeper bedrock aquifer. The perched aquifer is shallow, encountered generally between 1 and 11 feet bgs. The water table in bedrock is encountered deeper, generally 4 to 38 feet bgs. Groundwater flow in the bedrock and shallow aquifers is predominantly west to east toward Catskill Creek. Groundwater elevation contour maps for the overburden and bedrock based on groundwater elevation data collected on October 1, 1994 are

presented in Figures 4-3 and 4-4, respectively. Groundwater elevation measurements for two dates (August 22, 1994 and October 1, 1994) are presented in Table 4-3.

Groundwater flows beneath the site in both overburden and bedrock aquifers from areas of high topographic elevation, west and southwest of the site, toward Catskill Creek (see Figures 4-3 and 4-4). Horizontal hydraulic gradients in the overburden aquifer flatten (evidenced by wider spaced contour lines) in the middle of the site due to the influence of the Becker manufacturing building, and are also affected by the drainage ditches on the north side of the building, and on the west where bedrock outcrops occur (see Figure 4-3). Overall, the perched groundwater in overburden beneath the leachfield/debris pile area is believed to infiltrate downward into bedrock or be intercepted by the on-site drainage ditch system, which is trenched into bedrock at this part of the site.

Horizontal groundwater flow in bedrock appears to vary based on elevation. To interpret the general direction of flow, wells with screens installed between 420 and 450 feet MSL (roughly correlating to the depth between two interpreted siltstone beds), were used to assess bedrock groundwater (see Figure 4-4). This contour map of groundwater elevations for this depth interval show groundwater horizontal gradients are fairly low beneath the site (water elevations vary from approximately 474 to 470 ft MSL), and at approximately NYS Route 145, gradients steepen sharply as groundwater elevations drop to approximately 450 ft MSL. Groundwater flow direction in bedrock from the debris pile/leachfield area is angled toward the abandoned Weldon House property; groundwater flow from the chemical storage building area is directly toward Catskill Creek.

Groundwater elevations from bedrock wells outside the interval of 420 to 450 ft MSL deviate from the "smooth" bedrock conditions observed from wells within the depth interval. In particular, the well with the lowest water elevation is MW-113; during drilling groundwater was encountered in overburden/weathered bedrock at approximately 3 feet bgs, likely due to the proximity of the nearby stream. During borehole development and subsequent borehole geophysical logging, water temperature was higher in MW-113 than other bedrock boreholes, suggesting significant recharge was occurring from shallow groundwater. After the well was installed deep in the borehole and sealed, the water level dropped to approximately 411 ft MSL. This level is approximately 60 feet deeper than that measured in MW-6 located approximately 415 feet northwest of MW-113.

Wells MW-102S and MW-109, screened above 450 feet MSL have elevations near 465 feet MSL, 10 feet in elevation shallower than the deeper wells in the vicinity. This may indicate that deeper groundwater is confined beneath a bedrock layer.

Observations of different water levels present at different depths in bedrock indicate that portions of the site may be behaving as semiconfined (possibly with the siltstone bed(s) and shale acting as aquitards), and other portions of the site behaving as unconfined and/or perched. Overall, the cause of this hydrogeologic behavior is likely due to both the horizontal layered nature of the bedrock formation underlying the site and the vertical fracture system imposed on the rock.

Seepage velocities have been estimated from measured horizontal hydraulic gradients and hydraulic conductivities, and estimated porosities for the Becker site. Horizontal gradients (iH) in overburden range from approximately 0.021 feet per foot (ft/ft) to 0.063 ft/ft, with a geometric mean of 0.035 ft/ft. The seepage velocity is estimated using the following equation:

$$\text{Seepage Velocity} = K(iH)/n$$

where K is the hydraulic conductivity, iH is the horizontal gradient and n is porosity. Calculations for overburden/weathered bedrock were made using a porosity (n) of 30 percent. A bulk bedrock porosity (n) value of 15 percent is estimated for this bedrock aquifer based on information in the literature (Bouwer and Rice, 1976). Groundwater seepage velocities in overburden are estimated to range from $3x10^{-5}$ to 4.52 feet per day with a bulk value of 0.022 ft/day based on the geometric mean values for K (from slug tests) and iH. The large difference in estimated seepage velocities is believed due to the heterogeneous nature of the overburden/weathered bedrock material.

Horizontal gradients in bedrock range from approximately 0.002 ft/ft to 0.0845 ft/ft. Estimated seepage velocities in the bedrock range from $1.27x10^{-5}$ to 15.4 ft/day, with a bulk value of 0.051 ft/day based on the geometric mean values of K (from slug tests) and iH. The large difference in estimated seepage velocities is believed due to the heterogeneous nature of fractured bedrock at the site.

At locations where well/piezometer pairs were installed during the Phase II RI, vertical hydraulic gradients (iV) have been calculated for two rounds of water level

data (see Table 4-1). Vertical gradients between overburden and bedrock on-site are calculated to be between -0.09 ft/ft to -1.25 ft/ft (i.e., downward). Vertical gradients between overburden and bedrock off-site adjacent to Thorp Creek and Catskill Creek are calculated to be between +0.26 to +0.29 ft/ft (i.e., upward). Vertical hydraulic gradients vary with respect to location. Gradient directions are indicated with arrows on the groundwater contour maps (see Figures 4-3 and 4-4). Upward groundwater flow, or discharge, is measured along Thorp and Catskill Creeks.

In summary, groundwater flows beneath the site from west to east in the two aquifer systems (overburden and bedrock). Flow is faster in the more permeable bedrock than the overburden. Groundwater recharge occurs at the site, although some shallow groundwater is intercepted by on-site drainages. Groundwater discharge occurs east of the site along Thorp Creek and Catskill Creek.

Travel time for groundwater in bedrock to cross from the western boundary of the site and discharge to Catskill and Thorp Creeks (approximately 1,200 feet away) is estimated to be 65 years based on the bulk seepage velocity of 0.051 ft/day. The closest source of contamination, the chemical storage building, is located approximately 570 feet from the creeks; travel time from this part of the site to the creeks is estimated to be 31 years. Because of the time of use of the chlorinated solvent 1,1,1-TCA at the site (beginning in 1976) and surrounding area wells were found to contain at least traces of 1,1,1-TCA three years later (1979), it is believed that the estimates above are conservative; flow in significant fractures will be much faster, possibly approaching the estimated maximum seepage velocity of 15.41 ft/day in major fractures.

Figure 4-1 Results of Fracture Trace Analysis and Locations of Geologic Cross Sections A-A' and B-B'

Figure 4-2 Geologic Profiles A-A' and B-B'

Figure 4-3 Interpreted Overburden Groundwater Contour Map

Figure 4-4 Interpreted Bedrock Groundwater Contour Map

TABLE 4-1
RESULTS OF PHASE II RI PACKER TESTING

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

WELL	INTERVAL (feet)	HT (feet)	HP (PSI)	HG (feet)	AVG TEST K (feet/day)	AVG TEST K (cm/sec)
MW-101D	45-56	76.8	13	46.77	BDL	BDL
MW-101D	55-66	81.9	15	47.32	BDL	BDL
MW-101D	70-81	48.9	0	48.92	2.19E+00	7.74E-04
MW-102D	33-44	38.9	10	15.81	BDL	BDL
MW-102D	44-55	50.4	15	15.81	BDL	BDL
MW-102D	56-67	62.0	20	15.81	BDL	BDL
MW-102D	65-76	59.8	19	16.01	BDL	BDL
MW-105D	19-30	21.3	0	21.34	4.34E+00	1.53E-03
MW-105D	30-41	60.6	17	21.34	2.01E-02	7.10E-06
MW-105D	40-51	49.5	12	21.84	BDL	BDL
MW-105D	51-62	90.8	30	21.54	7.39E-02	2.61E-05
MW-106D	21-32	48.5	12	20.79	8.65E-02	3.05E-05
MW-106D	31-41	42.7	9	21.92	BDL	BDL
MW-106D	41-52	75.0	23	21.91	4.50E-01	1.59E-04
MW-106D	51-62	92.1	30	22.89	1.75E-01	6.16E-05
MW-108	20-30	46.0	11	20.61	8.48E-01	2.99E-04
MW-108	30-41	60.0	17	20.81	2.64E-01	9.31E-05
MW-108	40-51	74.4	23	21.31	4.43E-01	1.56E-04
MW-108	51-64	39.3	8	20.81	3.39E+00	1.20E-03
MW-109	32-43	82.9	20	36.72	1.18E-02	4.15E-06
MW-109	43-54	110.5	32	36.72	6.70E-02	2.37E-05
MW-109	53-64	105.9	30	36.72	4.60E-03	1.62E-06
MW-109	64-75	119.8	36	36.72	BDL	BDL
MW-110D	20-31	47.4	12	19.76	1.06E+00	3.72E-04
MW-110D	30-41	54.2	15	19.58	3.40E-02	1.20E-05
MW-110D	41-52	77.5	25	19.84	1.37E-02	4.84E-06
MW-110D	51-62	55.6	15	20.98	BDL	BDL
MW-111	34-44	60.5	10	37.47	8.05E-03	2.84E-06
MW-111	40-51	97.0	25	39.37	1.51E-02	5.32E-06
MW-111	51-62	108.3	30	39.07	2.16E-02	7.63E-06
MW-111	62-72	80.3	18	38.77	BDL	BDL
MW-111	73-84	86.7	21	38.27	BDL	BDL
MW-111	84-95	95.2	25	37.57	BDL	BDL
MW-112	32-43	55.0	9	34.2	BDL	BDL
MW-112	41-52	93.4	25	35.7	2.93E-01	1.03E-04
MW-112	53-64	103.4	30	34.2	3.96E-02	1.40E-05
MW-112	64-74	75.8	18	34.3	BDL	BDL
MW-112	73-84	132.1	42	35.2	3.61E-02	1.27E-05
MW-112	85-95	92.7	25	35.05	BDL	BDL
MW-113	19-30	35.9	12	8.24	5.66E-02	2.00E-05
MW-113	29-40	29.6	9	8.84	BDL	BDL
MW-113	40-51	43.0	15	8.44	BDL	BDL
MW-113	50-61	48.0	17	8.74	BDL	BDL

Notes:

1. Average K values above were calculated as detailed in the QAPP (ABB-ES, 1994a).
BDL - No flow detectable for the time period tested.
HT - Differential head on test section
HP - Test gauge pressure
HG - Height of gauge above water level in borehole (elevation head)
K - hydraulic conductivity

TABLE 4-2
SUMMARY OF HYDRAULIC CONDUCTIVITY VALUES - SLUG TESTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

MONITORING WELL	SCREENED INTERVAL MATERIAL	WELL DEPTH (ft bgs)	CASING RADIUS (ft)	BOREHOLE RADIUS (ft)	LENGTH SAND PACK (ft)	STATIC DEPTH TO WATER (ft)	HEIGHT WATER COLUMN (ft)	SATURATED THICKNESS (ft)	INITIAL DISPLACEMENT (ft)	TEST TYPE	NOTES	HYDRAULIC CONDUCTIVITY (ft/min)	HYDRAULIC CONDUCTIVITY (cm/sec)
PZ-4	OVERBURDEN	24	0.08	0.17	10	8.2	15	15	0.29	FALLING		3.0E-07	1.5E-07
PZ-4	OVERBURDEN	24	0.08	0.17	10	8.2	15	15	3.43	RISING		7.0E-07	3.6E-07
MW-103	OVERBURDEN	9	0.08	0.34	6	2.7	6	6	1.14	FALLING	*	1.3E-04	6.6E-05
MW-103	OVERBURDEN	9	0.08	0.34	6	2.7	6	6	1.77	RISING		2.2E-04	1.1E-04
MW-104	OVERBURDEN	20	0.08	0.17	13	2.11	18	30	3.43	RISING		4.1E-04	2.1E-04
MW-104	OVERBURDEN	20	0.08	0.17	13	2.11	18	30	3.42	RISING		4.0E-04	2.0E-04
MW-105S	OVERBURDEN	22.5	0.08	0.17	15.7	6.29	16	16	3.29	FALLING		5.1E-05	2.6E-05
MW-105S	OVERBURDEN	22.5	0.08	0.17	15.7	6.29	16	16	2.29	RISING		4.5E-06	2.3E-06
MW-106S	OVERBURDEN	23	0.08	0.17	13	2.37	20	20	3.9	FALLING		4.9E-05	2.5E-05
MW-106S	OVERBURDEN	23	0.08	0.17	13	2.37	20	20	3.42	RISING		5.3E-05	2.7E-05
MW-107	OVERBURDEN	20	0.08	0.17	14	5.52	10	30	2.65	FALLING	*	7.2E-03	3.7E-03
MW-107	OVERBURDEN	20	0.08	0.17	14	5.52	10	30	4.32	RISING		1.5E-02	7.6E-03
MW-110S	OVERBURDEN	21.5	0.08	0.21	13.5	11.23	12	12	1.7	FALLING	*	3.4E-03	1.7E-03
MW-110S	OVERBURDEN	21.5	0.08	0.21	13.5	11.2	12	12	2.28	RISING		2.1E-03	1.1E-03
MW-4	BEDROCK	38.2	0.08	0.15	17.2	12.6	25	65	1.95	FALLING	*	1.3E-03	6.6E-04
MW-4	BEDROCK	38.2	0.08	0.15	17.2	12.6	25	65	3.11	FALLING	*	1.3E-03	6.6E-04
MW-4	BEDROCK	38.2	0.08	0.15	17.2	12.6	25	65	2.63	RISING		8.0E-04	4.1E-04
MW-5	BEDROCK	61.2	0.08	0.15	16.2	13.58	40	65	2.29	FALLING	*	6.7E-03	3.4E-03
MW-5	BEDROCK	61.2	0.08	0.15	16.2	13.6	40	65	3.21	RISING		4.8E-03	2.4E-03
MW-6	BEDROCK	48.3	0.08	0.15	15.3	14.43	30	65	2.95	FALLING		3.1E-05	1.6E-05
MW-6	BEDROCK	48.3	0.08	0.15	15.3	14.4	30	65	3.27	RISING		3.0E-05	1.5E-05
MW-101D	BEDROCK	85.1	0.08	0.21	14.1	37.76	47	65	0.32	FALLING		1.4E-03	7.1E-04
MW-101D	BEDROCK	85.1	0.08	0.21	14.1	37.8	47	65	3.05	RISING		8.6E-03	4.4E-03
MW-102S	BEDROCK	37	0.08	0.21	17	11.52	10	10	0.66	FALLING		1.0E-03	5.1E-04
MW-102S	BEDROCK	37	0.08	0.21	17	11.5	10	10	2.06	RISING		1.3E-03	6.6E-04
MW-105D	BEDROCK	62	0.08	0.21	14	14.86	48	65	3.86	FALLING		2.5E-04	1.3E-04
MW-105D	BEDROCK	62	0.08	0.21	14	14.9	48	65	3.24	RISING		3.3E-04	1.7E-04
MW-106D	BEDROCK	62	0.08	0.21	18	14.08	58	58	2.88	FALLING		5.1E-04	2.6E-04
MW-106D	BEDROCK	62	0.08	0.21	18	14.1	58	58	3.2	RISING		5.9E-04	3.0E-04
MW-108	BEDROCK	63.8	0.08	0.21	15.8	13.87	40	65	3.18	FALLING		1.9E-02	9.7E-03
MW-108	BEDROCK	63.8	0.08	0.21	15.8	13.9	40	65	3.37	RISING		1.6E-02	8.1E-03
MW-110D	BEDROCK	50.2	0.08	0.21	17.2	4.27	48	49	3.11	FALLING		7.5E-05	3.8E-05
MW-110D	BEDROCK	50.2	0.08	0.21	17.2	4.27	48	49	3.34	RISING		5.8E-05	2.9E-05
MW-111	BEDROCK	69	0.08	0.21	18	38.2	33	33	3.51	FALLING		3.4E-05	1.7E-05
MW-111	BEDROCK	69	0.08	0.21	18	38.2	33	33	3.41	RISING		3.7E-05	1.9E-05
MW-112	BEDROCK	89	0.17	0.21	20	30	59	65	3.18	FALLING		6.6E-07	3.4E-07
MW-112	BEDROCK	89	0.17	0.21	20	30	59	65	0.96	FALLING	*	2.4E-06	1.2E-06

NOTES:

ft bgs - FEET BELOW GROUND SURFACE
ft - FEET
ft/min - FEET PER MINUTE
cm/sec - CENTIMETERS PER SECOND
STATIC DEPTH TO WATER IS FT BELOW GROUND SURFACE
* - DENOTES TEST WHERE SLUG WAS WITHIN VOLUME OF DISPLACED WATER, RESULTING IN ARTIFICIALLY HIGHER RESULT.

TABLE 4–3
SUMMARY OF PHASE II WATER LEVEL OBSERVATIONS AND VERTICAL HYDRAULIC GRADIENTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

WELL/GAUGE	GROUND ELEVATION (ft, MSL)	CASING ELEVATION (ft, MSL)	ELEVATION, BOTTOM OF SCREEN (ft, MSL)	RISER OR REFERENCE ELEVATION (ft, MSL)	WATER LEVEL (ft, MSL) ROUND I 8/22/94	WATER LEVEL (ft, MSL) ROUND II 10/01/94	VERTICAL HYDRAULIC GRADIENT (1) ROUND I	VERTICAL HYDRAULIC GRADIENT (1) ROUND II
MW–4 (2)	486.2	488.13	451.2	487.98	473.47	472.98		
PZ–4	486.4	488.62	462.4	488.62	476.92	477.94	–0.3080357	–0.4428571
MW–5 (2)	486.2	489.46	426.4	489.31	472.66	473.94		
MW–6 (2)	486.4	488.63	438.4	488.46	471.91	472.1		
PZ–6	485.9	488.64	465.7	488.38	477.33	477.12	–0.1985347	–0.1838827
MW–101D	511.9	514.53	427.9	514.2	473.06	474.32		
MW–102S	500.7	503.21	464	503.31	466.57	464.87		
MW–102D	500.9	503.09	482.9	502.94	488.86	488.68	–1.1793650	–1.2597883
MW–103	503.6	505.56	494.6	505.65	501.73	500.46		
MW–104	485.3	487.53	465.3	487.39	482.47	481.87		
MW–105S	486.4	488.57	464.1	488.4	481.87	481.76		
MW–105D	486.6	488.59	425.6	488.5	471.1	471.57	–0.2797402	–0.2646753
MW–106S	486.5	488.57	463.5	488.85	484.41	482.89		
MW–106D	486.9	488.63	429.9	488.49	471.96	473.08	–0.3705357	–0.2919642
MW–107	482.2	486.5	462.2	486.36	478.68	477.32		
MW–108	487.5	490.04	426.5	489.85	472.73	474.05		
MW–2S	487.39	487.39	480.04	487.04	486.51	485.85	–0.2573776	–0.2203959
MW–109	504	506.1	454	505.92	465.27	463.45		
PZ–110	456.63	456.63	435.63	456.12	445.33	444.75		
MW–110D	456.55	456.55	411.55	456.23	451.51	451.45	0.25664451	0.27823920
MW–111	484.6	485.96	420.6	485.76	447.08	447.22		
MW–112	480.1	482.12	396.1	481.83	449.98	450.64		
MW–113	474.79	476.12	410.79	475.95	413.21	410.87		
MW–1–EPS	487.91	487.91	477.91	487.55	485.85	484.97		
MW–3–EPS	487	490.85	474.3	489.71	484.38	482.3		
MW–4–EPS	487	490.63	482.2	490.3	485.43	484.78		
MW–5–EPS	487.3	490.84	475	490.58	485.57	483.65		
MW–BOX	487.6	490.04	487.6	490.04	481.78	481.91		
MW–TANK	486.6	489.75	486.6	489.75	485.8	DRY		
MW–SPILL	487.3	490.84	487.3	490.84	485.39	484.78		

TABLE 4–3
SUMMARY OF PHASE II WATER LEVEL OBSERVATIONS AND VERTICAL HYDRAULIC GRADIENTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

WELL/GAUGE	GROUND ELEVATION (ft, MSL)	CASING ELEVATION (ft, MSL)	ELEVATION, BOTTOM OF SCREEN (ft, MSL)	RISER OR REFERENCE ELEVATION (ft, MSL)	WATER LEVEL (ft, MSL)		VERTICAL HYDRAULIC GRADIENT (1)	
					ROUND I 8/22/94	ROUND II 10/01/94	ROUND I	ROUND II
MW–STS–3	486.61	489.58	486.61	489.58	485.72	483.96		
STREAM GAUGE #A (3)				440.25	NS (4)	440.44		
STREAM GAUGE #B (3)				435.08	NS (4)	435.58		
BRIDGE REF. (3)				458.52	440.96	440.39		

Notes:

(1) Vertical hydrualic gradients in feet per foot. Negative numbers indicate downward gradient
(2) MW–4, MW–5, and MW–6 are previous wells which have been reconstructed; Phase II RI water level data from these wells are not comparable to Phase I RI data.
(3) Stream Gauge #A and Bridge Ref. located at Rt. 67A Bridge; Stream Gauge #B located at confluence of Thorp and Catskill Creek.
(4) NS – Not surveyed on date indicated.

5.0 NATURE AND DISTRIBUTION OF CONTAMINATION

This section describes the laboratory analytical results for samples collected during the 1990 Phase I RI (M&E, 1992c) and Phase II RI sampling, and identifies site contaminants. Identification of site contaminants was accomplished as described in Subsection 2.5.

To assess the nature and distribution of contamination at the Becker site, the site has been separated into several operable units: (1) septic system no. 1; (2) septic system no. 2/debris pile area; (3) septic system no. 3; (4) chemical storage building area; (5) site drainages/surface water bodies; and (6) groundwater. Results are presented in Figures 5-1 through 5-15 and summarized in this subsection by operable unit.

5.1 SOIL/DEBRIS/SEPTIC TANK RESULTS

Soil, debris, and septic tank water and sediment samples from Phase I and Phase II were collected for laboratory analysis for TCL VOCs, SVOCs, pesticides/PCBs, and metals.

5.1.1 Septic System No. 1

Septic system no. 1 reportedly received only sanitary waste from the eastern portion of the Becker manufacturing building (M&E, 1992c).

Samples collected from septic system no. 1 during the Phase I RI are septic tank sediment/water samples ST-1-SD/SW and subsurface soil sample ST-1-TP (see Figure 5-1).

Water from the septic tank (ST-1-SW) contained the VOCs 1,1-dichloroethane (DCA) (9 μg/L) and 1,1,1-TCA (27 μg/L), and several inorganics including iron (1,720 μg/L) and lead (20.7 μg/L). SVOCs and pesticides/PCBs were not detected.

Sediment from the septic tank and subsurface soil from the leachfield did not contain VOCs or pesticides/PCBs. SVOCs detected in the samples include 1,4-dichlorobenzene (up to 540 μg/kg); the PAHs fluoranthene (up to 450 μg/kg),

pyrene (up to 260 μg/kg), chrysene (up to 140 μg/kg), and benzo(b)fluoranthene (up to 140 μg/kg); and the phthalates di-n-butylphthalate (320 μg/kg), butylbenzylphthalate (up to 480 μg/kg), bis(2-ethylhexyl)phthalate (BEHP) (up to 11,000 μg/kg), and di-n-octylphthalate (up to 610 μg/kg). Inorganics present in soil at concentrations exceeding background are copper, mercury, and zinc.

No additional sampling of media at septic system no. 1 was performed during the Phase II RI.

5.1.2 Septic System No. 2/Debris Pile Area

Septic system no. 2 reportedly received discharges from the Becker manufacturing building paint shop (fume hood cascade water) and parts cleaning baths (M&E, 1992c).

5.1.2.1 Phase I Samples. Samples collected from septic system no. 2 and debris pile area during the Phase I RI are septic tank sediment sample ST-2-SD, inlet pipe sediment sample PP-1; outlet pipe water sample ST-2-DPW; subsurface soil samples ST-2-SL, BL-1 and BL-2; and surface soil samples SS-3 through SS-10 and SS-19 (see Figures 5-2 and 5-3).

Septic System Samples. Samples PP-1 (liquid) and ST-2-SD (sediment) were collected to characterize the contents of the septic system to identify likely contaminants that could have been discharged to the leachfield and assess whether the structure is a potential continuing source of contamination (see Figure 5-3). VOC results from sample PP-1 from the Phase I RI are all rejected (unusable). VOCs detected in sediment sample ST-2-SD from the septic tank adjacent to the manufacturing building include chloroethane (380 μg/kg), 1,1-DCA (76 μg/kg), 1,1,1-TCA (53 μg/kg) and toluene (54 μg/kg). SVOCs detected in ST-2-SD include benzoic acid (up to 11,000 μg/kg), the PAH 2-methylnaphthalene (up to 1,100 μg/kg), and the phthalates di-n-butylphthalate (up to 650 μg/kg) and BEHP (38,000 μg/kg). Sample PP-1 contained the same SVOCs, at similar concentrations. Pesticides/PCBs were not detected in the samples. Metals detected in ST-2-SD at concentrations exceeding background concentrations for soil (see Table 2-12) are cadmium, manganese, and zinc. These inorganics were also present in pipe liquid sample PP-1.

A water sample collected from the discharge pipe between the septic tank and the leachfield (liquid sample ST-2-DPW) contained the VOCs 1,1-DCA (31 μg/L) and 1,1,1-TCA (49 μg/L). SVOCs were not detected and the sample was not analyzed for pesticides/PCBs or metals.

Subsurface Soil Samples. Phase I subsurface soil sampling locations (ST-2-SL, BL-1, and BL-2) are shown in Figure 5-3. Subsurface soil samples were collected from 2 to 5 feet bgs. The VOC 1,1,1-TCA (3 μg/kg) was detected in sample ST-2-SL. VOC results for BL-1 (located at the leachfield) are unusable (rejected). VOCs were not detected in the two samples from BL-2 (located between ST-2 and the manufacturing building). SVOCs detected in BL-2 were the phthalates butylbenzylphthalate (up to 170 μg/kg), BEHP (up to 6,700 μg/kg) and di-n-octylphthalate (up to 1,900 μg/kg). SVOC results were non-detect or below Contract Required Quantitation Limits (CRQLs) for samples BL-1 and ST-2-SL. Pesticides/PCBs were not detected in the samples. Metal concentrations were not found to exceed background concentrations in Phase I subsurface soil samples.

Surface Soil Samples. Phase I surface soil sampling locations (SS-3, SS-4, SS-5, SS-6, SS-7, SS-9, SS-8, SS-9, and SS-10) are shown in Figures 5-2 and 5-3. Surface soil samples were collected to characterize soil near the septic tank, the leachfield area, and among surface debris piles. The only VOCs detected in surface soil samples associated with the septic/system no. 2 or debris pile area were methylene chloride (1,800 μg/kg in SS-19) and toluene (9 μg/kg in SS-7 duplicate, 8 μg/kg in SS-9 and 7 μg/kg in SS-10). SVOCs detected in the samples were 1,4-dichlorobenzene (up to 200 μg/kg); the PAHs 2-methylnaphthalene (420 μg/kg in SS-19) and phenanthrene (350 μg/kg in SS-19); and the phthalates butylbenzylphthalate (up to 260 μg/kg), BEHP (up to 14,000 μg/kg) and di-n-octylphthalate (up to 7,400 μg/kg). Pesticides/PCBs were not detected. The only metals exceeding background concentrations for soil were cadmium, lead, and zinc in sample SS-3 (see Figure 5-3).

5.1.2.2 Phase II Samples. Samples collected from the septic system no. 2/debris pile area during the Phase II RI are test pit samples TP-101 through TP-117 and Geoprobe boring samples GP-1 through GP-7. Samples were collected from 2 to 10 feet bgs to characterize the wood debris, buried debris, and subsurface soil and fill materials. Results of test pitting in the debris pile area is shown in Figure 5-2; results of sampling to characterize septic system no. 2 and buried (non-wood) debris and fill is shown in Figure 5-4. Samples were collected for laboratory analysis for

TCL VOCs, SVOCs, and metals; two composite debris samples were also analyzed for TCL VOCs, SVOCs, and metals.

Septic System Samples. Sample PP-1 was collected during Phase II from piping believed to be the same as that sampled in the Phase I RI (see Figure 5-4) to assess concentrations of VOCs remaining in piping. Bitter odors and a PID reading of up to 15 ppm were emanating from the pipe. Sample PP-1 was collected from a pipe cleanout along an outer wall where what is believed to be septic system piping exits the building. TCL VOCs detected in sample PP-1 were 1,1,1-TCA (2 μg/L), 1,1-DCA (32 μg/L), and chloroethane (4 μg/L) (see Figure 5-4).

Subsurface Soil Samples. Subsurface samples were collected during the Phase II RI (a) to characterize subsurface soils beneath the building where an addition (a truck loading dock) was constructed over septic system piping; and (b) to characterize subsurface soil debris and fill in the vicinity of the septic system leachfield.

Subsurface soil samples were collected from TP-125 and GP-1 through GP-7 to characterize soil at the loading dock area (see Figure 5-4). Soil samples were collected from 3 feet bgs to 10 feet bgs. TCL VOCs detected were 1,1,1-TCA (up to 93 μg/kg), 1,1-DCA (up to 38 μg/kg), 1,1-dichloroethene (DCE) (up to 8 μg/kg), chloroethane (up to 0.8 μg/kg), 2-butanone (up to 20 μg/kg), and toluene (up to 0.6 μg/kg). The sample from TP-125 was also analyzed for TCL SVOCs and metals. TCL SVOCs detected were di-n-octylphthalate (1,400 μg/kg) and BEHP (1,100 μg/kg); metals were not detected at concentrations exceeding background in the sample from TP-125.

Subsurface soil samples were collected from TP-111 through TP-117 to characterize soil, debris, and fill in the vicinity of the septic system no. 2 leachfield (see Figure 5-4). Samples were collected from between 2 and 9 feet bgs; piping believed to represent the leachfield (4-inch perforated PVC pipe) was encountered in TP-114; black 2-inch PVC pipe was encountered in TP-111. Isolated, crushed, empty remains of metal drums were encountered in all of the test pits except TP-115.

TCL VOCs were detected in all leachfield area samples except TP-115; in general, the highest concentrations of VOCs were detected in the 3 foot bgs sample from TP-111 (see Figure 5-4). TCL VOCs detected were 1,1,1-TCA (up to 15 μg/kg), 1,1-DCA (up to 28 μg/kg), 2-butanone (up to 17 μg/kg), chloroethane (up to

160 μg/kg), ethylbenzene (up to 19 μg/kg), toluene (up to 39 μg/kg), xylenes (up to 90 μg/kg), and 1,1,2,2-tetrachloroethane (up to 2 μg/kg).

TCL SVOCs were detected in all leachfield area samples except TP-115, TP-116, and TP-117; by far the highest number and total concentration of SVOCs was detected in the 4 feet bgs sample from TP-113 (see Figure 5-4). TCL SVOCs detected in the samples include phenols, naphthalenes, PAHs, and phthalates. The only TCL metals reported in the samples at concentrations exceeding background are arsenic, cadmium, and zinc.

Debris Pile Samples. Ten subsurface soil samples and two composite samples were collected from test pits TP-101 through TP-110 in the debris piles. These test pits were excavated specifically to address whether (a) buried drums were present in the debris piles; (b) debris was contaminated with chlorinated solvents reportedly disposed in the debris; and (c) debris could be considered a hazardous waste. Excavations were advanced as deep as possible to assess the thickness of debris and the depth to bedrock. Analytical results are presented in Figure 5-2. Of the samples collected, the samples from TP-101, TP-102, TP-105, TP-106, TP-107, and TP-110 were of wood debris; the remaining samples were of soil (TP-103, TP-108, TP-109) or other fill (TP-104).

TCL VOCs were not detected in test pits TP-104, TP-105, TP-106, TP-109, and TP-110 samples, or the two composite samples. TCL VOCs detected in the remaining samples were 1,1,1-TCA (up to 12 μg/kg), acetone (530 μg/kg in TP-101 only), ethylbenzene (up to 88 μg/kg), 2-butanone (23 μg/kg in TP-109 only), and xylenes (up to 40 μg/kg). Acetone is a common laboratory contaminant and may not actually be present, although as indicated in Subsection 5.3, acetone was detected in a bedrock groundwater sample downgradient of this area.

The only TCL SVOCs detected in the samples and composites are the phthalates di-n-octylphthalate (up to 58,000 μg/kg) and BEHP (up to 580,000 μg/kg); TCL SVOCs were not detected in TP-104 and TP-109 samples (see Figure 5-2). Results show detections of phthalates in both wood debris and subsurface soil, and the composites concur roughly with debris results. The only TCL metal detected in the debris pile discrete and composite samples at concentrations exceeding site background (for soil) is cadmium.

5.1.3 Septic System No. 3

Septic system no. 3 reportedly received sanitary waste from the northern portion of the Becker manufacturing building (M&E, 1992c).

Samples collected from septic system no. 3 during the Phase I RI are septic tank sediment/water samples ST-3-SD/SW (see Figure 5-5) and subsurface soil sample ST-3-TP. To address potential surface dumping of contaminants in this area, surface soil samples SS-1, SS-2, SS-15, SS-16, and SS-18 were also collected to characterize this area.

Water from the septic tank (ST-3-SW) was non detect for VOCs, SVOCs, and pesticides/PCBs. Inorganic concentrations detected were lower than concentrations in water samples from the other two septic tanks.

Sediment from the septic tank (ST-3-SD) and subsurface soil from the outfall pipe (ST-3-TP) from the leachfield to the drainage ditch did not contain pesticides/PCBs. The only VOC detected was toluene (320 μg/kg in ST-3-SD). SVOCs detected in the samples include 1,4-dichlorobenzene (up to 8,600 μg/kg); the PAHs acenaphthene (up to 680 μg/kg), phenanthrene (up to 47 μg/kg), fluoranthene (up to 940 μg/kg), and pyrene (up to 370 μg/kg); and the phthalates BEHP (up to 170,000 μg/kg); and di-n-octylphthalate (up to 1,700 μg/kg). Inorganics present in ST-3-SD (sediment) at concentrations exceeding soil background are arsenic, beryllium, cadmium, cobalt, copper, lead, magnesium, mercury, vanadium, and zinc.

Surface soil results are presented in Figure 5-5. VOCs were detected only in sample SS-18, located near a building door east of the septic system. TCL VOCs detected in SS-18 were 1,1-DCA (8 μg/kg), 2-butanone (56 μg/kg), 4-methyl-2-pentanone (9 μg/kg), toluene (22 μg/kg), and xylenes (16 μg/kg).

Several TCL SVOCs were detected in the surface soil samples, with the highest numbers and concentrations reported in sample SS-2. SVOCs detected were phenol (54 μg/kg), benzoic acid (up to 540 μg/kg), naphthalene (up to 75 μg/kg), 2-methylnaphthalene (230 μg/kg), acenaphthene (330 μg/kg), dibenzofuran (250 μg/kg), fluorene (240 μg/kg), phenanthrene (up to 1,500 μg/kg), anthracene (190 μg/kg), fluoranthene (up to 1,100 μg/kg), pyrene (890 μg/kg), benzo(a)anthracene (up to 420 μg/kg), chrysene (up to 490 μg/kg),

di-n-butylphthalate (100 μg/kg), BEHP (up to 11;000 μg/kg), di-n-octylphthalate (up to 1,000 μg/kg), benzo(b)fluoranthene (up to 830 μg/kg), benzo(a)pyrene (up to 440 μg/kg), indeno(1,2,3-cd)pyrene (370 μg/kg), and benzo(g,h,i)perylene (400 μg/kg). Pesticides/PCBs were not detected. The only TCL metals exceeding background concentrations for soil were mercury and zinc.

No additional septic system or soil samples were collected in the Phase II RI.

5.1.4 Chemical Storage Building Area

Surface soil and subsurface soil samples were collected from the chemical storage building area in Phase I RI. During the Phase II RI, only subsurface soil samples were collected.

5.1.4.1 Phase I Samples. To address potential surface dumping in this area, surface soil samples SS-11 through SS-14 and SS-17, and subsurface soil samples BL-3 and BL-4 were collected for laboratory analysis during the Phase I RI (see Figure 5-6).

Surface Soil Samples. VOCs detected in surface soil in the vicinity of the chemical storage building were 1,1,1-TCA (up to 750 μg/kg), TCE (22 μg/kg), and toluene (up to 27 μg/kg). The highest concentrations and number of VOCs were in sample SS-11 collected adjacent to the outside waste drum storage pad. SVOCs detected in the samples were benzoic acid (up to 15,000 μg/kg); the PAHs pyrene (up to 130 μg/kg) and chrysene (up to 170 μg/kg); and the phthalates di-n-butylphthalate (up to 3,800 μg/kg); butylbenzylphthalate (up to 2,100 μg/kg); BEHP (up to 45,000 μg/kg); and di-n-octylphthalate (up to 4,400 μg/kg). Pesticides/PCBs were not detected. The only TCL metal exceeding background concentrations for soil is zinc.

Subsurface Soil Samples. VOCs and pesticides/PCBs were not detected in subsurface soil samples from BL-3 and BL-4. SVOCs were not detected in BL-4; SVOCs detected in BL-3 are the phthalates BEHP (910 μg/kg) and di-n-octylphthalate (190 μg/kg). Metals were not detected at concentrations exceeding background for soil.

5.1.4.2 Phase II Samples. Subsurface soil samples collected in the vicinity of the chemical storage building during the Phase II RI are TP-118 through TP-122, and GP-8 and GP-9. Samples were collected from 1 to 6 feet bgs to characterize the

subsurface soil and fill materials encountered (see Figure 5-7). Samples were collected for laboratory analysis for TCL VOCs, SVOCs, and metals; two samples (GP-8 and GP-9) were collected for TCL VOC analysis only.

TCL VOCs were detected in every sample. VOCs detected in the samples were 2-butanone (up to 51,000 μg/kg), 1,1,1-TCA (up to 64,000 μg/kg), TCE (up to 4,800 μg/kg), 2-hexanone (up to 540 μg/kg), PCE (up to 340 μg/kg), 1,1,2,2-tetrachloroethane (up to 4 μg/kg), toluene (up to 2,000,000 μg/kg); ethylbenzene (up to 600,000 μg/kg), and xylenes (up to 3,400,000 μg/kg). Overall, these high concentrations of VOCs were present in samples TP-119, TP-122, and GP-8. These samples were all collected in the vicinity of the drum storage pad outside the chemical storage building.

TCL SVOCs were detected in all samples except TP-118. TCL SVOCs detected were 4-methylphenol (1,300 μg/kg in TP-119), N-nitrosodiphenylamine (110 μg/kg in TP-120), naphthalene (up to 7,800 μg/kg), 2-methylnaphthalene (140 μg/kg in TP-122), phenanthrene (91 μg/kg in TP-122), and pyrene (1,000 μg/kg in TP-119); and the phthalates di-n-octylphthalate (up to 2,000 μg/kg) and BEHP (up to 56,000 μg/kg).

The inorganics detected at concentrations exceeding soil background are arsenic, cyanide, and zinc.

5.2 SURFACE WATER/SEDIMENT RESULTS

5.2.1 Phase I Samples

Surface water and sediment samples were collected from the on-site fire pond and drainage ditches, and from off-site locations along Thorp Creek and Catskill Creek to assess whether these media were contaminant migration pathways and provide data for risk assessment purposes.

5.2.1.1 On-site Sediment and Surface Water Samples. Surface water and sediment samples were collected onsite during the Phase I RI from the fire pond and from drainage ditches draining the site. On-site samples include FP-1-SW/BW/SD to FP-3-SW/BW/SD and DD-1-SW/SD through DD-9-SW/SD. Surface water

results are shown in Figures 5-8 and 5-9; sediment results are shown in Figures 5-10 and 5-11.

Fire pond surface water results are shown in Figure 5-9. VOCs, SVOCs, pesticides/PCBs were not detected in fire pond water samples. Metals detected in fire pond water samples include chromium (up to 62 μg/L) and lead (up to 185 μg/L). The highest metal concentrations are in basal water samples. Metals exceeding background surface water concentrations (see Table 2-13) are beryllium, cadmium, chromium, copper, lead, nickel, and zinc.

Drainage ditch surface water results are shown in Figure 5-8. Surface water samples from drainage ditches contained the VOCs 1,1-DCA (up to 26 μg/L), 1,2-DCE (up to 16 μg/L), 1,1,1-TCA (up to 62 μg/L), TCE (up to 12 μg/L), and benzene (up to 2 μg/L). SVOCs detected were benzoic acid (18 μg/L in DD-9-SW) and BEHP (14 μg/L in DD-2-SW). Pesticides/PCBs were not detected. Metals detected in drainage ditch surface water include chromium (up to 120 μg/L) and lead (up to 125 μg/L). Overall, metals were detected at the highest concentration in sample DD-9-SW, collected from a drainage ditch along the edge of a dirt access road in the debris pile area. Metals exceeding surface water background (see Table 2-13) are beryllium, cadmium, chromium, copper, lead, nickel, and zinc. VOC results appear to confirm a contaminant migration pathway from DD-5-SW to DD-6-SW, and on to DD-8-SW (e.g., from below the debris pile/leachfield area to an off-site drainage ditch along NYS Route 145).

Fire pond sediment results are shown in Figure 5-11. VOCs were not detected in fire pond sediment samples. SVOCs were detected only in fire pond sediment sample FP-2-SD and include: benzoic acid (650 μg/kg), 4-nitrophenol (180 μg/kg), butylbenzylphthalate (44 μg/kg), and BEHP (1,100 μg/kg). The only TCL metal detected in fire pond sediment samples exceeding sediment and soil background concentrations (see Table 2-12) was copper in sample FP-2-SED.

Drainage ditch sediment results are shown in Figure 5-10. VOCs detected in drainage ditch sediment samples are chloroethane (up to 13 μg/kg), 1,1,-DCA (up to 36 μg/kg), and 1,1,1-TCA (up to 28 μg/kg). SVOCs in drainage ditch sediment are 1,4-dichlorobenzene (up to 260 μg/kg), nitrobenzene (up to 59 μg/kg), benzoic acid (up to 390 μg/kg), naphthalene (59 μg/kg), 2-methylnaphthalene (63 μg/kg), acenaphthalene (54 μg/kg), acenaphthene (58 μg/kg), dibenzofuran (55 μg/kg),

diethylphthalate (up to 110 μg/kg), fluorene (59 μg/kg), phenanthrene (150 μg/kg), anthracene (41 μg/kg), di-n-butylphthalate (up to 260 μg/kg), fluoranthene (up to 290 μg/kg), pyrene (up to 290 μg/kg), butylbenzylphthalate (up to 720 μg/kg), benzo(a)anthracene (up to 130 μg/kg), chrysene (up to 170 μg/kg), BEHP (up to 65,000 μg/kg), and di-n-octylphthalate (up to 2,500 μg/kg), benzo(b)fluoranthene (up to 220 μg/kg), benzo(k)fluoranthene (110 μg/kg), benzo(a)pyrene (110 μg/kg), and indeno(1,2,3-cd)pyrene (180 μg/kg). The PCB Aroclor-1254 was detected in one sediment sample (DD-4-SD at 4,100 μg/kg). Pesticides were not detected. Metals exceeding background concentrations for sediment and soil (see Table 2-12) are cadmium and zinc in samples DD-3-SED and DD-4-SED.

5.2.1.2 Off-site Surface Water and Sediment Samples. Downstream surface water and sediment samples were collected from Thorp Creek (DD-TC-1-SW/SD, DD-TC-2-SW/SD) and Catskill Creek (DD-CC-1-SW/SD, and DD-CC-2-SW/SD) at locations interpreted to be either downstream of the site, or in the vicinity of where bedrock groundwater migrating from the site discharges upward into these two water bodies. Results are shown in Figures 5-9 and 5-11.

VOCs were not detected in surface water samples DD-TC-1-SW or DD-CC-2-SW; VOCs detected in DD-TC-2-SW and DD-CC-1-SW were 1,2-DCE (up to 2 μg/L) and TCE (up to 10 μg/L) (see Figure 5-9). SVOCs and pesticides/PCBs were not detected in the samples. Metals were not detected in the samples at concentrations exceeding NYSDEC Class C surface water standards or exceeding background concentrations (see Tables 2-10 and 2-13).

The only VOC detected in sediment samples was toluene (detected only in DD-TC-1-SD at 3 μg/kg) (see Figure 5-11). SVOCs and pesticides/PCBs were not detected. Metals were not detected in sediment samples at concentrations exceeding background for sediment and soil.

5.2.2 Phase II Samples

Samples SW-101 through SW-106 were collected during the Phase II RI to characterize surface water in on-site drainages; three seep samples (SW-107, SW-108, and SW-109) were collected where groundwater discharges from bedrock to Catskill Creek. During the surface water sampling, selected water quality parameters (e.g., temperature, specific conductance, etc.) were measured to ensure that representative

samples were collected, and to provide qualitative data to assess the potential impact to surrounding surface water at the site. Surface water samples were analyzed for TCL VOCs, SVOCs and metals; seep samples were analyzed for TCL VOCs.

5.2.2.1 Water Quality Parameters. The following parameters were measured by ABB-ES personnel during the Phase II RI collection of surface water samples:

- temperature
- pH
- specific conductance
- dissolved oxygen (DO)
- salinity
- turbidity

Water quality data are summarized in Table 5-1. Field water quality data was collected with a Horiba U-10 water quality checker calibrated daily with appropriate standards.

Many inorganic water quality standards in NYS are based on the hardness measurement in aqueous media. Hardness (as milligrams per liter [mg/L] of calcium carbonate [$CaCO_3$]) of surface water and groundwater samples was computed from the TCL inorganic laboratory analytical results by the following equation (Hem, 1989; Standard Methods, 1989):

Hardness [mg $CaCO_3$/L] = 2.497 [Calcium, mg/L] + 4.118 [magnesium, mg/L]

The hardness results are summarized with other water quality data in Table 5-1.

Water quality parameter measurements represent the status of an aqueous medium at the point and moment of sampling, and are used to: (1) monitor water body classification status; (2) qualitatively confirm chemical analysis results; and (3) assess pollution load. NYS water quality parameters of pH and DO content are used to monitor classification of surface water.

Table 2-10 shows the classification limits for pH and DO for maintenance of NYS Class C surface water standards. Surface water samples SW-101 (from the fire pond) and SW-103 (from near the debris piles) do not meet the NYS Class C standard for

pH of between 6.5 and 8.5. Surface water samples SW-104 and SW-105 do not meet the NYS Class C DO standard of 4 mg/L.

Parameters including specific conductance and hardness can be used as indicators of potential impact to surface water resulting from the release of contaminants from waste disposal sites. For surface water, the measured values for specific conductance, and the calculated values for hardness are highest in samples SW-104 and SW-105. Each of these samples was collected along a drainage ditch exiting the northern boundary of the Becker site.

5.2.2.2 Surface Water Analytical Results. Six surface water samples and three seep samples were collected in the Phase II RI. Results are presented in Figure 5-12. A single sample (SW-101) and duplicate were collected from the fire pond to characterize surface water near the debris piles (see Figure 5-12). TCL VOCs and SVOCs were not detected in the sample and duplicate. TCL metals detected at concentrations exceeding NYS Class C surface water standards in sample SW-101 and duplicate are aluminum, copper, selenium, and iron.

Five surface water samples (SW-102 through SW-106) were collected from the site drainages (see Figure 5-12). The TCL VOCs detected were 1,1,1-TCA (up to 16 μg/L), 1,1-DCA (up to 5 μg/L), and TCE (up to 3 μg/L). The highest concentrations of VOCs are detected in samples SW-104 and SW-102. The only TCL SVOC detected was BEHP (up to 2 μg/L) in SW-103 and SW-106. TCL metals detected at concentrations exceeding NYS Class C surface water standards are aluminum, iron, and zinc. The only TCL metal exceeding surface water background concentrations (see Table 2-13) is copper.

Three seep samples (SW-107, SW-108, and SW-109) were collected from three locations where groundwater was observed discharging from the bedrock cliff at Catskill Creek (see Figure 5-12). Samples were analyzed for TCL VOCs. TCL VOCs detected in the samples were 1,1,1-TCA (up to 110 μg/L), 1,1-DCA (up to 560 μg/L), 1,1-DCE (up to 64 μg/L), 1,2-DCE (up to 42 μg/L); tetrachloroethane (PCE) (up to 23 μg/L); TCE (up to 21 μg/L), and vinyl chloride (up to 12 μg/L). Results are highest in sample SW-108 collected immediately at the confluence of Thorp and Catskill Creeks.

5.2.2.3 Sediment Results. Six sediment samples were collected in the Phase II RI. Results are presented in Figure 5-13. Results from sediment samples SD-101 (from the fire pond) and SD-102 through SD-106 (drainage ditch samples) are shown in Figure 5-13. TCL VOCs were only detected in SD-101 (sample and duplicate), SD-102, and SD-104, VOCs detected were 1,1,1-TCA (up to 51 μg/kg), 1,1-DCA (up to 7 μg/kg), 1,1-DCE (reported at 31 μg/kg in SD-101-DUP), and TCE (reported at 9 μg/kg in SD-101 duplicate). TCL SVOCs were detected in all samples. TCL SVOCs detected were primarily BEHP (up to 56,000 μg/kg) and di-n-octylphthalate (up to 2,100 μg/kg); PAHs were reported only in sample SD-106. TCL Metals detected at concentrations exceeding sediment and soil background concentrations are arsenic and zinc (in sample SD-104).

5.3 GROUNDWATER RESULTS

5.3.1 Phase I RI Samples

Groundwater samples were collected during the Phase I RI from the on-site Becker WSW-2 and WSW-3, overburden well MW-2S, and bedrock monitoring wells MW-4, MW-5, and MW-6 (see Figures 5-14 and 5-15).

VOCs detected in on-site groundwater samples are 1,1-DCE (up to 230 μg/L), 1,1-DCA (up to 670 μg/L), 1,2-DCE (up to 400 μg/L), chloroform (up to 17 μg/L), 1,1,1-TCA (2,200 μg/L), TCE (up to 530 μg/L), PCE (up to 52 μg/L), and toluene (up to 62 μg/L). Overall, the highest concentrations and numbers of VOCs were detected in the samples from wells MW-2S, MW-4, and MW-5. The only SVOC detected was BEHP (up to 250 μg/L). Pesticides/PCBs were not detected. Inorganics exceeding site background concentrations (see Table 2-13) are aluminum, arsenic, barium, beryllium, cadmium, lead, mercury, potassium and zinc.

Of the organic and inorganic chemicals detected in site groundwater in Phase I RI samples, the following exceedances of NYS Class GA standards, USEPA MCLs, or USEPA MCLGs (see Table 2-10) were found:

- The concentration of 1,1-DCA exceeds the NYS Class GA standard in all Phase I RI groundwater samples.

- The concentration of 1,1-DCE exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-5, MW-4, and MW-2S.

- The concentration of chloroform in MW-5 exceeds the NYS Class GA standard and the USEPA MCLG.

- The concentration of 1,2-DCE in MW-4 exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG.

- The concentration of TCE in MW-4 and Becker WSW-2 exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG.

- The concentration of PCE in MW-4 exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG.

- The concentration of toluene in MW-4 and MW-5 exceeds the NYS Class GA standard.

- Metals detected in on-site groundwater at concentrations exceeding NYS Class GA groundwater standards and site background are lead (up to 232 μg/L with the highest concentration in WSW-2) and mercury (up to 2.3 μg/L with the highest concentration in MW-2S).

5.3.2 Phase II RI Samples

During groundwater sampling, selected water quality parameters (e.g., temperature, specific conductance) were measured to ensure that representative samples were collected, and to provide qualitative data to assess the potential impact to surrounding groundwater at the site.

5.3.2.1 Water Quality Parameters. The following field parameters were measured by ABB-ES personnel during the Phase II RI collection of groundwater samples:

- temperature
- pH

- specific conductance
- DO
- salinity
- turbidity

Water quality data are summarized in Table 5-1. Field water quality data were collected with a Horiba U-10 water quality checker calibrated daily with appropriate standards. In addition to the field parameters, three groundwater samples (from MW-105D, MW-106D, and MW-108) were collected for laboratory analysis for TSS, alkalinity, BOD, COD, and TOC.

Many inorganic water quality standards in NYS are based on the hardness measurement in aqueous media. Hardness (as mg/L of $CaCO_3$) of surface water and groundwater samples was computed using the equation described previously for surface water. The hardness results are summarized with other water quality data in Table 5-1.

Water quality parameter measurements represent the status of an aqueous medium at the point and moment of sampling, and are used to: (1) monitor water body classification status; (2) qualitatively confirm chemical analysis results; and (3) assess pollution load.

There are no pH or DO standards for classification of groundwater. The pH of shallow (overburden) groundwater was similar to that measured in surface water samples (see Subsection 5.2.2). In general, the pH of groundwater in the deeper bedrock wells is higher (less acidic) than the pH values measured in shallow groundwater and surface water. Most bedrock wells have pH values between 7.1 and 9.2; wells MW-6, MW-109, MW-110, and MW-112 had greater pHs potentially indicating grout used in well installation is influencing groundwater pH at each well. The DO content of groundwater in overburden and bedrock was generally less than 5 mg/L, and has been measured at less than 1 mg/L in some wells.

Parameters including TSS, alkalinity, BOD, COD, TOC, specific conductance and hardness can be used as indicators of potential impact to groundwater resulting from the release of contaminants from waste disposal sites. For groundwater, the measured values for specific conductance and the calculated values for hardness are highest in wells MW-109 and MW-112. Each of these samples was collected

downgradient of sources at the Becker site. As described above for pH, it is not known if these data reflect groundwater conditions or the influence of cement/ bentonite grout.

5.3.2.2 Laboratory Analytical Results. Groundwater samples were collected from all Phase II monitoring wells, reconstructed Phase I monitoring wells MW-4, MW-5, and MW-6, and from other on-site wells (MW-BOX, MW-SPILL, MW-1EPS, MW-3EPS, MW-4EPS, and MW-5EPS). Results are shown in Figure 5-14 (overburden/shallow groundwater) and Figure 5-15 (bedrock).

VOCs detected in groundwater at and downgradient of the site are vinyl chloride (up to 15 μg/L), 1,1,1-TCA (up to 20,000 μg/L), 1,1-DCA (up to 7,100 μg/L), 1,1-DCE (up to 2,000 μg/L), 2-butanone (up to 900 μg/L), chloroethane (up to 310 μg/L), TCE (up to 1,800 μg/L), PCE (up to 24 μg/L), chloroform (up to 2 μg/L), and xylenes (up to 130 μg/L), 1,2-DCE (up to 12 μg/L), and 1,2-DCA (up to 10 μg/L). TCL SVOCs were not detected. Of the wells sampled, MW-106S (overburden) and MW-106D (bedrock) contained the greatest concentrations of VOCs. Bedrock wells tend overall to be more contaminated with VOCs than overburden/shallow groundwater wells.

Inorganics were analyzed for in bedrock wells (see Figure 5-15). The inorganics arsenic, barium, calcium, magnesium, and potassium are detected in upgradient background well MW-101D. All other wells contained greater numbers and concentrations of inorganics. Inorganics detected in Phase II bedrock wells at concentrations exceeding site background (see Table 2-13) are aluminum, arsenic, barium, cadmium, calcium, lead, potassium, vanadium, manganese, mercury, and sodium.

Of the organic and inorganic chemicals detected in site groundwater in the Phase II RI samples, the following exceedances of NYS Class GA standards, USEPA MCLs, or USEPA MCLGs were found:

- The concentration of 1,1-DCA exceeds the NYS Class GA standard in MW-5, MW-108, MW-109, MW-6, MW-112, MW-4, MW-106D, MW-111, MW-107, MW-1EPS, MW-106S, MW-3EPS, MW-105S, MW-4EPS, and MW-2S.

- The concentration of 1,1-DCE exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-4EPS, MW-106S, MW-2S, MW-5, MW-109, MW-106D, MW-6, MW-4, MW-112, and MW-111.

- The concentration of 1,2-DCE exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-106D and MW-4.

- The concentration of TCE exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-106S, MW-107, MW-5, MW-108, MW-106D, MW-112, MW-4, and MW-111.

- The concentration of PCE exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-4.

- The concentration of vinyl chloride exceeds the NYS Class GA standard, the USEPA MCL, and the USEPA MCLG in MW-5 and MW-112.

- Inorganics present in bedrock groundwater at concentrations exceeding NYS Class GA criteria and site background are arsenic (38.5 μg/L in MW-112), barium (up to 3,830 μg/L in MW-112 and MW-109), manganese (up to 2,620 μg/L in MW-106D), lead (up to 110 μg/L in MW-112, MW-110, MW-6, and MW-109), and sodium (245,000 μg/L in MW-109).

5.4 DISCUSSION OF RESULTS

RI activities performed at the Becker site identified the presence of several sources of environmental contamination and delineated the nature and distribution of contamination migrating from these sources. Primary site contaminants consist of solvent-related VOCs (principally 1,1,1-TCA, TCE, and their degradation products), SVOCs related to use and disposal of epoxy-saturated wood products (chip board or particle board - principally the phthalate BEHP), other SVOCs released to the site via other industrial processes (naphtha compounds, chlorobenzenes, phenols, and

PAHs), and metals (primarily arsenic, cadmium, and zinc) associated with subsurface disposal of debris from the manufacture of electrical components.

Of the chemical classes released to the site, only the VOCs are directly attributed to release of hazardous waste (chlorinated and non-chlorinated listed hazardous wastes [F001, F002, F003, and F005] as set forth in 6 NYCRR Part 371); remaining contaminants are related to disposal of materials not classified as hazardous waste, but may be present at concentrations potentially posing a significant threat to human health and the environment.

To summarize all of the RI and other data collected at the Becker site, tables of chemicals detected were prepared for the following media:

- septic system sediment/sludge results (Table 5-2);
- septic system tank liquid/pipe results (Table 5-3);
- subsurface soil/fill (Table 5-4);
- surface soil (Table 5-5);
- sediment (Table 5-6);
- surface water (Table 5-7); and
- groundwater (Table 5-8).

The tables indicate frequency of detection, maximum and minimum concentrations detected, and the location of the maximum detected value. The tables list inorganics present in media at concentrations exceeding background as shown in Table 2-12 and 2-13. Results show that the greatest concentrations of VOCs (the principal site contaminants) are in subsurface and surface soil at the chemical storage building (i.e., explorations GP-8, TP-112, and TP-119). This correlates with the presence of the highest concentrations of VOCs in groundwater at MW-106D and MW-106S.

5.4.1 Nature and Distribution of VOC Contaminants

Figures 5-16, 5-18, and 5-19 present the nature and distribution of VOC contamination at the Becker site in site soils/sediment, overburden/shallow groundwater, and bedrock groundwater, respectively, based on the Phase I and Phase II RI and results of previous and concurrent NYSDEC investigations. In Figure 5-16, the VOC contamination contours are identified as the total concentrations of chlorinated and non-chlorinated TCL VOCs, and outlines those

areas of the site which contain total VOC concentrations exceeding 5 μg/kg, 50 μg/kg, 500 μg/kg, and 5,000 μg/kg total VOCs. Figure 5-16 shows that the highest levels of VOC contamination are in soil at the chemical storage building. Based on the contours indicated for soil contaminated by more than 500 μg/kg total TCL VOCs (an area approximately 110 feet long, 30 feet wide) and the estimated depth to bedrock (10 feet bgs), approximately 1,200 cubic yards of soil contaminated by VOCs is present at the chemical storage building. The only other area of the site with soil contaminated by more than 500 μg/kg total TCL VOCs is at the debris pile area (TP-101). This anomaly is due primarily to the concentration of acetone; it is possible that acetone is a laboratory artifact, however it was also detected in downgradient monitoring well MW-109. Other lesser VOC contamination is detected at the septic system no. 2 leachfield, sporadically in drainage ditches, the loading dock area near the former septic system no. 2 tank location, in surface soil west of septic system no. 3, and in other debris pile test pits.

In Figures 5-18 and 5-19, groundwater contamination contours are identified as the concentrations of chlorinated and non-chlorinated TCL VOCs. These contours outline those areas at and downgradient of the site which contain total VOC concentrations, exceeding 5 μg/L, 50 μg/L, 500 μg/L, and 5,000 μg/L.

Figure 5-18 shows the distribution of overburden/shallow groundwater VOC contamination, based on Phase II RI results (see Figure 5-14 for individual compound concentrations). Figure 5-18 shows that the downgradient extent of shallow groundwater contamination is not delineated. It is believed that shallow groundwater contamination either reaches Thorp and Catskill Creek or drains downward entirely into bedrock. Overall, the greatest shallow groundwater contamination is observed at the chemical storage building correlating with the results of soil data (see Figure 5-16). The geometry of the contours suggest VOC contamination in the debris pile area and associated with septic system no. 2 are sources of continuing groundwater contamination.

Figure 5-19 shows the distribution of bedrock groundwater VOC contamination, based on Phase II RI results (see Figure 5-15 for individual compound concentrations). Figure 5-19 shows that bedrock groundwater contamination is migrating from the site toward Thorp and Catskill Creek. It is believed that, based on groundwater flow directions, the core of the plume ("hotspot") extends from the chemical storage building to Catskill Creek south of MW-112. Seep results (see

Figure 5-12) and Thorp Creek and Catskill Creek surface water results (see Figure 5-9) confirm that groundwater contamination discharges to the creeks and is potentially diluted to non-detectable concentrations.

5.4.2 Nature and Distribution of SVOC Contaminants

Figure 5-17 presents the nature and distribution of selected SVOCs (phthalates) at the Becker site in site soils/sediment based on the Phase I and Phase II RI and results of previous and concurrent investigations. In Figure 5-17, soil/sediment contamination is identified as concentrations of total phthalates exceeding 500 μg/kg, 5,000 μg/kg, and 50,000 μg/kg. In Figure 5-17, the most extensive area of phthalate contamination, including the highest concentrations of phthalates (primarily BEHP), is the surface debris piles in the southeast corner of the site. Additional areas of phthalate contamination are the septic system no. 2 leachfield, septic system no. 3 soil, the chemical storage building area soil, and site drainages. The source of the phthalate contamination is believed to be both particle board debris and wastewater from the Becker manufacturing building (as evidenced by phthalates in residual wastewater from piping (see PP-1 on Figure 5-3). Additional SVOC contamination is also present at the site (PAHs, phenols), with the highest concentrations at septic system no. 2 (see ST-2-SL on Figure 5-3; results of TP-113 on Figure 5-4).

5.4.3 Nature and Distribution of Inorganic Contaminants

Review of inorganic data from site soils, sediment, and surficial and buried debris show levels of the inorganics arsenic, cadmium, copper, lead, mercury, and zinc at concentrations exceeding site soil background concentrations (see Tables 5-4, 5-5, and 5-6). Metals in Phase II RI on-site fire pond and drainage ditch surface water samples exceeding NYS Class C surface water standards are sporadic detections of aluminum, copper, selenium, iron, and zinc (see Table 5-7). Metals were not detected in downstream surface water samples above background from Thorp Creek or Catskill Creek in the Phase I RI. Inorganics in groundwater in Phase II RI samples exceeding NYS Class GA criteria (see Table 2-10) and site background (see Table 2-13) are arsenic, barium, iron, lead, manganese, and sodium (see Table 5-8). Groundwater results may indicate leaching of inorganics from site source materials (debris, soil, and sediment) and geologic materials (bedrock) is potentially occurring. The concentrations of inorganics could also be the result of interaction of well

construction materials (i.e., cement/bentonite grout) on water quality in the vicinity of the monitoring wells.

Of particular note for the site is that historical information (see Section 1.0) identified that caustic (high pH) material was discharged through septic system no. 2. Review of data show wells with the highest pH (see Table 5-1) are bedrock wells MW-5, MW-6, MW-109, W-110D, and MW-112 (pH ranges from 9 to 12.9). Except for MW-110D, these wells are located downgradient of septic system no. 2. Overall, it is difficult to assess whether the high pHs reflect caustic residuals in groundwater or reflect use of cement/bentonite grout in well construction.

Figure 5-1 Phase I RI Results - Septic System No. 1

Figure 5-2 Phase I and Phase II RI Results - Surface Debris Pile Area

Figure 5-3 Phase I RI Results - Septic System No. 2/Buried Debris Area

Figure 5-4 Phase II RI Results - Septic System No. 2

Figure 5-5 Septic System No. 3

Figure 5-6 Phase I RI Results - Chemical Storage Building Area

Figure 5-7 Phase II RI Results - Chemical Storage Building Area

Figure 5-8 Phase I RI Drainage Ditch Surface Water Results

Figure 5-9 Phase I RI Fire Pond, Thorp Creek, and Catskill Creek Surface Water Results

Figure 5-10 Phase I RI Drainage Ditch Sediment Results

Figure 5-11 Phase I RI Fire Pond, Thorp Creek, and Catskill Creek Sediment Results

Figure 5-12 Phase II RI Surface Water and Seep Results

Figure 5-13 Phase II RI Sediment Results

Figure 5-14 Shallow Groundwater Results

Figure 5-15 RI Bedrock Groundwater Results

Figure 5-16 Interpreted Distribution of Soil, Debris, and Sediment Contaminated by TCL VOCs

Figure 5-17 Interpreted Distribution of Soil, Debris, and Sediment Contaminated by Selected SVOCs (Phthalates)

Figure 5-18 Interpreted Distribution of VOC Contamination in Overburden/ Shallow Groundwater

Figure 5-19 Interpreted Distribution of VOC Contamination in Bedrock Groundwater

TABLE 5–1
PHASE II RI WATER QUALITY PARAMETERS

BECKER ELECTRONICS MANUFACTURING SITE
REMEDIAL INVESTIGATION REPORT

SAMPLE	ALKALINITY mg/L	BIOCHEMICAL OXYGEN DEMAND mg/L	CHEMICAL OXYGEN DEMAND mg/L	TOTAL ORGANIC CARBON mg/L	TOTAL SUSPENDED SOLIDS mg/L	TEMP deg C	ACIDITY pH	SPECIFIC CONDUCTANCE mS/cm	SALINITY %	DISSOLVED OXYGEN mg/L	TURBIDITY NTUs	CALCULATED HARDNESS mg/L
Surface Water												
SW–101	NA	NA	NA	NA	NA	17.8	6.21	0.184	0	4.05	9	80.0
SW–102	NA	NA	NA	NA	NA	18	7.3	0.24	0	6.1	0	114.9
SW–103	NA	NA	NA	NA	NA	14	6.3	0.13	0	6	10	45.4
SW–104	NA	NA	NA	NA	NA	15	6.9	0.41	0	3.4	10	201.9
SW–105	NA	NA	NA	NA	NA	17	7.1	0.41	0	2.7	0	219.1
SW–106	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	103.5
SW–107	NA	NA	NA	NA	NA	13	7.1	0.34	0	6.5	640	NA
SW–108	NA	NA	NA	NA	NA	17	7.6	0.31	0	8.1	250	NA
SW–109	NA	NA	NA	NA	NA	20	8.2	0.18	0	9.3	0	NA
Overburden/Shallow Bedrock Wells												
MW–102D	NA	NA	NA	NA	NA	14	6.8	0.46	0	1.8	990	NA
MW–103	NA	NA	NA	NA	NA	16	6.6	0.69	0	3.8	490	NA
MW–104	NA	NA	NA	NA	NA	14.7	5.92	0.201	0	5.67	999	NA
MW–105S	NA	NA	NA	NA	NA	23.7	7	0.382	0.01	5.27	321	NA
MW–106S	NA	NA	NA	NA	NA	15.4	7	0.461	0.01	8.02	97	NA
MW–107	NA	NA	NA	NA	NA	16.3	8.06	0.341	0.01	1	6	NA
MW–2S	NA	NA	NA	NA	NA	17.6	7.02	0.697	0.02	4.35	999	NA
MW–1–EPS	NA	NA	NA	NA	NA	19	6.7	0.75	0	2.9	990	NA
MW–3–EPS	NA	NA	NA	NA	NA	18	6.4	0.24	0	0.8	NA	NA
MW–4–EPS	NA	NA	NA	NA	NA	20.7	6.7	0.401	0.01	2.64	500	NA
MW–5–EPS	NA	NA	NA	NA	NA	14.9	7.16	0.514	0.02	5.31	255	NA
MW–BOX	NA	NA	NA	NA	NA	17.9	6.95	0.157	0	4.03	13	NA
MW–TANK	NA	NA	NA	NA	NA	20	7.75	0.32	0.01	6.5	999	NA
MW–SPILL	NA	NA	NA	NA	NA	18.9	6.84	0.429	0.01	0.67	3	NA
MW–STS–3	NA	NA	NA	NA	NA							
Bedrock Wells												
MW–4	NA	NA	NA	NA	NA	12.7	8.48	0.556	0.02	2.28	148	229.5
MW–5	NA	NA	NA	NA	NA	12	9.2	0.5	0	2	1	230.1
MW–6	NA	NA	NA	NA	NA	14.7	11.54	0.25	0	4.5	104	303.9
MW–101D	NA	NA	NA	NA	NA	10.9	7.66	0.295	0.01	0.77	1	87.2
MW–102S	NA	NA	NA	NA	NA	12	7.2	0.42	0	3.4	130	NA
MW–105D	172	4	10	BDL	153	12.5	7.18	0.37	0.01	1.71	406	181.8
MW–106D	234	4	29	BDL	15	11.4	7.15	0.561	0.02	4.8	43	299.1
MW–108	182	BDL	BDL	BDL	BDL	11.7	7.33	0.391	0.01	1.32	0	188.5

TABLE 5–1
PHASE II RI WATER QUALITY PARAMETERS

BECKER ELECTRONICS MANUFACTURING SITE
REMEDIAL INVESTIGATION REPORT

SAMPLE	ALKALINITY mg/L	BIOCHEMICAL OXYGEN DEMAND mg/L	CHEMICAL OXYGEN DEMAND mg/L	TOTAL ORGANIC CARBON mg/L	TOTAL SUSPENDED SOLIDS mg/L	TEMP deg C	ACIDITY pH	SPECIFIC CONDUCTANCE mS/cm	SALINITY %	DISSOLVED OXYGEN mg/L	TURBIDITY NTUs	CALCULATED HARDNESS mg/L
MW–109	NA	NA	NA	NA	NA	13	12.9	14	0.08	9.5	700	2921.0
MW–110D	NA	NA	NA	NA	NA	11	12.1	2.5	0.1	1.7	30	470.6
MW–111	NA	NA	NA	NA	NA	12	7.2	0.49	0	3.7	400	211.2
MW–112	NA	NA	NA	NA	NA	13	12.1	4.8	0.2	3.8	40	2906.3
MW–113	NA	NA	NA	NA	NA	12	7.1	0.6	0	4.3	470	208.3

Notes:

mg/L – milligrams per liter
mS/cm – milliSeimens per centimeter
deg C – degrees Centigrade
(1). Hardness calculated from TCL Inorganics results for Calcium and Magnesium using the method in Standard Methods (1989).

TABLE 5-2
SUMMARY OF SEPTIC SYSTEM SEDIMENT/SLUDGE RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
TCL-INORGANICS (mg/kg)						
Arsenic	3	3	166	2.0	ST-3-SD	11/08/90
Beryllium	3	3	57.0	5.0	ST-3-SD	11/08/90
Cadmium	3	3	118	3.0	ST-3-SD	11/08/90
Cobalt	3	3	253	14.9	ST-3-SD	11/08/90
Copper	3	3	34200	117	ST-3-SD	11/08/90
Lead	3	3	4000	23.4	ST-3-SD	11/08/90
Manganese	3	3	15000	411	ST-2-SD	12/05/90
Mercury	2	3	2.0	0.23	ST-3-SD	11/08/90
Vanadium	3	3	767	12.4	ST-3-SD	11/08/90
Zinc	3	3	224000	1580	ST-3-SD	11/08/90
TCL-SVOA (μg/kg)						
1,4-Dichlorobenzene	2	3	8600	540	ST-3-SD	05/07/91
2-Methylnaphthalene	1	3	1100	1100	ST-2-SD	05/07/91
Acenaphthene	1	3	680	680	ST-3-SD	05/07/91
Benzoic Acid	1	3	11000	11000	ST-2-SD	05/07/91
Butylbenzylphthalate	1	3	480	480	ST-1-SD	05/06/91
Chrysene	1	3	140	140	ST-1-SD	05/06/91
Di-n-butylphthalate	2	3	650	320	ST-2-SD	05/07/91
Di-n-octylphthalate	2	3	1700	190	ST-3-SD	05/07/91
Fluoranthene	2	3	940	450	ST-3-SD	05/07/91
Pyrene	2	3	370	260	ST-3-SD	05/07/91
bis(2-Ethylhexyl)phthalate	3	3	170000	11000	ST-3-SD	05/07/91

(continued)

TABLE 5-2
SUMMARY OF SEPTIC SYSTEM SEDIMENT/SLUDGE RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
TCL-VOA (μg/kg)						
1,1,1-Trichloroethene	1	3	53	53	ST-2-SD	05/07/91
1,1-Dichloroethane	1	3	76	76	ST-2-SD	05/07/91
Chloroethane	1	3	380	380	ST-2-SD	05/07/91
Toluene	2	3	320	54	ST-3-SD	11/08/90

Notes:

1. The following samples were used to prepare this table:

ST-1-SD (11/07/90), ST-1-SD (05/06/91), ST-2-SD (12/05/90), ST-2-SD (05/07/91), ST-3-SD (11/08/90), ST-3-SD (05/07/91)

2. Only results for inorganics exceeding background are shown.

TABLE 5-3
SUMMARY OF SEPTIC SYSTEM TANK LIQUID/PIPE LIQUID RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
TCL-INORGANICS (µg/L)						
Aluminum	2	2	3330	309	PP-1	11/19/90
Arsenic	2	3	14.6	0.80	PP-1	11/19/90
Barium	2	3	4380	142	PP-1	11/19/90
Beryllium	1	3	28.5	28.5	PP-1	11/19/90
Cadmium	1	3	13.1	13.1	PP-1	11/19/90
Calcium	3	3	86900	18200	PP-1	11/19/90
Chromium	2	3	257	8.0	PP-1	11/19/90
Cobalt	1	3	30.7	30.7	PP-1	11/19/90
Copper	2	3	1140	9.0	PP-1	11/19/90
Iron	2	2	240000	1720	PP-1	11/19/90
Lead	3	3	181	2.0	PP-1	11/19/90
Magnesium	3	3	6210	1040	PP-1	11/19/90
Manganese	3	3	12800	49.0	PP-1	11/19/90
Mercury	1	3	0.16	0.16	PP-1	11/19/90
Nickel	1	3	112	112	PP-1	11/19/90
Potassium	2	3	1730	1440	ST-1-SW	11/07/90
Sodium	2	3	8020	4830	PP-1	11/19/90
Thallium	1	3	0.28	0.28	PP-1	11/19/90
Vanadium	1	3	9.0	9.0	PP-1	11/19/90
Zinc	2	2	29400	850	PP-1	11/19/90
TCL-PESTICIDES/PCBs (µg/L)						
Methoxyclor	1	3	1.0	1.0	ST-3-SW	11/08/90
TCL-SVOA (µg/L)						
2-Methylnaphthalene	1	3	590	590	PP-1	05/07/91

(continued)

TABLE 5-3
SUMMARY OF SEPTIC SYSTEM TANK LIQUID/PIPE LIQUID RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
Benzoic Acid	1	3	290	290	PP-1	05/07/91
Di-n-butylphthalate	1	3	6200	6200	PP-1	05/07/91
bis(2-Ethylhexyl)phthalate	1	3	38000	38000	PP-1	05/07/91
TCL-VOA (μg/L)						
1,1,1-Trichloroethene	2	3	27	2.0	ST-1-SW	11/07/90
1,1-Dichloroethane	2	3	32	9.0	PP-1	08/26/94
Chloroethane	1	3	4.0	4.0	PP-1	08/26/94

Notes:

The following samples were used to prepare this table:

PP-1 (11/19/90), PP-1 (05/07/91), PP-1 (08/26/94), ST-1-SW (11/07/90), ST-1-SW (05/06/91), ST-3-SW (11/08/90), ST-3-SW (05/07/91)

TABLE 5-4
SUMMARY OF ALL PHASE I AND PHASE II RI SUBSURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION DEPTH (FEET), AND DATE OF MAXIMUM DETECT		
TCL INORGANICS (mg/kg)							
Antimony	3	21	18.2	14.7	TP-117	5	07/10/94
Arsenic	19	25	15.6	1.0	TP-115	2	07/10/94
Cadmium	21	29	243	0.86	TP-113	4	07/09/94
Selenium	1	29	0.42	0.42	TP-117	5	07/10/94
Silver	5	21	7.0	1.0	TP-113	4	07/09/94
Zinc	28	28	856	11.0	TP-114	4	07/09/94
TCL-SVOA (µg/kg)							
2,4-Dimethylphenol	1	29	2800	2800	TP-113	4	07/09/94
2-Methylnaphthalene	5	29	9200	25	TP-113	4	07/09/94
2-Methylphenol	1	29	3400	3400	TP-113	4	07/09/94
4-Methylphenol	2	29	25000	340	TP-113	4	07/09/94
Acenaphthene	2	29	520	110	TP-113	4	07/09/94
Acenaphthylene	1	29	250	250	TP-113	4	07/09/94
Benzo(a)Anthracene	2	29	1200	30	TP-113	4	07/09/94
Benzo(a)Pyrene	2	29	940	23	TP-113	4	07/09/94
Benzo(b)Fluoranthene	2	29	1000	140	TP-113	4	07/09/94
Benzo(g,h,i)Pyrene	1	29	470	470	TP-113	4	07/09/94
Benzo(k)Fluoranthene	1	29	790	790	TP-113	4	07/09/94
Benzoic Acid	1	9	310	310	ST-1-SL	5	05/06/91
Butylbenzylphthalate	1	28	170	170	BL-2	2-4	05/06/91
Carbazole	2	21	1400	87	TP-113	4	07/09/94
Chrysene	2	28	630	31	TP-113	4	07/09/94
Di-n-butylphthalate	1	29	50	50	ST-1-SL	5	05/06/91
Di-n-octylphthalate	16	29	58000	170	TP-110	2	07/08/94

(continued)

TABLE 5-4
SUMMARY OF ALL PHASE I AND PHASE II RI SUBSURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION DEPTH (FEET), AND DATE OF MAXIMUM DETECT		
Dibenz(a,h)Anthracene	1	29	150	150	TP-113	4	07/09/94
Dibenzofuran	2	29	770	94	TP-113	4	07/09/94
Dimethylphthalate	1	29	1100	1100	TP-113	4	07/09/94
Fluoranthene	4	29	1300	62	TP-113	4	07/09/94
Fluorene	2	29	1400	92	TP-113	4	07/09/94
Indeno(1,2,-c,d)Perylene	1	29	280	280	TP-113	4	07/09/94
Naphthalene	4	29	11000	71	TP-113	4	07/09/94
Phenanthrene	5	28	5700	47	TP-113	4	07/09/94
Phenol	1	29	13000	13000	TP-113	4	07/09/94
Pyrene	4	29	4900	50	TP-113	4	07/09/94
bis(2-Ethylhexyl)phthalate	19	29	580000	84	TP-107	7	07/07/94
TCL-VOA (μg/kg)							
1,1,1-Trichloroethane	14	37	64000	2.0	GP-8	6	08/25/94
1,1,2,2-Tetrachloroethane	3	37	4.0	1.0	TP-118	6	07/09/94
1,1-Dichloroethane	9	37	200	2.0	GP-8	6	08/25/94
1,1-Dichloroethene	6	37	3500	0.8	TP-122	2	07/10/94
2-Butanone	9	37	51000	5.0	TP-122	2	07/10/94
2-Hexanone	1	37	1400	1400	TP-122	2	07/10/94
Chloroethane	2	37	160	51	TP-111	3	07/08/94
Ethylbenzene	6	37	1000	6.0	TP-122	2	07/10/94
Tetrachloroethene	1	37	340	1400	TP-122	2	07/10/94
Toluene	6	37	43000	0.6	TP-122	2	07/10/94
Total Xylenes	7	37	6200	14	TP-122	2	07/10/94
Trichloroethene	3	37	4800	43	TP-122	2	07/10/94

(continued)

TABLE 5-4
SUMMARY OF ALL PHASE I AND PHASE II RI SUBSURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION	DEPTH (FEET), AND DATE OF MAXIMUM DETECT	
1,2-Dichloroethene	1	37	25	2J	GP-9	4	08/25/94

Notes:

1. The following samples were used to prepare this table:

BL-1 (3-5 ft., 12/03/90), BL-1 (3-5 ft., 05/06/91), BL-2 (2-4 ft., 11/14/90), BL-2 (2-4 ft., 05/06/91), BL-2(DUP) (2-4, 05/06/91), BL-2 (4-6 ft., 11/14/90), BL-2 (4-6 ft., 05/06/91), BL-3 (0-2 ft., 11/14/90), BL-3 (0-2 ft., 05/01/91), BL-4 (2-4 ft., 11/14/90), BL-4 (2-4 ft., 05/01/91), ST-1-SL (5 ft., 11/07/90, ST-1-SL (5 ft., 05/06/91), ST-2-SL (3 ft., 05/07/90), ST-2-SL (3 ft., 12/05/90), ST-3-SL (3.5 ft., 11/08/90), ST-3-SL(DUP) (3.5 ft., 11/08/90), ST-3-SL (3.5 ft., 05/07/91), ST-3-SL(DUP) (3.5 ft., 05/07/91), TP-102 (4 ft., 07/06/94), TP-103 (7 ft., 07/06/94), TP-104 (4 ft., 07/07/94), TP-105 (7 ft., 07/07/94), TP-106 (2 ft., 07/07/94), TP-107 (7 ft., 07/07/94), TP-108 (6 ft., 07/07/94), TP-109 (11 ft., 07/08/94), TP-110 (2 ft., 07/08/94), TP-110(DUP) (2 ft., 07/08/94), TP-111 (3 ft., 07/08/94), TP-111 (4 ft., 07/08/94), TP-112 (3 ft., 07/09/94), TP-113 (4 ft., 07/09/94), TP-114 (4 ft., 07/09/94), TP-115 (2 ft., 07/10/94), TP-116 (9 ft., 07/10/94), TP-117 (5 ft., 07/10/94), TP-118 (6 ft., 07/09/94), TP-122 (2 ft., 07/10/94), TP-122(DUP) (2 ft., 07/10/94), TP-125 (3 ft., 07/06/94), TP-COMP (2 ft., 07/08/94), GP-1 (10 ft., 08/25/94), GP-2 (10 ft., 08/25/94), GP-3 (6 ft., 08/25/94), GP-4 (8 ft., 08/25/94), GP-5 (6 ft., 08/25/94), GP-6 (7 ft., 08/25/94), GP-7 (7 ft., 08/25/94), GP-8 (6 ft., 08/25/94), and GP-9 (4 ft., 08/25/94),

2. Only results for inorganics exceeding background are shown. Note background has not been established for antimony and silver.

TABLE 5-5
SUMMARY OF ALL RI SURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION, DEPTH (FEET) AND DATE OF MAXIMUM DETECT		
TCL-INORGANICS (mg/kg)							
Antimony	1	5	13.8	13.8	TP-121	1	07/10/94
Arsenic	22	24	95.0	0.59	TP-121	1	07/10/94
Cadmium	21	33	99.0	0.78	DEC-220-SS		01/11/93
Cyanide	1	3	13.0	13.0	TP-121	1	07/10/94
Lead	25	25	584	5.0	DEC-220-SS		01/11/93
Mercury	1	20	1.0	1.0	SS-1	0-0.5	11/12/90
Zinc	33	33	4480	19.8	TP-119	1	07/09/94
TCL-SVOA (μg/kg)							
1,4-Dichlorobenzene	3	23	200	79	SS-4	0-0.5	04/25/91
2-Methylnaphthalene	3	23	440	54	SS-19	D 0-0.5	11/13/90
4-Methylphenol	1	35	1300	1300	TP-119	1	07/09/94
Acenaphthene	1	23	330	330	SS-2	D 0-0.5	04/25/91
Anthracene	3	23	280	80	SS-19	D 0-0.5	11/13/90
Benzo(a)Anthracene	2	23	420	190	SS-2	D 0-0.5	04/25/91
Benzo(a)Pyrene	2	23	440	230	SS-2	D 0-0.5	04/25/91
Benzo(b)Fluoranthene	2	23	830	420	SS-2	D 0-0.5	04/25/91
Benzo(g,h,i)Perylene	2	22	400	260	SS-2	D 0-0.5	04/25/91
Benzoic Acid	4	20	15000	130	SS-12	0-0.5	04/25/91
Butylbenzylphthalate	4	23	2100	54	SS-17	0-0.5	11/13/90
Chrysene	3	23	490	170	SS-2	D 0-0.5	04/25/91
Di-n-butylphthalate	3	23	3800	21	SS-12	0-0.5	04/25/91
Di-n-octylphthalate	12	23	55000	46	TP-COMP	1	07/07/94
Dibenzofuran	2	23	250	62	SS-2	D 0-0.5	04/25/91
Diethylphthalate	1	23	21	21	SS-15	0-0.5	04/25/91
Fluoranthene	2	23	1100	410	SS-2	D 0-0.5	04/25/91
Fluorene	2	23	240	72	SS-2	D 0-0.5	04/25/91
Indeno(1,2-cd)Pyrene	2	23	370	220	SS-2	D 0-0.5	04/25/91
N-Nitrosodidiphenylamine	1	5	110	110	TP-120	1	07/09/94
Naphthalene	2	23	7800	75	TP-119	1	07/09/94
Phenanthrene	3	23	490	100	SS-15	0-0.5	04/25/91

(continued)

TABLE 5-5
SUMMARY OF ALL RI SURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION, DEPTH (FEET) AND DATE OF MAXIMUM DETECT		
Phenol	1	23	54	54	SS-2	0-0.5	04/25/91
Pyrene	4	23	1000	130	TP-119	1	07/09/94
bis(2-Ethylhexyl)phthalate	16	23	270000	1500	TP-COMP	1	07/07/94
TCL-VOA (μg/kg)							
1,1,1-Trichloroethane	5	32	750	14	SS-11	0-0.5	11/13/90
1,1-Dichloroethane	1	32	8.0	8.0	SS-18	0-0.5	11/12/90
2-Butanone	2	32	19000	56	TP-119	1	07/09/94
4-Methyl-2-Pentanone	1	32	9.0	9.0	SS-18	0-0.5	11/12/90
Acetone	1	36	530	530	TP-101	1	07/06/94
Ethylbenzene	1	36	600000	600000	TP-119	1	07/09/94
Tetrachloroethene	2	32	180	3.0	TP-119	1	07/09/94
Toluene	8	32	2000000	7.0	TP-119	1	07/09/94
Total Xylenes	3	32	3400000	16	TP-119	1	07/09/94
Trichloroethene	2	32	22	6.0	SS-11	0-0.5	11/13/90

Notes:

1. The following samples were used to prepare this table:

DEC-212-SS (01/11/93), DEC-213-SS (01/11/93), DEC-214-SS (01/11/93), DEC-215-SS (01/11/93), DEC-216-SS (01/11/93), DEC-217-SS (01/11/93), DEC-218-SS (01/11/93), DEC-219-SS (01/11/93), DEC-220-SS (01/11/93), SS-1 (0-0.5 ft., 11/12/90), SS-1 (0-0.5 ft,. 04/25/91), SS-10(0-0.5 ft., 11/13/90), SS-11 (0-0.5 ft., 11/13/90)), SS-11 (0-0.5 ft., 04/25/91), SS-12 (0-0.5 ft., 11/13/90), SS-12 (0-0.5 ft., 04/25/91), SS-13 (0-0.5 ft., 11/13/90), SS-14 (0-0.5 ft., 11/13/90), SS-14 (0-0.5 ft., 04/25/91), SS-15 (0-0.5 ft., 11/12/90), SS-15 (0-0.5 ft., 04/25/91), SS-16 (0-0.5 ft., 11/12/90), SS-16 (0-0.5 ft., 04/25/91), SS-17 (0-0.5 ft., 11/13/90), SS-18 (0-0.5 ft., 11/12/90), SS-18 (0-0.5 ft., 04/25/91), SS-19 (0-0.5 ft., 11/13/90, SS-19(DUP) (0-0.5 ft., 11/13/90) SS-2 (0-0.5 ft., 11/12/90, SS-2 (0-0.5 ft., 04/25/91), SS-2(DUP) (0-0.5 ft., 04/25/91), SS-3 (0-0.5 ft., 11/13/90), SS-4 (0-0.5 ft., 11/13/90), SS-4 (0-0.5 ft., 04/25/91), SS-5 (0-0.5 ft., 11/13/90), SS-5 (0-0.5 ft., 04/25/91), SS-6 (0-0.5 ft., 11/13/90), SS-6 (0-0.5 ft., 04/25/91), SS-7 (0-0.5 ft., 11/13/90), SS-7(DUP) (0-0.5 ft., 11/13/90), SS-7 (0-0.5 ft., 04/25/91), SS-7(DUP) (0-0.5 ft., 04/25/91), SS-8 (0-0.5 ft., 11/13/90), SS-9 (0-0.5 ft., 11/13/90), SS-9 (0-0.5 ft., 04/25/91) TP-101 (1 ft., 07/06/94), TP-101(DUP) (1 ft., 07/06/94), TP-119 (1 ft., 07/09/94), TP-120 (1 ft., 07/09/94), TP-121 (1 ft., 07/10/94), TP-COMP (1 ft., 07/07/94)

2. Only results for inorganics exceeding background are shown. Note background has not been established for antimony and silver.

TABLE 5-6
SUMMARY OF ALL RI SEDIMENT RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION, DEPTH (FEET), AND DATE OF MAXIMUM DETECT		
TCL-INORGANICS (mg/kg)							
Arsenic	19	19	13.8	1.0	SD-104	0-0.5	08/24/94
Cadmium	17	32	13.1	0.88	DD-4-SED	0-0.5	11/13/90
Copper	32	32	693	2.0	FP-2-SED	0-0.5	11/14/90
Zinc	32	32	861	58.1	DEC-203-SED		12/01/92
TCL-PESTICIDES/PCBs (µg/kg)							
Aroclor-1254	1	21	4100	4100	DD-4-SED	0-0.5	11/13/90
TCL-SVOA (µg/kg)							
1,4-Dichlorobenzene	4	22	260	85	DD-8-SED	0-0.5	04/24/91
2-Methylnaphthalene	1	22	63	63	DD-6-SED	0-0.5	04/24/91
Acenaphthene	1	22	58	58	DD-6-SED	0-0.5	04/24/91
Acenaphthylene	1	22	54	54	DD-6-SED	0-0.5	04/24/91
Anthracene	1	22	41	41	DD-6-SED	0-0.5	04/24/91
Benzo(a)Anthracene	3	22	130	39	DD-8-SED	0-0.5	04/24/91
Benzo(a)Pyrene	2	22	110	43	DD-8-SED	0-0.5	04/24/91
Benzo(b)Fluoranthene	1	22	220	220	DD-8-SED	D 0-0.5	04/24/91
Benzo(k)Fluoranthene	2	22	110	66	DD-8-SED	D 0-0.5	04/24/91
Benzoic Acid	3	22	650	220	FP-2-SED	0-0.5	05/01/91
Butylbenzylphthalate	4	22	720	44	DD-9-SED	0-0.5	11/13/90
Chrysene	3	22	170	59	DD-8-SED	D 0-0.5	04/24/91
Di-n-butylphthalate	2	22	250	74	DD-2-SED	0-0.5	04/24/91
Di-n-octylphthalate	7	22	2500	47	DD-2-SED	0-0.5	04/24/91
Dibenzofuran	1	22	55	55	DD-6-SED	0-0.5	04/24/91
Diethylphthalate	4	22	110	43	DD-6-SED	0-0.5	04/24/91
Fluoranthene	3	22	260	54	DD-8-SED	D 0-0.5	04/24/91
Fluorene	1	22	59	59	DD-6-SED	0-0.5	04/24/91
Indeno(1,2-cd)Perylene	1	22	180	180	DD-8-SED	D 0-0.5	04/24/91
Isophorone	1	22	59	59	DD-6-SED	0-0.5	04/24/91
Naphthalene	1	22	59	59	DD-6-SED	0-0.5	04/24/91
Phenanthrene	2	22	150	58	DD-8-SED	D 0-0.5	04/24/91
Pyrene	3	22	290	61	DD-8-SED	D 0-0.5	04/24/91

(continued)

TABLE 5-6
SUMMARY OF ALL RI SEDIMENT RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION, DEPTH (FEET), AND DATE OF MAXIMUM DETECT		
bis(2-Ethylhexyl)phthalate	11	22	65000	57	DD-4-SED	0-0.5	11/13/90
TCL-VOA (μg/kg)							
1,1,1-Trichloroethane	5	33	51	4.0	SD-101		08/24/94
1,1-Dichloroethane	3	33	36	7.0	DD-4-SED	0-0.5	11/13/90
1,1-Dichloroethene	1	33	31	31	SD-101		08/24/94
1,2-Dichloroethene	1	33	11	11	SD-101		08/24/94
Chloroethane	1	33	13	13	DD-4-SED	0-0.5	11/13/90
Toluene	1	33	3.0	3.0	TC-2-SED	0-0.5	04/26/91
Trichloroethene	1	33	11	11	TC-2-SED	0-0.5	04/26/91

Notes:

1. The following samples were used to prepare this table:

CC-1-SED (0-0.5 ft., 11/19/90), CC-1-SED (0-0.5 ft., 04/26/91, CC-2-SED (0-0.5 ft., 11/19/90), CC-2-SED (0-0.5 ft., 04/26/91), DD-1-SED (0-0.5 ft., 11/16/90), DD-2-SED (0-0.5 ft., 11/15/90), DD-2-SED (0-0.5 ft., 04/24/91), DD-3-SED (0-0.5 ft., 11/15/90), DD-3-SED (0-0.5 ft., 04/24/91), DD-3-SED (0-0.5 ft., 04/25/91), DD-4-SED (0-0.5 ft., 11/13/90), DD-5-SED (0-0.5 ft., 11/15/90), DD-5-SED (0-0.5 ft., 04/24/91), DD-6-SED (0-0.5 ft., 11/15/90), DD-6-SED(DUP) (0-0.5 ft., 11/15/90), DD-6-SED (0-0.5 ft., 04/24/91), DD-6-SED(DUP) (0-0.5 ft., 04/24/91), DD-7-SED (0-0.5 ft.,11/15/90), DD-7-SED (0-0.5 ft., 04/24/91), DD-8-SED (0-0.5 ft., 11/16/90), DD-8-SED(DUP) (0-0.5 ft., 11/16/90), DD-8-SED (0-0.5 ft., 04/24/91), DD-8-SED(DUP) (0-0.5 ft., 04/24/91), DD-9-SED (0-0.5 ft., 11/13/90), DD-9-SED (0-0.5 ft., 04/25/91), DEC-201-SED (12/01/92), DEC-202-SED (12/01/92), DEC-203-SED (12/01/92), DEC-204-SED (12/01/92), DEC-205-SED (12/01/92), DEC-206-SED (12/01/92), DEC-207-SED (12/01/92), DEC-208-SED (12/01/92), DEC-209-SED (12/01/92), DEC-210-SED (12/01/92), FP-1-SED(0-0.5 ft., 11/14/90),FP-1-SED (0-0.5 ft., 05/01/91), FP-2-SED (0-0.5 ft., 11/14/90), FP-2-SED (0-0.5 ft., 05/01/91), FP-3-SED (0-0.5 ft., 11/14/90), FP-3-SED(DUP) (0-0.5 ft., 11/14/90), FP-3-SED (0-0.5 ft., 05/01/91), FP-3-SED(DUP) 0-0.5 ft., 05/01/91), SD-101 (08/24/94), SD-101(DUP) (08/24/94), SD-102 (08/24/94, SD-103 (08/24/94), SD-104 (08/24/94), SD-105 (08/24/94), SD-106 (08/24/94), TC-1-SED (0-0.5 ft., 11/19/90), TC-1-SED (0-0.5 ft., 04/26/91), TC-2-SED (0-0.5 ft., 11/19/90), TC-2-SED(DUP) (0-0.5 ft., 11/19/90), TC-2-SED (0-0.5 ft., 04/26/91), TC-2-SED(DUP) (0-0.5 ft., 04/26/91)

2. Only results for inorganics exceeding background are shown.

TABLE 5-7
SUMMARY OF ALL RI SURFACE WATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
TCL-INORGANICS (μg/kg)						
Aluminum	11	14	6410	115	DD-5-SW	11/15/90
Arsenic	13	25	13.7	0.60	DD-9-SW	11/13/90
Barium	21	25	3110	35.0	DD-9-SW	11/13/90
Beryllium	4	36	27.0	2.0	DD-9-SW	11/13/90
Cadmium	5	36	21.0	5.0	DD-9-SW	11/13/90
Calcium	21	21	186000	14700	DD-9-SW	11/13/90
Chromium	8	36	120	3.0	DD-9-SW	11/13/90
Cobalt	3	25	105	18.0	DD-9-SW	11/13/90
Copper	23	36	447	7.0	DD-9-SW	11/13/90
Iron	21	22	144000	213	DD-9-SW	11/13/90
Lead	26	32	185	0.60	FP-1-BW	11/14/90
Magnesium	25	25	38200	1620	DD-9-SW	11/13/90
Manganese	21	21	15900	44.0	DD-9-SW	11/13/90
Mercury	1	19	0.32	0.32	DD-9-SW	11/13/90
Nickel	6	30	283	17.2	DD-9-SW	11/13/90
Potassium	21	25	51700	856	DD-9-SW	11/13/90
Selenium	1	25	11.3	11.3	SW-101	08/24/94
Sodium	24	25	61600	3110	DD-9-SW	11/13/90
Vanadium	6	25	112	9.0	DD-9-SW	11/13/90
Zinc	28	30	1370	7.0	DD-9-SW	11/13/90
TCL-SVOA (μg/kg)						
Benzoic Acid	1	19	18	18	DD-9-SW	11/13/90
bis(2-Ethylhexyl)phthalate	3	25	14	1.0	DD-2-SW	04/24/91
TCL-VOA (μg/kg)						
1,1,1-Trichloroethane	13	39	110	3.0	SW-107	08/24/94
1,1-Dichloroethane	9	39	560	2.0	SW-108	08/24/94
1,1-Dichloroethene	2	39	64	11	SW-108	08/24/94
1,2-Dichloroethene	6	39	42	2.0	SW-108	08/24/94
Benzene	1	39	2.0	2.0	DD-6-SW	11/15/90
Tetrachloroethene	1	39	3.0	3.0	SW-107	08/24/94

(continued)

TABLE 5-7
SUMMARY OF ALL RI SURFACE WATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT	
Trichloroethene	8	39	23	2.0	SW-108	08/24/94
Vinyl Chloride	1	39	12	12	SW-108	08/24/94

Notes:

The following samples were used to prepare this table:

CC-1-SW (11/19/90), CC-1-SW (04/26/91), CC-2-SW (11/19/90), CC-2-SW (04/26/91), DD-1-SW (11/16/90), DD-1-SW (04/24/91), DD-1-SW (04/25/91), DD-2-SW (11/15/90), DD-2-SW (04/24/91), DD-2-SW (04/25/91), DD-3-SW (11/15/90), DD-3-SW (04/24/91), DD-3-SW (04/25/91), DD-4-SW (11/13/90), DD-4-SW (04/25/91), DD-5-SW (11/15/90), DD-5-SW (04/24/91), DD-5-SW (04/25/91), DD-6-SW (11/15/90), DD-6-SW(DUP) (11/15/90), DD-6-SW (04/24/91), DD-6-SW(DUP) (04/24/91), DD-6-SW (04/25/91), DD-6-SW(DUP) (04/25/91), DD-7-SW (11/15/90), DD-7-SW (04/24/91), DD-7-SW (04/25/91), DD-8-SW (11/16/90), DD-8-SW(DUP) (11/16/90), DD-8-SW (04/24/91), DD-8-SW(DUP) (04/24/91), DD-8-SW (04/25/91), DD-8-SW(DUP) (04/25/91), DD-9-SW (11/13/90), DD-9-SW (04/25/91), DEC-201-SW (12/01/92), DEC-202-SW (12/01/92), DEC-203-SW (12/01/92), DEC-204-SW (12/01/92), DEC-205-SW (12/01/92), DEC-206-SW (12/01/92), DEC-207-SW (12/01/92), DEC-208-SW (12/01/92), DEC-209-SW (12/01/92), DEC-210-SW (12/01/92), DEC-211-SW (12/01/92), FP-1-BW (11/14/90), FP-1-SW (11/14/90), FP-1-SW (04/30/91), FP-2-BW (11/14/90), FP-2-BW(DUP) (11/14/90), FP-2-BW (04/30/91), FP-2-SW (11/14/90), FP-2-SW (DUP) (11/14/90), FP-2-SW (04/30/91), FP-3-BW (11/14/90), FP-3-BW (04/30/91), FP-3-SW (11/14/90), FP-3-SW (04/30/91), FP-3-SW(DUP) (04/30/91), SW-101 (08/24/94), SW-101(DUP) (08/24/94), SW-102 (08/24/94), SW-103 (08/24/94), SW-104 (08/24/94), SW-105 (08/24/94), SW-106 (08/24/94), SW-107 (08/24/94), SW-108 (08/24/94), SW-109 (08/24/94), TC-1-SW (11/19/90), TC-1-SW (04/26/91), TC-2-SW (11/19/90), TC-2-SW(DUP) (11/19/90), TC-2-SW (04/26/91), TC-2-SW(DUP) (04/26/91)

TABLE 5-8
SUMMARY OF 1994 GROUNDWATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT
TCL INORGANICS (µg/L)					
Aluminum	9	12	10600	483	MW-109 08/24/94
Antimony	1	12	62.5	62.5	MW-108 08/23/94
Arsenic	10	12	38.5	4.0	MW-112 08/25/94
Barium	12	12	3830	180	MW-112 08/25/94
Cadmium	2	12	6.0	5.0	MW-113 08/25/94
Calcium	12	12	1158000	29200	MW-109 08/24/94
Lead	9	12	110	2.0	MW-112 08/25/94
Manganese	7	7	2620	182	MW-106D 08/23/94
Mercury	6	9	0.90	0.36	MW-108 08/23/94
Potassium	11	12	189000	773	MW-109 08/24/94
Selenium	1	12	2.0	2.0	MW-105D 08/23/94
Sodium	4	4	245000	37700	MW-109 08/24/94
Thallium	1	12	3.0	3.0	MW-4 08/22/94
Vanadium	1	12	137	137	MW-112 08/25/94
TCL-VOA (µg/L)					
1,1,1-Trichloroethane	19	26	20000	3.0	MW-106D 08/23/94
1,1,2-Trichloroethane	1	26	2.0	2.0	MW-106S 08/23/94
1,1-Dichloroethane	20	26	7100	1.0	MW-106D 08/23/94
1,1-Dichloroethene	14	26	2200	2.0	MW-106D 08/23/94
1,2-Dichloroethane	2	26	10	3.0	MW-106S 08/23/94
1,2-Dichloroethene	9	26	2000	3.0	MW-106D 08/23/94
2-Butanone	2	26	900	13	MW-106D 08/23/94
Acetone	1	26	68	68	MW-109 08/24/94
Chloroethane	5	26	310	1.0	MW-106D 08/23/94

(continued)

TABLE 5-8
SUMMARY OF 1994 GROUNDWATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	NO. OF DETECTS	NO. OF SAMPLES	MAXIMUM DETECT	MINIMUM DETECT	LOCATION AND DATE OF MAXIMUM DETECT
Chloroform	2	26	2.0	0.90	MW-5 08/22/94
Tetrachloroethane	2	26	24	2.0	MW-4 08/22/94
Total Xylenes	1	26	130	130	MW-103 08/24/94
Trichloroethene	12	26	1800	2.0	MW-106D 08/23/94
Vinyl Chloride	2	26	15	2.0	MW-112 08/25/94

Notes:

1. The following samples were used to prepare this table:

MW-101D (08/23/94)), MW-102 (08/24/94), MW-102D (08/24/94), MW-103 (08/24/94), MW-104 (08/23/94), MW-105D (08/23/94), MW-105S (08/23/94), MW-106D (08/23/94), MW-106S, (08/23/94), MW-107 (08/22/94), MW-107(DUP) (08/22/94), MW-108 (08/23/94), MW-108(DUP) (08/23/94), MW-109 (08/24/94), MW-110 (08/25/94), MW-111 (08/25/94), MW-112 (08/25/94), MW-113 (08/25/94), MW-1EPS (08/25/94), MW-2S (08/23/94), MW-3EPS (08/25/94), MW-4 (08/22/94), MW-4EPS (08/25/94), MW-5 (08/22/94), MW-5(DUP) (08/22/94), MW-5EPS (08/25/94), MW-6 (08/22/94), MW-BOX (08/25/94), MW-SPILL (08/25/94)

2. Only inorganics results exceeding background are shown.

6.0 CONTAMINANT FATE AND TRANSPORT

This section evaluates the migration potential and potential environmental fate of site contaminants. Contaminants found at the Becker site include VOCs, SVOCs, and inorganics. The observed distribution of these contaminants in different environmental media (soil, sediment, surface water, and groundwater) at the Becker site is the result of waste disposal practices, contaminant physico-chemical properties, and site conditions. Site conditions governing fate and transport (i.e., persistence and migration) of chemicals include original chemical distribution, topography, meteorological conditions, and hydrogeology. Applicable physico-chemical properties for organic chemicals at the Becker site include specific gravity, solubility, and the organic carbon partition coefficient (K_{oc}). Applicable physico-chemical properties for inorganic constituents at the Becker site include oxidation state, pH, and specific solute species.

6.1 CONTAMINANT TRANSPORT

Site conditions and the physico-chemical properties of site contaminants determine which contaminant transport mechanisms will predominate. Once the dominant transport mechanisms have been identified, the contaminant distribution can be interpreted in terms of past events, and the future contaminant distribution can be estimated.

Applicable physico-chemical properties of the contaminants are listed in Table 6-1. Specific gravity is the ratio of the mass of a given volume of a liquid substance to the mass of an equal volume of water. Liquids with specific gravities greater than 1 are termed heavier than water. Solubility values and the K_{oc} represent measures of the tendency of a material to move from one phase to another. Solubility measures the partitioning between the pure liquid or solid form of a chemical and the aqueous phase, or the tendency of a material to dissolve in water. Substances with relatively low solubilities are more likely to remain in a separate phase when in contact with water; substances with high solubilities will dissolve and move with water. K_{oc} measures the extent that an organic chemical partitions between a solid phase and a liquid phase, and is used to predict whether a chemical could be adsorbed to soil organic carbon (Ney, 1990). Chemicals with a K_{oc} of greater than 10,000 will adsorb

to soil organic carbon. Chemicals with a K_{oc} in the range of 1,000 to 10,000 can be partially adsorbed or retarded during transport with water. Chemicals with a K_{oc} of less than 1,000 will not adsorb to soil organic carbon and are mobile.

Note that specific gravities, solubilities, and K_{oc} values are not provided for inorganics listed in Table 6-1. This is because inorganic analyses measure the total amount of a particular constituent in the sample; not the actual chemical form (such as a metal hydroxide complex or metal-ligand complex) or metal oxidation state. The distribution of specific solute species, pH, and oxidation state are important in determining the total solubility or mobility of a given inorganic.

6.1.1 Atmospheric Migration

Atmospheric migration of contaminants occurs primarily by: (1) volatilization of the chemical into air, and (2) release of fugitive dust with chemicals adsorbed to soil or wood debris particulates. The first mechanism, volatilization, is a major pathway for VOCs from surface soils to receptors either on or off site. The second method, fugitive dust release, predominates for organic compounds with high adsorption characteristics (i.e., high K_{oc} values) such as SVOCs (phthalates and PAHs), and for inorganics. The extent to which the mechanisms operate is governed in part by meteorological conditions and the amount of exposed contaminated surface materials.

Atmospheric migration via volatilization from surface soil is a possible contaminant migration pathway. This is evidenced from observed chemical odors in the vicinity of the chemical storage building observed during Phase II RI activities. In addition, quantitative air monitoring was conducted during the Phase II RI (see Section 2.0) to determine the nature and distribution of contaminants in the atmosphere at the site. Baseline air monitoring samples detected concentrations of VOCs near the chemical storage building. Contaminants that could be volatilized and transported off site in significant concentrations via atmospheric migration are the VOCs 1,1,1-TCA, xylenes, and chloroethane. In addition to chemical contaminants quantified at the Becker site, gaseous chemicals often identified at landfills (such as methane) are also likely to be present and volatilize to the atmosphere as wood debris decays.

Atmospheric migration via wind-blown particulate matter is also expected to be a significant exposure pathway because the debris pile area is not covered. Dry sawdust and wood particulates contaminated with phthalates are anticipated to be transported as dust during dry periods. Due to wet conditions during the Phase II RI, dust monitoring performed during test pitting and drilling did not detect significant concentrations of airborne dust.

6.1.2 Surface Water Migration

Surface water can transport chemicals either as a dissolved phase or adsorbed onto entrained particulate matter. Dissolved and adsorbed phase contaminants move to surface water via either runoff from contaminated surface soils and refuse or discharge from contaminated groundwater. Runoff from contaminated surface soil is not expected to be a significant migration pathway because of the limited amount of possible contamination by inorganics and organic chemicals detected in the soil at the surface. Discharge of shallow groundwater (dissolved phase) contamination to surface water at the Becker site is possibly evidenced by two factors: (1) the presence of contaminated shallow groundwater within a few feet of the ground surface in areas drained by site drainage ditches, and (2) the presence of VOCs, inorganics, and other contaminants (phthalates and 1,4-dichlorobenzene) in surface water and sediment in the drainages adjacent to or downstream of contaminated portions of the Becker site.

6.1.3 Groundwater Migration

Contaminants enter groundwater at the Becker site through the downward seepage of chemicals, either as pure liquids or dissolved in water by the action of rain, surface water, or shallow groundwater percolating (leaching) through stockpiled debris materials or subsurface soil. In all cases, the concentrations in groundwater depend on the solubility of the chemical in water. Contaminants entering groundwater as a dissolved phase move with groundwater flow. If contaminants enter groundwater as a non-aqueous chemical phase liquid, the contaminants will migrate in a direction dependent on the specific gravity of the chemical phase, groundwater flow, entry pressures, and the surface topography of any confining layers. Monitoring well data (see Section 5.0) show only concentrations of organic contaminants significantly below solubility limits, suggesting that non-aqueous phase liquid (NAPL) chemical contamination is not present in bedrock at the Becker site; there is the potential,

however, for NAPL to be present in soil, as evidenced from test pit results from soil collected below the water table at the chemical storage building.

Hydrogeologic data and borehole geophysical logging were used to assess potential vertical migration of dissolved contaminants in groundwater at the Becker site. Hydrogeologic data from monitoring well and piezometer clusters at the Becker site show vertical hydraulic gradients that indicate groundwater moves downward from overburden into bedrock beneath the site. Strong upward gradients at Thorp Creek and Catskill Creek suggest groundwater discharges upwards into these water bodies (see Subsection 4.0). Overall, groundwater contamination migrating from the site is expected to migrate in bedrock through fractures in the direction of groundwater flow.

6.2 CONTAMINANT FATE

VOCs and inorganics are the primary contaminants at the Becker site that appear to be migrating from the debris pile materials or subsurface soil to groundwater, and ultimately to surface water in the vicinity of the site or downstream at Thorp Creek and Catskill Creek. SVOCs appear to migrate in a limited fashion via surface water from site sources; SVOCs have not been identified as contaminants in Thorp Creek and Catskill Creek.

6.2.1 VOCs

The VOC contaminants are halogenated hydrocarbons (i.e., vinyl chloride, chloroethane, 1,1-DCA, 1,2-DCE, 1,1,1-TCA, TCE, and PCE), ketones (i.e., 2-butanone), and aromatic hydrocarbons (i.e., benzene, toluene, ethylbenzene, and xylenes). All the VOCs are present in groundwater and surface water at concentrations much less than their solubilities. Processes that will control the fate of VOCs at the Becker site include volatilization, biodegradation, and dissolution.

Dissolution of VOCs from site sources to groundwater is believed to be the most significant transport mechanism for VOCs at the Becker site. Factors affecting dissolution of VOCs from the site sources are: (1) water table elevation in comparison to soil contamination, and (2) flow rate (residence time) of the groundwater in the contaminated material.

Biodegradation reactions can reduce the total mass of VOCs in surface water and groundwater. Naturally occurring soil and aquatic microorganisms capable of degrading aromatic hydrocarbons (and ketones) have been studied (Jamison, et al., 1975; and Bailey, et al., 1973). Because these microorganisms require oxygen for aerobic biodegradation activity, the concentration of DO provides a means of assessing the potential for aerobic biologic activity in groundwater or surface water. The solubility of oxygen in groundwater is approximately 10 mg/L (Freeze and Cherry, 1979). Surface water, and groundwater samples from the Becker site frequently contain less than 4 mg/L DO and groundwater has a measurable COD (see Table 5-8). Reduced DO and measurable COD at the Becker site indicate that potential oxygen-consuming reactions (biologic or chemical) are occurring. DO concentration less than about 2 mg/L is below the DO threshold shown to be necessary to sustain aerobic degradation (Chiang, et al., 1989). Where DO content limits aerobic biodegradation, anaerobic biodegradation may occur. Overall, as the aromatic hydrocarbons and ketones are mobilized from the site, they are likely to remain undegraded (at similar concentrations between groundwater and surface water discharge) until the oxygen content rises above 2 mg/L. At those locations, biologic degradation of aromatic hydrocarbons and ketones compounds will resume.

Halogenated VOCs are degraded by different mechanisms than are aromatic hydrocarbons and ketones. The primary halogenated VOCs at the Becker site are 1,1,1-TCA and PCE. Both are solvents used widely by industry for various purposes ranging from dry cleaning to degreasing. Under aerobic conditions, halogenated VOCs are more stable and persistent in the environment but slow degradation will occur. Under anaerobic conditions such as those at the Becker site, however, halogenated VOCs are believed to undergo biologic transformation as the dominant fate process. The anaerobic biologic transformation pathways for PCE, TCE, and 1,1,1-TCA are well-documented (Vogel and McCarty, 1985; Vogel and McCarty, 1987) and shown as follows:

(1) PCE → TCE → 1,2-DCE → vinyl chloride → chloroethane
(2) PCE → TCE → 1,2-DCE → 1,2-DCA → vinyl chloride → chloroethane
(3) 1,1,1-TCA → 1,1-DCA → vinyl chloride → chloroethane
(4) 1,1,1-TCA → 1,1-DCE → vinyl chloride → chloroethane

Because all these compounds were detected in groundwater and surface water in at least trace amounts at the Becker site (see Section 5.0), anaerobic degradation

(reductive dechlorination) of PCE, TCE and 1,1,1-TCA to vinyl chloride and chloroethane is believed to be the most significant fate for these compounds. As vinyl chloride and chloroethane are produced, these in turn can be further transformed to carbon dioxide (CO_2), or volatilized to the atmosphere.

6.2.2 SVOCs

Processes that control the fate of SVOCs (primarily phenols, PAHs, and phthalates) at the Becker site include adsorption, biodegradation, and dissolution. The TCL SVOCs detected in source materials at the site are expected to be relatively immobile because of adsorption to the organic carbon fraction of the soil predicted through organic carbon-water partition coefficients and low solubilities (Tinsley, 1979; Kenaga and Goring, 1978). However, leaching of some types of SVOCs (traces of BEHP) from source materials to groundwater (and surface water) is observed to be occurring at the site, and concentrations are significantly below solubilities for the compounds. This provides a continuing source of SVOCs to be concentrated in surface soil and in sediment in the adjacent surface water bodies.

Because DO concentrations in groundwater are less than 4 mg/L beneath the site, anaerobic conditions are thought to be present in site source areas and associated overburden. In aerobic environments, natural biodegradation processes can decrease the concentrations of PAHs (Kenaga and Goring, 1978; Weil, Dune, and Quentin, 1973). These processes could be significant in decreasing concentrations of these compounds in surface water in the adjacent surface water bodies. Overall, adsorption to soil and sediment is the expected fate of PAHs, phenols, and phthalates at the Becker site.

6.2.3 Inorganics

Inorganics detected at the Becker site at concentrations exceeding soil background or exceeding water quality standards or guidance are metals (lead), transition metals (iron and copper), non-transition metals (mercury, cadmium, and zinc), alkaline earth metals (beryllium, and barium), and nonmetallic elements (arsenic, antimony). Of these, iron and zinc are the metallic elements detected at the highest concentrations in different media at the Becker site.

The inorganic chemistry of iron and zinc are discussed in this subsection to assess the overall fate of inorganics leaching from sources at the site. The discussion in this subsection remains qualitative because of the complex nature of inorganic chemistry. Mobility of inorganics in soil-groundwater systems is strongly affected by compound solubility, pH, soil cation exchange capacity, soil type, oxidation-reduction potential, adsorption processes, major ion concentrations, and salinity. At the Becker site, source materials (wood debris and buried refuse) and geologic materials (overburden and shale bedrock) contain inorganics that could be available for transport to groundwater and ultimately to surface water and sediment in the adjacent drainages (see Section 5.0).

The most mobile oxidation state of iron is Fe^{2+}. Iron readily forms complexes with organic matter, carbonate, sulfate, or hydroxides. High Fe^{2+} concentrations in groundwater can be observed where a relatively low oxidation potential exists because of chemical reactions that deplete the availability of dissolved oxygen (Hem, 1989). If groundwater containing Fe^{2+} comes in contact with air, iron becomes oxidized to Fe^{3+}, which may subsequently precipitate as ferric hydroxide. Bacteria are known to cause iron precipitation (oxidizing bacteria) or dissolution of iron (reducing bacteria). Iron oxides are typically described as orange or red.

Zinc deposition in soil occurs primarily by complexation/adsorption on hydrated oxides of manganese and iron, clays, organic matter, and by precipitation reactions (IRP, 1990). Zinc concentrations in most natural waters are less than 45 μg/L (Hem, 1989). Zinc mobility increases with decreasing pH. Zn^{2+} is the dissolved ionic form found in solution below pH 7.7.

6.3 SITE CONCEPTUAL MODEL

Based on previous investigations and data, and site geology, ABB-ES developed a conceptual model of the site (see Figure 6-1). The conceptual model can be summarized as follows:

- Becker Electronics Manufacturing Corporation appears to have released solvents to the environment through various means, including (1) discharge to on-site sanitary waste and industrial waste septic systems, (2) spills at the chemical storage building, and (3) disposal on

the ground surface and on debris piles. The primary solvent released at the site was 1,1,1-TCA, and secondarily TCE and PCE. Degradation products of the solvents (vinyl chloride, 1,1-DCE, 1,1-DCA, 1,2-DCE, 1,2-DCA and chloroethane) are present in site media.

- Once released to the thin overburden on the site via leachfields or surface spills, the solvents migrated to groundwater. Groundwater at the site is located in both overburden and bedrock. Shallow groundwater (in overburden) discharges downward into bedrock and laterally into site drainage ditches. Bedrock groundwater flow is toward Thorp and Catskill Creeks east of the site.

- Possible dense NAPL may be present in overburden, based on a one-time reported detection of 72 mg/L of 1,1,1-TCA in a water supply well immediately south of the site (at a location potentially downgradient of the industrial leachfield and debris pile); a one-time reported detection of 27 mg/L of 1,1,1-TCA in an on-site water supply well; current data (concentrations) in bedrock well MW-106D; and historical information that at least one drum of waste 1,1,1-TCA was spilled on the ground surface at the chemical storage building.

- Groundwater VOC data and groundwater flow directions infer that sources of groundwater contamination observed in MW-4 and MW-5 (located north and south, respectively, of the chemical storage building) may not have been identified: (a) test pitting in the debris pile/leachfield did identify VOCs; however concentrations in overburden/fill materials were not high enough to cause the groundwater concentrations observed at MW-5 or MW-109; and (b) MW-4 data is similar between the Phase I RI and Phase II RI data, however, a source of this contamination has not been delineated upgradient of this well.

- Contaminated groundwater migrating from the site moves northeast and east along fracture zones in the bedrock toward Catskill Creek. Along these flow paths, contaminated groundwater is intercepted by

several water supply wells. Seep data confirm contamination discharges to the Catskill and Thorp Creeks.

- Ultimately, contaminated surface water and groundwater discharging to Catskill Creek is diluted to non-detectable levels. Phase I RI sampling shows surface water in on-site ditches and the adjacent creeks to contain 1,1,1-TCA and other VOCs. The NYSDEC sampling showed traces of 1,1,1-TCA in one on-site surface water sample. Phase II RI data also show detections of 1,1,1-TCA and other VOCs in on-site surface water.

Figure 6-1 Site Conceptual Model

TABLE 6-1
PHYSICO-CHEMICAL PROPERTIES OF SITE CONTAMINANTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

ANALYTE	MEDIA CONTAMINATED						CAS NUMBER	WATER SOLUBILITY (mg/L)	DENSITY (mg/cm3)	Koc (ml/g)
	ST	SBS	SS	SD	SW	GW				
VOCs										
Chloroethane	X	X		X		X	75-0-3	5740	0.0903	17
1,1-Dichloroethane	X	X	X	X	X	X	75-34-3	5500	1.1835	30
1,1-Dichloroethene				X	X	X				
1,2-Dichloroethane		X				X	107-06-02	8520	NAV	14
Chloroform						X	67-63-3	8200	NAV	31
Vinyl chloride					X	X	75-01-4	2670	NAV	57
1,2-Dichloroethene (cis)		X			X	X	540-59-0	3500	1.2736	49
1,1,1-Trichloroethane	X	X	X	X	X	X	71-55-6	1500	1.3492	152
1,1,2-Trichloroethane						X				
Trichloroethene		X	X	X	X	X	79-1-6	1100	1.4679	126
Tetrachloroethene		X	X		X	X	127-18-4	150	1.6311	364
Acetone			X			X	67-64-1	INFINITE	0.791	2.2
2-Butanone		X	X			X	78-93-3	268000	0.805	4.5
2-Hexanone		X					591-78-6	14000	0.6732	NAV
4-Methyl-2-Pentanone			X				108-10-1	17000	0.8006	NAV
Benzene					X		71-43-2	1750	0.8737	83
1,1,2,2-Tetrachloroethane		X					79-34-5	2900	NAV	118
Ethylbenzene		X	X				100-41-4	152	0.867	1100
Toluene	X	X	X	X			108-88-3	535	0.8623	300
Xylenes		X	X			X	1330-20-7	198	0.86	240
SVOCs										
Bis(2-ethylhexyl)Phthalate	X	X	X	X	X		117-81-7	0.285	0.9843	5900
Benzoic Acid	X	X	X	X	X					
Butylbenzylphthalate	X	X	X	X			85-68-7	42.2	1.1	NAV
Diethylphthalate		X	X	X			84-66-2	896	1.12	142
2-Methylphenol		X					95-48-7	NAV	NAV	NAV
1,2-Dichlorobenzene		X					95-50-1	100	NAV	1700
1,4-Dichlorobenzene	X		X	X			106-46-7	79	NAV	1700
4-Methylphenol		X	X				106-44-5	NAV	1.035	NAV
Dibenzofuran		X	X	X			132-64-9	4.75	1.089	NAV
Acenaphthene	X	X	X	X			83-32-9	3.42	1.069	4600
Anthracene			X	X			120-12-7	0.045	1.25	14000
Benzo(a)Pyrene		X	X	X			50-32-8	0.0012	NAV	5500000
Benzo(b)Fluoranthene		X	X	X			205-99-2	0.014	NAV	550000
Benzo(k)Fluoranthene		X		X			207-08-9	0.0043	NAV	550000
Chrysene	X	X	X	X			218-01-9	0.0018	1.274	200000
Fluorene		X	X	X			86-73-7	1.69	NAV	7300
Fluoranthene	X	X	X	X			206-44-0	0.0206	1.252	38000
Indeno(1,2,3-cd)Pyrene		X	X	X			193-99-5	0.00053	NAV	1600000
2-Methylnaphthalene	X	X	X	X			91-57-6	25.4	0.994	8500
Naphthalene		X	X	X			91-20-3	31.7	0.9752	1300
Phenanthrene		X	X	X			85-01-8	1	1.025	14000
Pyrene	X	X	X	X			129-00-0	0.132	1.271	38000
Benzo(a)Anthracene		X	X	X			56-55-3	NAV	NAV	NAV
Phenol		X	X				108-95-2	88700	1.07	NAV
Isophorone				X			78-59-1	NAV	NAV	NAV
2,4-Dimethylphenol		X					105-67-9	6200	1.383	NAV
Acenaphthalene		X		X			208-96-8	NAV	NAV	NAV
Di-n-Butylphthalate	X	X	X	X			84-74-2	NAV	NAV	NAV
Di-n-Octylphthalate	X	X	X	X			117-84-0	NAV	NAV	NAV
Benzo(g,h,i)Perylene		X	X				191-24-2	NAV	NAV	NAV

TABLE 6-1
PHYSICO-CHEMICAL PROPERTIES OF SITE CONTAMINANTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

ANALYTE	MEDIA CONTAMINATED						CAS NUMBER	WATER SOLUBILITY (mg/L)	DENSITY (mg/cm3)	Koc (ml/g)
	ST	SBS	SS	SD	SW	GW				
dibenz(a,h)Anthracene		X								
PESTICIDES/PCBs										
Methoxyclor	X									
Aroclor-1254				X			11097-69-1	0.057	1.5	64565
INORGANICS										
Aluminum					X	X	7429-90-5	NA	NA	NA
Antimony		X	X		X	X	7440-36-0	NA	NA	NA
Arsenic	X	X	X	X	X	X	7440-38-2	NA	NA	NA
Barium					X	X	7440-39-3	NA	NA	NA
Beryllium	X				X		7440-41-7	NA	NA	NA
Cadmium	X	X	X	X	X	X	7740-43-9	NA	NA	NA
Chromium	X				X		7440-47-3	NA	NA	NA
Cobalt	X				X		7440-48-4	NA	NA	NA
Copper	X			X	X		7440-50-8	NA	NA	NA
Iron	X				X		7439-89-6	NA	NA	NA
Lead	X		X		X	X	7439-92-1	NA	NA	NA
Magnesium	X				X		7439-95-4	NA	NA	NA
Manganese	X				X	X	7439-96-5	NA	NA	NA
Mercury	X		X			X	7439-97-6	NA	NA	NA
Nickel	X				X		7440-02-0	NA	NA	NA
Potassium	X					X	151-50-8	NA	NA	NA
Selenium		X			X	X	7782-49-2	NA	NA	NA
Silver		X						NA	NA	NA
Vanadium	X				X	X	7440-62-2	NA	NA	NA
Zinc	X	X	X	X	X		7440-66-6	NA	NA	NA
Cyanide			X				57-12-5	NA	NA	NA

NOTES:

SOLUBILITY, DENSITY, AND Koc VALUES FROM (1) MERCER, J.W., SKIPP, D.C., AND GIFFIN, D., 1990 (EPA-600/8-90/003); (2) K. VERSCHUEREN, 1983; AND (3) MACKAY, D., W.Y. SHIU, AND K.C. MA, 1992
CAS = CHEMICAL ABSTRACTS SERVICE NUMBER
ST = SEPTIC TANKS
SD = SEDIMENT
SW = SURFACE WATER
SS = SURFACE SOIL
SBS = SUBSURFACE SOIL
GW = GROUNDWATER
VOCs = VOLATILE ORGANIC COMPOUNDS
SVOCs = SEMIVOLATILE ORGANIC COMPOUNDS
NAV = NOT AVAILABLE IN REFERENCES
NA = NOT APPLICABLE
PCBs = POLYCHLORINATED BIPHENYLS

7.0 BASELINE RISK ASSESSMENT

7.1 BASELINE PUBLIC HEALTH ASSESSMENT

This public health RA characterizes current and potential risks to human health based on results from the Phase II sampling program. The evaluation is a baseline assessment in that it assumes no remedial action will take place. This RA is based on the baseline human health risk and environmental risk assessment conducted in 1992 by M&E as part of the Phase I RI (M&E, 1992a). The baseline human health risk assessment is a quantitative evaluation of potential human health risks, and assessed both child and adult exposures to soil, sediment, surface water, and groundwater. No evaluation of subsurface soil or air emissions was conducted.

This RA, conducted as part of the Phase II RI, is a qualitative evaluation of potential health risks. New analytical results from the Phase II sampling program are compared to the appropriate concentrations used in the Phase I RI risk assessment and the media criteria established by the NYSDEC or USEPA. This RA is prepared in accordance with the USEPA Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (USEPA, 1989b). Media evaluated in this RA are groundwater, subsurface soil, sediment, surface water, surface soil, and air. This baseline RA also identified CPCs for the Becker site for further evaluation in the FS. CPCs are those site contaminants present at average concentrations exceeding background and exceeding potential chemical-specific ARARs and SCGs. The potential chemical-specific ARARs and SCGs are typically risk-based criteria.

7.1.1 Summary of Phase I Risk Assessment

The Phase I RI baseline public health risk assessment was conducted assuming exposure to site-related contaminants involving both children and adults. Trespassing exposure scenarios were used for both age groups. Exposure point concentrations were the arithmetic mean and the 95 percent upper confidence level (UCL) of the mean for the media-specific analytical results. Residential, domestic use of the groundwater was used to assess potential health risks associated with the groundwater. Surface water and sediment samples from both a drainage ditch and the fire pond were assessed separately. Exposures were assumed to occur through incidental ingestion and dermal contact with the surface soil, sediments, and surface

water. Exposure to groundwater was assumed to occur through ingestion, dermal contact, and inhalation.

The quantitative risk characterization for potential carcinogenic risks, using both average and 95 percent UCL concentrations, calculated risk levels within or below the USEPA cancer risk range of 10^{-6} to 10^{-4} for exposures to surface soil, surface water and sediments. Cancer risk levels calculated for exposures to groundwater, however, exceeded the 10^{-4} risk level for both adult and child exposures. The chemical causing the highest cancer risk was 1,1-DCE. Noncancer risks were also evaluated. The total (all site related exposure pathways) noncancer risk level for children using average concentrations only slightly exceeded a Hazard Index (HI) of 1, and the total adult risk level was below an HI of 1. The total noncancer risks for both children and adults using the 95 percent UCL slightly exceed an HI of 1, with the majority of risk attributable to groundwater. The Phase I RI public health RA concluded that the human health risks for the site are dominated by groundwater exposure pathways to VOCs, but all identified users of the groundwater were treating the water with granular activated carbon (M&E, 1992a; 1992c).

7.1.2 Data Evaluation

Data from the Phase II RI, Phase I RI, and other investigations were selected for evaluation in this qualitative RA. The Phase II RI sampling was conducted in 1994 by ABB-ES as described in Subsection 2.2. The data was evaluated and validated as described in Subsections 2.2 and 2.3. The nature and distribution of media-specific contamination are discussed in Section 5.0. Only the maximum detected concentration for an analyte in a respective media was evaluated in this RA. Sample locations for the respective media used in this evaluation are presented in Tables 5-2 through 5-6. TOC concentrations for calculating sediment criteria were determined from data presented in Appendix B. The analytical results are compared to those used in the quantitative evaluation presented in the Phase I public health RA.

7.1.3 Identification of Chemicals of Potential Concern

Potential site contaminants were identified as described in Subsection 2.4. The CPCs selected for evaluation in this RA for groundwater, subsurface soil, sediment, surface water, surface soil, and air are presented in Tables 7-1 through 7-6, respectively. The CPCs which were selected in the Phase I RA are also presented in the respective

tables, in the column labeled Phase I concentrations. A comparison of the CPCs selected in the Phase I RA to the CPCs identified in this RA is presented in the following media-specific discussions. To aid in identification of CPCs, average detected concentrations of contaminants are also indicated in Tables 7-1 through 7-6. Because of the sporadic nature of detections and concentrations, a contaminant is listed in the Tables as a CPC if its average concentration exceeds applicable criteria.

7.1.4 Exposure Assessment

The potential exposure pathways, receptors, and exposure concentrations used in the Phase I RA were evaluated for completeness. The Phase I RA evaluated exposures to adult and children trespassing on the site and domestic use of the groundwater. The exposure pathways used for groundwater were complete, involving ingestion, dermal contact, and inhalation of volatile compounds. The trespassing scenarios evaluated incidental ingestion and dermal contact to surface soil, surface water, and sediment. The Phase I RA, however, did not evaluate inhalation of particulates from surface soil, which may be a minor exposure pathway. Although the site is currently not used commercially, construction and groundskeeping activities at the site may occur in the future. However, exposures to a future worker at the site were not evaluated. Also, exposures to subsurface soil and inhalation of vapors by on-site workers were not evaluated.

When comparing the Phase II concentrations to the Phase I concentrations used in the quantitative RA, the same exposure pathways and parameters are assumed for evaluation of groundwater, surface soil, sediment, and surface water. These media are also evaluated by comparison to media-specific criteria developed by NYSDEC or the USEPA. Worker exposures to subsurface soil are evaluated using the soil criteria developed by NYSDEC (1994). Worker exposures to air emissions are evaluated by comparison to criteria developed by the American Conference of Governmental Industrial Hygienists (ACGIH, 1994).

The exposure point concentrations used in the Phase I evaluation did not evaluate the maximum detected concentrations of CPCs. This RA uses the maximum detected concentration to evaluate if risk levels may have increased compared to the Phase I evaluation. Because the site is fenced and access restricted, and exposure point concentrations would better reflect average concentrations rather than maximum concentrations, and groundwater currently used for domestic use is carbon

filtered, actual exposures at the site are expected to be less than those evaluated in this RA and the potential health risks overestimated.

7.1.5 Risk Characterization

Risk characterization involves the qualitative or quantitative evaluation of potential health risks associated with exposure to chemicals, substances, or situations in the environment. The Phase I RA characterized estimates of potential carcinogenic and noncarcinogenic risks associated with groundwater as exceeding the USEPA risk range and level, respectively. Risks characterized for exposures to the other media evaluated did not exceed these levels. The risk characterization for this RA is a qualitative comparison of the maximum detected concentrations from the Phase II RI to the concentrations used in the Phase I RA and to media specific criteria such as USEPA MCLs, MCLGs, and soil cleanup levels. The risk characterizations for the individual media are presented in the following paragraphs.

7.1.5.1 Groundwater. The CPCs, maximum detected concentrations, Phase I CPCs and 95 percent UCL concentrations, and criteria for groundwater are presented in Table 7-1. The Phase I RA identified only a few inorganics and VOCs as CPCs. Based on the criteria in Subsection 7.1.3, the Phase II RI identified the VOCs as 1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCE, PCE, TCE, 1,2-DCA, 2-butanone, acetone, chloroethane, xylenes, and vinyl chloride as CPCs. The inorganics antimony, lead, and thallium are also identified as CPCs in Table 7-1; however, there are insufficient background data for antimony and thallium (other than data for background Well MW-101, no other data for Greere County are available), and on average, lead in groundwater is within background. For all of the CPCs, except tetrachloroethene, the maximum detected concentrations in Phase II exceed the Phase I concentrations. As shown in Table 7-1, the concentrations of several CPCs detected in Phase II, but not evaluated in Phase I, exceed the groundwater criteria NYS Class GA standards and/or USEPA MCLs and MCLGs (see Table 2-10). These results indicate that the potential health risks associated with exposures to groundwater may be greater than initially evaluated in Phase I and the risk levels are greater than the Phase I risk estimate of $1x10^{-4}$, exceeding the NYSDOH risk criteria and the USEPA target risk range of 10^{-6} to 10^{-4}.

7.1.5.2 Subsurface Soil. The CPCs, maximum detected concentrations, soil criteria and background concentrations, for subsurface soil are presented in

Table 7-2. The Phase I RA did not evaluate subsurface soil, and direct comparison to concentrations used for the surface soil evaluation may not be appropriate because of different potential exposures. Inorganics, SVOCs and VOCs are identified as CPCs in the Phase II RA. As shown in the table, CPCs are identified if the average concentration exceeds the NYS soil criteria (NYSDEC, 1994). The NYS soil criteria are based on human health and potential contamination to groundwater. CPCs identified in subsurface soil in the Phase II RI based on the criteria in Subsection 7.1.3 are the VOCs 1,1,1-TCA and 2-butanone; the SVOCs 2-methylphenol, 4-methylphenol, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, phenol, and BEHP; and the inorganics cadmium and zinc (see Table 7-2). These results indicate that potential health risks or contamination of groundwater are associated with exposures to subsurface soil, and if calculated, risks would likely exceed NYSDOH and USEPA carcinogenic and noncarcinogenic risk criteria of note is that on a local scale, other VOCs would be identified as CPCs due to high concentrations, in particular VOCs at the chemical storage building.

7.1.5.3 Sediment. The CPCs, maximum detected concentrations, Phase I CPCs and 95 percent UCL concentrations, and criteria and background concentrations for sediment are presented in Table 7-3. The Phase I RA identified only a few inorganics, Aroclor-1254, several SVOCs, and the VOC 1,1-DCA as CPCs. CPCs identified in sediment in the Phase II RI based on the criteria in Subsection 7.1.3 is the VOC 1,1-DCE; the SVOCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)perylene, and BEHP; and the inorganics cadmium, copper, and zinc. The Phase II maximum concentrations for cadmium, lead, phthalates, and 1,1-DCA are identified as exceeding the Phase I concentrations. Generally, the SVOCs, including the PAHs and phthalates, were higher concentration in the Phase II RA. These results indicate that the potential health risks associated with exposures to sediment may be greater than initially evaluated in Phase I and could potentially exceed NYSDOH and USEPA carcinogenic and noncarcinogenic risk criteria.

7.1.5.4 Surface Water. The CPCs, maximum detected concentrations, Phase I CPCs and 95 percent UCL concentrations, and criteria for surface water are presented in Table 7-4. The Phase I RA identified several inorganics, no SVOCs, and only TCE as CPCs. CPCs identified in surface water in the Phase II RI based on the criteria in Subsection 7.1.3 are the VOCs 1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCE, PCE, and vinyl chloride; the SVOC BEHP; and the inorganics aluminum,

cobalt, iron, manganese, nickel, and zinc (see Table 7-4). For all of the CPCs, the maximum detected concentrations in Phase II exceed the Phase I concentrations. These results indicate that the potential health risks associated with exposures to surface water may be greater than initially evaluated in Phase I and could exceed NYSDOH and USEPA carcinogenic and noncarcinogenic risk criteria.

7.1.5.5 Surface Soil. The CPCs, maximum detected concentrations, Phase I CPCs and 95 percent UCL, soil criteria, and background concentrations for surface soil are presented in Table 7-5. The Phase I RA identified several inorganics, SVOCs, and VOCs as CPCs. CPCs identified in surface soil in the Phase II RI based on the criteria in Subsection 7.1.3 are the VOCs 2-butanone, acetone, ethylbenzene, toluene, and xylenes; the SVOCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and phenol; and the inorganics cadmium, lead, and zinc. Note that in surface soil at the debris pile area, additional SVOCs (such as BEHP) are present at concentrations such that they could be considered CPCs. The maximum detected concentrations of inorganics in Phase II are greater than the concentrations evaluated in the Phase I RA. Of the SVOCs detected, the PAHs are generally at lower concentrations in Phase II, and the phthalates at higher concentrations compared to Phase I. As shown in the table, the concentrations of several CPCs detected in Phase II, but not evaluated in Phase I, exceed the NYS soil criteria (NYSDEC, 1994). Particularly of interest are ethylbenzene, toluene, and xylenes at 600,000, 2,000,000, and 3,400,000 μg/kg, respectively, compared to the soil criteria concentrations of 5,500, 1,500, and 1,200 μg/kg, respectively. These results indicate that the potential health risks associated with exposures to surface soil may be greater than initially evaluated in Phase I and could potentially exceed NYSDOH and USEPA carcinogenic and noncarcinogenic risk criteria.

7.1.5.6 Air. Air samples were not collected in the Phase I RI. The maximum detected concentrations in air samples collected as part of Phase II are presented in Table 7-6. As shown in the table, no concentrations were identified as exceeding the air criteria concentrations for worker exposures. No health risks associated with exposure to air emissions are identified.

7.1.6 Uncertainty Evaluation

Quantitative estimates of risk are based on numerous assumptions, most of which are intended to protect human health (i.e., are conservative). The use of the maximum

detected concentrations in the Phase II RA assumes a worst case exposure point concentration. Qualitative comparison of Phase II data to the concentrations used in the Phase I RA may not adequately characterize the potential health risks associated with the site. While it is true that there are some uncertainties in the RA methodology that might lead to an underestimation of true risks, most assumptions will bias the evaluation in the direction of overestimation of risk.

7.1.7 Risk Assessment Summary

The maximum and average concentrations detected in the Phase II RI were compared to concentrations used in the Phase I RA, to background, and to potential chemical-specific ARARs and SCGs. Media not evaluated in the Phase I RA but included in the Phase II evaluation are subsurface soil and air. In the Phase I RA, potential risks associated with exposures to groundwater were characterized as exceeding the USEPA risk range for carcinogens and the risk level for noncarcinogens. The Phase II evaluation identified additional CPCs and concentrations greater than those used in Phase I, indicating that potential health risks may be greater than initially characterized for all media evaluated.

Results for surface water, sediment, and surface soil were similar to groundwater, in that additional CPCs, higher concentrations, and exceedances of criteria concentrations are identified in the Phase II evaluation. These results indicate that potential health risks may be greater than initially evaluated. Although subsurface soil was not evaluated in Phase I, comparison of CPC concentrations in subsurface soil to soil criteria indicate higher concentrations than criteria, and may reflect potential health risks or sources of contamination to groundwater. Evaluation of air concentrations identified no human health risks.

7.2 HABITAT-BASED ECOLOGICAL ASSESSMENT

This subsection presents the results of an ecological habitat-based assessment (HBA) of the Becker site performed in accordance with NYSDEC (1989b, 1991a, and 1993c) guidance, which provides an approach for "the characterization of the fish and wildlife values and threats at hazardous waste sites being considered for remediation." The objectives of the HBA are:

- to provide a characterization of the existing ecological habitats at the site;
- to identify those ecological habitats which may be located within pathways of contamination; and
- to identify the types of fish and wildlife receptors which would utilize those habitats which may be located within pathways of contamination.

In accordance with NYSDEC guidance (1989b, 1991a, 1993c), this HBA includes the Step I evaluation: "A Description of the Existing Environment." The Step I description of the existing environment includes a site description, resource characterization, and hazard threshold identification. Components of the Step I HBA have been incorporated into the following ecological evaluation.

This evaluation was conducted in accordance with the following state and federal guidance documents:

- "Ecological Assessment of Hazardous Waste Site: A Field and Laboratory Reference " (USEPA, 1989c);
- "Habitat Based Assessment Guidance Document for Conducting Environmental Risk Assessment at Hazardous Waste Sites" (NYSDEC, 1989b);
- "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites" (NYSDEC, 1991a); and
- "Technical Guidance for Screening Contaminated Sediment" (NYSDEC, 1993c).

7.2.1 Selection of Chemicals of Potential Concern

The selection of CPCs in the ecological evaluation is a screening process used to define the site-related contaminants requiring evaluation. Factors considered when selecting CPCs include: the validity of the data for ecological risk assessment; the classification of chemicals (i.e., inorganic, organic, pesticides); comparison of

chemical concentrations to naturally occurring background concentrations; the physical and chemical properties of chemicals; the frequency of release and detection; and the inherent toxicity of exogenous chemicals (USEPA, 1989c).

Sampling conducted as part of the RI revealed the presence of organic and inorganic contaminants in the following environmental media:

- surface soils
- subsurface soils
- groundwater
- surface water
- sediments

A detailed discussion of the sampling program is presented in Section 2.0. The results of the sampling program, and the nature and distribution of contamination are discussed in Section 5.0. Qualitative evaluation of CPCs identified in these media is conducted by comparing the maximum detected concentration in the media to media-specific criteria. The criteria used for comparison are discussed in Subsection 7.1. The CPCs, criteria, and results of the comparison are presented in Tables 7-1, 7-3, 7-4, and 7-5 for groundwater, sediment, surface water, and surface soil, respectively.

7.2.2 Site Description

The purpose of the ecological characterization is to identify ecological receptors potentially exposed to contamination at the Becker site. This subsection includes general descriptions and mapping of vegetative cover-types at the Becker site, and is based upon a review of scientific literature and other published accounts, site-specific reports and records, contact with regional authorities, and observations made during 1994 site visits. The presence or absence of rare and endangered flora and fauna at the site, as well as information regarding any other critical ecological receptors, is reviewed in this subsection.

In accordance with the NYSDEC "Step I" requirements, the major vegetative cover types within one half mile of the site were mapped (Figure 7-1). A map of vegetative cover types at the site and immediate vicinity (i.e., the area comprising the approximately 13-acre site) was also prepared (Figure 7-2). The site is surrounded by woods, open fields, and developed areas situated along NYS Route 145. Two NYSDEC-designated protected wetlands are located near the site, along the source of Thorp Creek and Catskill Creek, respectively (see Figure 7-1 and Section 3.0). The site is characterized by a wooded area, open grassy fields, abandoned manufacturing and out-buildings, a fire pond, several drainage streams, and a waste debris pile area (with minimal vegetation) composed mostly of scrap wood from speaker cabinet construction (see Figure 7-2). Surface water drainage and groundwater flow is generally toward the east, toward Catskill Creek and Thorp Creek (a tributary of Catskill Creek). Thorp Creek and Catskill Creek are listed as NYSDEC Class C(TS)-C and C(T)-C trout streams, respectively.

7.2.3 Resource Characterization

This subsection describes the fish and wildlife species that may inhabit the Becker site and the area around the site. The fish and species occurring within at least 0.5 mile of the site were identified based on field observations during the 1994 site visit, as well as information sources such as the New York Breeding Bird Atlas, discussions with wildlife officials, and habitat and range information presented in the scientific literature.

Factors that can affect habitat suitability include the diversity of plant community types, plant species composition, extent of interspersion of open water with vegetation, interspersion of wetland types, surface water characteristics and chemistry. Other than the debris pile area (which has minimal vegetation), no areas of noticeably stressed vegetation were observed. The following paragraphs discuss the flora and fauna observed at the site.

7.2.3.1 Flora. A number of herbaceous and several woody species have colonized the former manufacturing site. The flora species identified from the 1994 field effort are presented in Table 7-7. Specific, distinct areas of vegetation, including open fields, woodland, and wetland communities, are located on the site (Figure 7-2). Surrounding the site are open fields (to the north, south and

immediately west), upland woodland (to the west), and mixed commercial and residential development (to the east) (Figure 7-1).

7.2.3.2 Fauna. Many invertebrate species feed on flowers, fruits, and leaves of plants; conversely, invertebrates serve as prey items for a variety of predators, including predaceous insects, amphibians, reptiles, birds, and mammals. Invertebrates also serve as important detritivores, scavengers, and pollinators. Insects, as well as other invertebrates, are critical members of the various wetland communities in the vicinity of the site. These invertebrate species form the faunal base of aquatic and semi-terrestrial food chains, and are available for consumption by a range of higher predators.

The vegetative cover, fire pond, and drainage ditches at the Becker site, and the area around the site, provide habitat for a number of invertebrate and vertebrate species. Fish and aquatic species, amphibians, reptiles, birds, and mammals may occur at the site. Species identified during the 1994 field program are presented in Table 7-8. These are potential ecological receptors to CPCs identified at the Becker site.

A number of amphibian species probably occur in the vicinity of the site (Smith, 1978; RPA, 1991). True frog species, including the northern leopard frog (*Rana pipiens*), green frog (*R. clamitans*), and wood frog (*R. sylvatica*) likely occur in the wet areas in the vicinity of the site. Other amphibians thought to occur in the area include the northern spring peeper (*Hyla c. crucifer*), greater gray treefrog (*Hyla versicolor*), red-backed salamander (*Plethodon c. cinereus*), and spotted salamander (*Ambystoma maculatum*).

The most common upland reptiles in the vicinity of the site include the northern black racer (*Coluber c. constrictor*), brown snake (*Storeria dekayi*), and eastern garter snake (*Thamnophis s. sirtalis*). The common snapping turtle (*Chelydra serpentina*), eastern painted turtle (*Chrysemys p. picta*), and northern water snake (*Nerodia sipedon*) may be residents of wetlands in the vicinity of the site. The reptiles of the area are not distributed evenly throughout their ranges, but occur in spotty distributions, depending upon habitat types and other ecological factors (Conant, 1975).

Although disturbed, the terrestrial habitat at the site may provide nesting habitat for several avian species, including the mourning dove (*Zanaidura macroura*) and the

killdeer (*Charadrius vociferus*). Birds such as the common crow (corvus brachyrhychos) and eastern kingbird (tyrannus tyrannus) may also be found at the site.

The mammalian fauna in the vicinity of the site include white-tailed deer (*Odocoileus virginianus*), and secondary consumers such as red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis marsupialis*), and raccoon (*Procyon lotor*). Small mammals likely to occur at the site include various Chiropterans (bats), meadow voles (*Microtus pennsylvanicus*), white-footed mice (*Peromyscus leucopus*), short-tailed shrew (*Blarina brevicauda*), meadow jumping mice (*Zapus hudsonicus*), masked shrew (*Sorex cinereus*), and eastern cottontail rabbits (*Sylvilagus floridanus*).

7.2.4 Hazard Threshold Identification

Ecological receptors may be exposed to CPCs associated with the Becker site from various media. The CPCs identified in media investigated at the site are discussed in Section 5.0 These CPCs, for the appropriate media, are evaluated qualitatively by comparing the maximum detected concentration in the media to media-specific criteria. The criteria used for the evaluation were obtained from NYSDEC guidance documents (NYSDEC, 1991a; 1993c) and discussed in Subsection 7.2. The CPCs, criteria, and results of the comparison are presented in Tables 7-1, 7-3, 7-4, and 7-5 for groundwater, sediment, surface water, and surface soil, respectively. Ecological receptors are expected to have potential exposures to only surface soil, sediment, and surface water. Discharge of groundwater to the surface or to surface water bodies may be another route of exposure (at seeps for example), although direct exposure to groundwater is not expected.

As shown in the tables (7-3, 7-4, and 7-5), several CPCs in sediment, surface water, and surface soil exceeded the criteria concentrations. Groundwater concentrations of several CPCs, notably chlorinated solvents, also exceed criteria concentrations. These results indicate that CPCs associated with the site may pose potential risks to ecological receptors. Because of the lack of exposure to groundwater, the potential risks to ecological receptors as a result of contamination identified in groundwater is expected to be minimal. However, additional evaluation of groundwater discharge to surface water bodies, particularly Catskill Creek, may be warranted.

Figure 7-1 Vegetative Cover Type (1.0-Mile Diameter)

Figure 7-2 Aquatic and Vegetative Contour Map

(somehow inserted between T. 7-1 pages)

TABLE 7-1
CHEMICALS OF POTENTIAL CONCERN
FOR THE HUMAN HEALTH RISK EVALUATION GROUNDWATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION	GROUNDWATER CRITERIA[3]	IDENTIFIED AS CPC
TCL INORGANICS (µg/L)						
Aluminum	9/12	10,600		3,567		
Antimony	1/12	62.5		30.4	6	Y
Arsenic	10/12	38.5		10.2	50	N
Barium	12/12	3830		892	2,000	N
Cadmium	2/12	6.0		2.0	5	N
Calcium	12/12	1,158,000		259,833		
Lead	9/12	110	104	20.6	15(A)	Y
Manganese	7/7	2,620		841		
Mercury	6/9	0.90	2.3	0.4	2	N
Potassium	11/12	189,000		23,631		
Selenium	1/12	2.0		1.0	50	N
Sodium	4/4	245,000		105,775		
Thallium	1/12	3.0		2	2	Y
Vanadium	1/12	137		17.7		
Zinc	3/7	72.3		16.1		
TCL-VOA (µg/L)						
1,1,1-Trichloroethane	19/26	20,000	1,170	976	5	Y
1,1,2-Trichloroethane	1/26	2.0		36*	5(M)	N
1,1-Dichloroethane	20/26	7,100	326	397	5	Y
1,1-Dichloroethene	14/26	2,200	106	119	5	Y
1,2-Dichloroethane	2/26	10		35	5	Y
1,2-Dichlorethene	9/26	2,000	154	95	5	Y
1,4-Dioxane	2/2	30		16		
2-Butanone	2/26	900		47	50	Y
Acetone	1/26	68		34	50	Y
Chloroethane	5/26	310		25	50	Y

(continued)

TABLE 7-1
CHEMICALS OF POTENTIAL CONCERN
FOR THE HUMAN HEALTH RISK EVALUATION GROUNDWATER RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION	GROUNDWATER CRITERIA[3]	IDENTIFIED AS CPC
Chloroform	2/26	2.0		36*	7	N
Tetrachloroethene	2/26	24	34.2	35	5	Y
Total Xylenes	1/26	130		41	5	Y
Trichloroethene	12/26	1,800	201	81	5	Y
Vinyl Chloride	2/26	15		36*	2	Y

Notes:

1. Maximum detected concentration in Phase II RI.
2. 95 percent upper confidence level (UCL) concentration used in Phase I Risk Assessment (RA).
3. Groundwater criteria from Cleanup Policy and Guidelines, Vol. 1; Class GA (NYSDEC, 1991c).
4. Averages calculated using average of duplicates and ½ SQLs for non-detects.
5. Table shows inorganics at concentrations exceeding background.

Federal MCLs used for inorganic compounds and 1,1,2-trichloroethane

SQL = Sample Quantitation Limit
* = Average concentration exceeds maximum detected due to higher SQLs in most samples than detected values.

TABLE 7-2
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SUBSURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION[3]	SOIL CRITERIA[1]	IDENTIFIED AS CPC
TCL INORGANICS (mg/kg)[4]					
Antimony	3/21	18.2	13	30	N
Arsenic	19/25	15.6	4.0	7.5	N
Cadmium	21/29	243	10.7	1.0	Y
Silver	5/21	7.0	1.0	200	N
Zinc	28/28	856	130	20	Y
TCL-SVOA (μg/kg)					
2,4-Dimethyphenol	1/29	2,800*	4,303		
2-Methylnaphthalene	5/29	9,200	4,518	36,400	N
2-Methylphenol	1/29	3,400*	4,324	100	Y
4-Methylphenol	2/29	25,000	5,073	900	Y
Acenaphthene	2/29	520*	4,222	50,000	N
Acenaphthylene	1/29	250*	4,215	41,000	N
Benzo(a)Anthracene	2/29	1,200*	4,243	220	Y
Benzo(a)Pyrene	2/29	940*	4,234	61	Y
Benzo(b)Fluoranthene	2/29	1,000*	4,246	1,100	N
Benzo(g,h,i)Pyrene	1/29	470*	4,223	50,000	N
Benzo(k)Fluoranthene	1/29	790*	4,234	1,100	N
Benzoic Acid	1/9	310	140	2,700	N
Butylbenzylphthalate	1/29	170*	4,382	50,000	N
Carbazole	2/21	1,400*	5,872		
Chrysene	2/28	630*	4,374	400	Y
Di-n-butylphthalate	1/29	50*	4,585	8,100	N
Di-n-octylphthalate	16/29	58,000	4,548	50,000	N
Dibenz(a,h)Anthracene	1/29	150*	4,212	14	Y
Dibenzofuran	2/29	770*	4,230	6,200	N
Dimethylphthalate	1/29	1,100*	4,245	2,000	N

(continued)

TABLE 7-2
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SUBSURFACE SOIL RESULTS

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION[3]	SOIL CRITERIA[1]	IDENTIFIED AS CPC
Fluoranthene	4/29	1,300*	4,254	50,000	N
Fluorene	2/29	1,400*	4,252	50,000	N
Indeno(1,2,-c,d)Perylene	1/29	280*	4,216	3,200	N
Naphthalene	4/29	11,000	4,575	13,000	N
Phenanthrene	5/28	5,700	4,550	50,000	N
Phenol	1/29	13,000	4,655	30	Y
Pyrene	4/29	4,900	4,377	50,000	N
bis(2-Ethylhexyl)phthalate	19/29	580,000	56,114	50,000	Y
TCL-VOA (μg/kg)					
1,1,1-Trichloroethane	14/37	64,000	953	800	Y
1,1,2,2-Tetrachloroethane	3/28	4.0*	31	600	N
1,1-Dichlorethane	9/37	200	32	200	N
1,1-Dichlorethene	6/37	3,500	81	400	N
2-Butanone	9/37	51,000	1,543	300	Y
2-Hexanone	1/37	1,400	28		
Chloroethane	2/37	160	39	1,900	N
Ethylbenzene	6/37	1,000	39	5,500	N
Tetrachloroethene	1/37	340	25	1,400	N
Toluene	6/37	43,000	795	1,500	N
Total Xylenes	7/37	6,200	155	1,200	N
Trichloroethene	3/37	4,800	120	700	N

Notes:

1. Maximum detected concentration in Phase II RI
2. Soil Criteria from TAGM "Determination of Soil Cleanup Objectives and Cleanup Levels" (NYSDEC, 1994).
3. Averages calculated using average of duplicates and ½ SQLs for non-detects.
4. Table shows inorganics at concentrations exceeding background.

* Average concentration exceeds maximum detected due to higher SQLs in most samples than detected values.

TABLE 7-3
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION SEDIMENT RESULTS

BECKER ELECTRONICS MANUFACTURING SITE PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SEDIMENT CRITERIA[3]	IDENTIFIED AS CPC
TCL-INORGANICS (mg/kg)[5]						
Arsenic	19/19	13.8		4.0	5	N
Cadmium	17/32	13.1	4.87	1.0	0.8	Y
Copper	32/32	693		40.6	19	Y
Zinc	32/32	861		158	85	Y
TCL-PESTICIDES/PCBs (µg/kg)						
Aroclor-1254	1/21	4,100	1,130	195	<8,280	Y,N
TCL-SVOA (µg/kg)						
1,4-Dichlorobenzene	4/22	260	1,180	275	360	N
2-Methylnaphthalen	1/22	63		249		
Acenaphthene	1/22	58*		249	21,900	N
Acenaphthylene	1/22	54*		249		
Anthracene	1/22	41*		249		
Benzo(a)Anthracene	3/22	130*	1,170	240	39	Y
Benzo(a)Pyrene	2/22	110*	1,190	238	39	Y
Benzo(b)Fluoranthene	1/22	220*	1,190	255	39	Y
Benzo(k)Fluoranthene	2/22	110*	1,180	239	39	Y
Benzoic Acid	3/22	650	1,070	300		
Butylbenzylphthalate	4/22	720		299		
Chrysene	3/22	170*	1,170	242	39	Y
Di-n-butylphthalate	2/22	250*		261		
Di-n-octylphthalate	7/22	2,500	1,080	351		Y
Dibenzofuran	1/22	55*		249		
Diethylphthalate	4/22	110*		257		

(continued)

TABLE 7-3
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION SEDIMENT RESULTS

BECKER ELECTRONICS MANUFACTURING SITE PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SEDIMENT CRITERIA[3]	IDENTIFIED AS CPC
Fluoranthene	3/22	260		245		
Fluorene	1/22	59*		249		
Indeno(1,2-cd)Perylene	1/22	180*	1,190	252	39	Y
Isophorone	1/22	59*		249		
Naphthalene	1/22	59*		249		
Phenanthrene	2/22	150*		253		
Pyrene	3/22	290		247		
bis(2-Ethylhexyl)phthalate	11/22	65,000	25,700	7,817	3,591	Y
TCL-VOA (μg/kg)						
1,1,1-Trichloroethane	5/33	51		3.0		
1,1-Dichlorethane	3/33	36	12.7	2.0		
1,1-Dichlorethene	1/33	31		1.0	0.6	Y
1,2-Dichlorethene	1/33	11		1.0		
Chloroethane	1/33	13		1.0		
Toluene	1/33	3.0		1.0		
Trichloroethene	1/33	11		1.0	60.0	N

Notes:

1. Maximum detected concentration in Phase II RI.
2. 95 percent UCL concentration used in Phase I RA.
3. Sediment criteria from Technical Guidance for Screening Contaminated Sediment (NYSDEC, 1993c). Criteria levels calculated with an organic carbon level of 3 percent.
4. Averages calculated using averages of duplicates and ½ SQLs for non-detects.
5. Table shows inorganics exceeding background concentrations.

* Average concentration exceeds maximum detected due to higher SQLs in most samples than detected values.

TABLE 7-4
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SURFACE WATER

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SURFACE WATER CRITERIA[3]	IDENTIFIED AS CPC
TCL-INORGANICS (µg/L)[5]						
Aluminum	11/14	6,410	2,710	1,101	100	Y
Arsenic	13/25	13.7		2.0	190	N
Barium	21/25	3,110		283	1,000	N
Beryllium	4/36	27.0	6.42	1.0	11/1,100	N
Cadmium	5/36	21.0	5.41	1.0	10	N
Calcium	21/21	186,000		50,635		
Chromium	8/36	120		8.0	11	N
Cobalt	3/25	105	28.4	8.0	5	Y
Copper	23/36	447		31.0	200	N
Iron	21/22	144,000	5,060	12,967	300	Y
Lead	26/32	185	453	19.9	50	N
Magnesium	25/25	38,200		6,170	35,000	N
Manganese	21/21	15,900		1,699	300	Y
Mercury	1/19	0.32		0.017	0.2	N
Nickel	6/30	283	61.5	17.8	13.4	Y
Potassium	21/25	51,700		4,484		
Selenium	1/25	11.3		0.45	1	N
Sodium	24/25	61,600		8,384	20,000	N
Vanadium	6/25	112	36.0	11.5	14	N
Zinc	28/30	1,370	466	283	30	Y
TCL-SVOA (µg/L)						
Benzoic Acid	1/19	18		0.095		
bis(2-Ethylhexyl)phthalate	3/25	14		3.0	0.6	Y
TCL-VOA (µg/L)						
1,1,1-Trichloroethane	13/39	110		11	5	Y
1,1-Dichloroethane	9/39	560		18	5	Y
1,1-Dichloroethene	2/39	64		5.0	5	Y
1,2-Dichloroethene	6/39	42		5.0	5	Y
Benzene	1/39	2.0		4.0	6	N
Tetrachloroethene	1/39	3.0		4.0	1	Y

(continued)

TABLE 7-4
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SURFACE WATER

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SURFACE WATER CRITERIA[3]	IDENTIFIED AS CPC
Trichloroethene	8/39	23	5.23	4.0	11	N
Vinyl Chloride	1/39	12		3.0	2	Y

Notes:

1. Maximum detected in Phase II RI.
2. 95 percent UCL used in Phase I RA.
3. Surface water criteria from Cleanup Policy and Guidelines, Vol. I; Class C (NYSDEC, 1991c).
4. Averages calculated using averages of duplicates and ½ SQLs for non-detects.
5. Table shows inorganics exceeding background concentrations.

* Average concentration exceeds maximum detected due to higher SQLs in most samples than detected values.

TABLE 7-5
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SURFACE SOIL

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SOIL CRITERIA[3]	IDENTIFIED AS CPC
TCL-INORGANICS (mg/kg)[5]						
Antimony	1/5	13.8		15.2	30	N
Arsenic	22/24	95.0		7.0	7.5	N
Cadmium	21/33	99.0	6.8	5.0	1.0	Y
Cyanide	1/3	13.0		5.0		
Lead	25/25	584		59.0	30	Y
Mercury	1/20	1.0	0.21	0.066	0.1	N
Zinc	33/33	4,480		367	20	Y
TCL-SVOA (µg/kg)						
1,4-Dichlorbenzene	3/23	200*		1,511	8,500	N
2-Methylnaphthalene	3/23	440*		1,510	36,400	N
4-Methylphenol	1/35	1,300		861	900	N
Acenaphthene	1/23	330*		1,500	50,000	N
Anthracene	3/23	280*		1,507	50,000	N
Benzo(a)Anthracene	2/23	420*	900	1,511	220	Y
Benzo(a)Pyrene	2/23	440*	896	1,514	61	Y
Benzo(b)Fluoranthene	2/23	830*	923	1,532	1,100	Y
Benzo(g,h,i)Perylene	2/22	400*		1,582	50,000	N
Benzoic Acid	4/20	15,000	4,680	819	2,700	N
Butylbenzylphthalate	4/23	2,100		1,601	50,000	N
Chrysene	3/23	490*	899	1,523	400	Y

(continued)

TABLE 7-5
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SURFACE SOIL

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SOIL CRITERIA[3]	IDENTIFIED AS CPC
Di-n-butylphthalate	3/23	3,800		1,665	8,100	N
Di-n-octylphthalate	12/23	55,000	1,700	4,802	50,000	N
Dibenzofuran	2/23	250*		1,501	6,200	N
Diethylphthalate	1/23	21*		1,494	7,100	N
Fluoranthene	2/23	1,100*		1,538	50,000	N
Fluorene	2/23	240*		1,502	50,000	N
Indeno(1,2-cd)Pyrene	2/23	370*	899	1,511	3,200	N
N-Nitrosodidiphenylamine	1/5	110*		6,811		
Naphthalene	2/23	7,800		1,595	13,000	N
Phenanthrene	3/23	490*	887	1,524	50,000	N
Phenol	1/23	54*		1,494	30	Y
Pyrene	4/23	1,000*		1,340	50,000	N
bis(2-Ethylhexyl)phthalate	16/23	270,000	12,500	25,963	50,000	Y
TCL-VOA (µg/kg)						
1,1,1-Trichloroethane	5/32	750	106	57	800	N
1,1-Dichloroethane	1/32	8.0*	4.25	23	200	N
2-Butanone	2/32	19,000	13.7	597	300	Y
4-Methyl-2-Pentanone	1/32	9.0*		23	1,000	N
Acetone	1/36	530		58	200	Y
Ethylbenzene	1/36	600,000		16,668	5,500	Y

(continued)

TABLE 7-5
CHEMICALS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK EVALUATION
SURFACE SOIL

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

PARAMETER	FREQUENCY OF DETECTION	PHASE II MAXIMUM CONCENTRATION[1]	PHASE I CONCENTRATION[2]	AVERAGE CONCENTRATION[4]	SOIL CRITERIA[3]	IDENTIFIED AS CPC
Tetrachloroethene	2/32	180		7.0	1,400	N
Toluene	8/32	2,000,000		62,505	1,500	Y
Total Xylenes	3/32	3,400,000		106,252	1,200	Y
Trichloroethene	2/32	22*	6.04	24	700	N

Notes:

1. Maximum detected concentration in Phase II RI.
2. 95 percent UCL used in Phase I RA.
3. Soil criteria from TAGM "Determination of Soil Cleanup Objectives and Cleanup Levels" (NYSDEC, 1994).
4. Averages calculated using averages of duplicates and ½ SQLs for non-detects.
5. Table shows inorganics exceeding background concentrations.

* Average concentration exceeds maximum detected due to higher SQLs in most samples than detected values.

TABLE 7-7
FLORA SPECIES IDENTIFIED

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

COMMON NAME	SCIENTIFIC NAME
Black eyed susan	Rudbeckia hirta
Motherwort	Leonurus cardiaca
Yellow sweet clover	Melilotus officinalis
White sweet clover	Melilotus alba
Four leafed milkweed	Asclepias quadrifolia
Ragweed	Ambrosia artemsiifolia
Black knapweed	Centaurea nigra
Common st. john's wort	Hypericum perforatum
Common mulein	Verbascum thapsus
Dwarf juniper	Juniperis communis
Hop clover	Trifolium agrarium
Red clover	Trifolium pratense
Black raspberry	Rubus occidentalis
Red Raspberry	Rubus idaeus
wood strawberry	Fragaria vesca
White pine	Pinus strobus
Gray birch	Betula populifolia
Paper birch	Betula papyrofera
Eastern hemlock	Tsuga canadensis
Red maple	Acer rubrum
Swamp oak	Quercus bicolor
beech	Fagus grandifolia
Balsam poplar	Populus balsamifera
Shagbark hickory	Carya ovata
Staghorn sumac	Rhus typhina

(continued)

TABLE 7-7
FLORA SPECIES IDENTIFIED

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

COMMON NAME	SCIENTIFIC NAME
Honey locust	Gledtisia triacanthos
Atlantic white cedar	Chamaecyparis thyoides
Weeping willow	Salix babylonica
Balsam fir	Abies balsamae
White ash	Fraxinus americana
Red pine	Pinus resinosa
White mulberry	Morus alba
cat o-nine tails (2)	

TABLE 7-8
FAUNA SPECIES IDENTIFIED

BECKER ELECTRONICS MANUFACTURING SITE
PHASE II REMEDIAL INVESTIGATION REPORT

COMMON NAME	SCIENTIFIC NAME
White tailed deer	Odocoileus virginianus
Rat *	
Gray squirrel	Sciurus carolinensis
Raccoon	Procyon lotor
Common crow	Corvus brachyrhychos
Barn swallow	
Morning dove	
Black/wood duck	
Red tail hawk	
Eastern kingbird	Tyrannus tyrannus
Robin	
Bullfrog	
Copperhead *	Agkistrodon contortrix

*Reported by drilling company on-site not observed by during site vist

8.0 RI SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Subsection 8.1 presents summaries of Sections 5.0, 6.0, and 7.0. Conclusions of the RI are presented in Subsection 8.2. Data gaps and recommendations for further work at the site are discussed in Subsection 8.3.

8.1 SUMMARY

The following subsections summarize the major findings of the Phase II RI concerning the nature and distribution of site contaminants, contaminant fate and transport, and the risk assessment.

8.1.1 Nature and Distribution of Contamination

The predominant site contaminants in soil, debris, sediment, surface water, and groundwater are VOCs (1,1,1-TCA, TCE, PCE, and their degradation products, and ethylbenzene, toluene, xylenes, and 2-butanone), SVOCs (phthalates, phenols, and PAHs), and inorganics. The distribution of these compounds in the environment is the result of leaching of landfilled solid waste materials (wood debris and other materials) or surface spill/disposal events involving hazardous wastes and the fate and transport mechanisms discussed in Section 6.0. Of these, only VOCs are directly related to hazardous waste disposal at the site. SVOCs and inorganics are related to other sources such as solid waste (wood debris) and other anthropogenic sources.

A summary of the Phase II RI activities and results of the investigation are summarized as follows by area:

Debris Pile Area

- The Phase II RI (a) determined that buried drums were not present in the surface wood debris; (b) identified that the wood debris was contaminated with hazardous waste constituents (i.e., solvents) but not at concentrations that could be classified as hazardous waste; and

(c) the estimated volume of surficial wood debris is approximately 6,130 cubic yards.

- Phase II RI activities consisted of geophysical survey and test pit explorations; wood debris, underlying soil, and debris composites were collected for laboratory analysis. Site survey activities included assessing vertical elevations of debris piles for volume estimation.

- Results of the geophysical survey showed few magnetic anomalies; the strongest anomalies were test pitted and were not shown to result from the presence of buried drums in the wood debris.

- Overall, test pits in the surface wood debris showed bedrock was shallow beneath the uphill (southwest) portion of the debris pile area; overburden thickens to the northeast and the surficial wood debris is underlain by other fill, including sawdust deposits.

- Laboratory analytical data from test pits TP-101 through TP-110 show sporadic detections of the VOCs 2-butanone, ethylbenzene, acetone, toluene, xylenes, and 1,1,1-TCA (low parts per billion [ppb] concentrations); all samples contained ppm concentrations of the phthalates BEHP and di-n-octylphthalate; the only inorganic in soil/debris exceeding site background was cadmium.

Septic System No. 2

- Septic system no. 2 is comprised of both the leachfield area and the septic tank locations. The purpose of the investigations was to (a) locate the leachfield; and (b) assess whether the location of the former septic tank, associated piping, and leachfield system was contaminated with hazardous waste constituents (solvents) and continued as a source of groundwater impact.

- The leachfield was investigated with surface geophysics during the debris pile study; the whole area of the suspected leachfield, east of the debris piles, was identified as having numerous magnetic and terrain conductivity anomalies due to subsurface materials.

- Subsequent test pit excavations (TP-111 through TP-117) were completed in the area; plastic piping believed to represent the leachfield was encountered in TP-111 and TP-114; buried metallic debris, wood, and other debris including crushed (empty) 55-gallon containers were observed in TP-111, TP-112, TP-113, TP-114, and TP-115. Samples were collected from each pit to characterize fill materials encountered.

- Laboratory analytical data from test pits TP-111 through TP-117 show sporadic detections of the VOCs 2-butanone, ethylbenzene, toluene, xylenes, 1,1-DCA, chloroethane, and 1,1,1-TCA (low ppb concentrations); samples contained concentrations of the SVOCs including phenols, phthalates, and PAHs, with the highest concentrations reported in TP-113; inorganics in soil/buried debris exceeding site background levels include cadmium, lead, manganese, arsenic, and zinc.

- The location of the former septic tank, surrounding vicinity, and piping was characterized through (a) excavation of TP-125; (b) seven Geoprobe® borings; and (c) collection of a liquid sample from a pipe cleanout (PP-1).

- Laboratory analytical data from TP-125 and borings GP-1 through GP-7 show sporadic detections of the VOCs 2-butanone, 1,1-DCE, 1,1-DCA, and 1,1,1-TCA (low ppb concentrations); TP-125 contained concentrations of the phthalates BEHP and di-n-octylphthalate; inorganics in soil from TP-125 do not exceed site background. Laboratory analytical data from pipe sample PP-1 shows residual liquid in the piping contains VOCs similar to those found in soil.

- No hazardous wastes were identified in the debris pile/leachfield area; the debris pile and fill materials at this portion of the site contain significant (ppm) concentrations of phenols, phthalates, metals, and traces of other compounds due to the material disposed both on and below the ground surface. Low (ppb) concentrations of hazardous waste-related solvents (primarily 1,1,1-TCA and xylenes) were detected sporadically in this area. Groundwater data infer a possible higher

concentration source of these solvents may be present in the area than detected in the RI.

Septic System No. 3

- No soil samples were collected to address septic system no. 3; characterization of this operable unit was to await groundwater results. As discussed in the groundwater results section, MW-104 and MW-105S contain only sporadic detections 1,1,1-TCA, TCE, and 1,1-DCE at low ppb levels. As such it is believed that no significant solvent contamination is present at this septic system; no further investigation of septic system no. 3 is warranted.

Chemical Storage Building

- Investigation of the chemical storage building area was performed to (a) assess the nature of previously detected solvent and ethylbenzene, toluene, and xylene contamination in area overburden; and (b) assess whether a UST was present at this location associated with a fuel pump.

- A limited GPR survey at this area detected no underground tank; however, soil conditions were not conducive to generating conclusive data.

- Phase II RI explorations at this operable unit included TP-118 through TP-122; and Geoprobe® borings GP-8 and GP-9. Laboratory analytical results from these explorations show that soil contamination is present near the drum storage area at the chemical storage building; soils encountered contained significant (ppm) concentrations of the VOCs 1,1-DCE, 2-butanone, 1,1,1-TCA, TCE, ethylbenzene, toluene, and xylenes, with the highest concentrations in GP-8, TP-122, and TP-119; samples also contained concentrations of SVOCs including PAHs and phthalates; inorganics at concentrations exceeding background levels include arsenic, cyanide, and zinc.

- Significant soil and groundwater contamination remains at the chemical storage building. Contamination extends from the ground surface to bedrock and consists of solvents, ethylbenzene, toluene, and xylenes. It is estimated that 1,200 cubic yards of soil contaminated with more than 500 μg/kg total TCL VOCs are present at this part of the Becker site.

Surface Water/Sediment

- Surface water/sediment sampling was performed to (a) confirm previous results; (b) for comparison of VOC data to current groundwater results; and (c) attempt to confirm that contaminated groundwater reaches the downgradient Thorp and Catskill Creeks.

- Phase II explorations consisted of SW/SD pairs SW/SD-101 through SW/SD-106 and seep samples SW-107 through SW-109.

- Surface water laboratory analytical results for samples SW-101 to SW-106, collected to characterize water in the immediate on-site drainages and fire pond show low (ppb) sporadic detections of TCE, 1,1,1-TCA, and 1,1-DCA. SVOCs were not detected; inorganics detected consist primarily of aluminum, calcium, manganese, magnesium, sodium, and zinc, with the highest concentrations generally in SW-104 and SW-105.

- Seep samples SW-107, SW-108, and SW-109 were collected at the base of the cliff at Catskill Creek east of the site. At each location, water was collected as it dripped from fractured shale bedrock (immediately beneath the siltstone unit) or emerged from soil uphill in elevation from the creek; laboratory analytical results for these seep samples show detections of the VOCs vinyl chloride, 1,1-DCE, 1,1-DCA, 1,1,1-TCA, TCE, and PCE; VOCs detected at the highest concentrations are 1,1-DCE (64 μg/L), 1,1-DCA (560 μg/L), and 1,1,1-TCA (110 μg/L). As these seeps discharge directly to the adjacent creek, this confirms contaminated groundwater is reaching the creeks.

Groundwater

- The Phase II RI focused on assessing the nature and distribution of contamination in groundwater in both the shallow (overburden) and deep (bedrock) aquifers. Shallow wells were analyzed for VOCs and SVOCs; bedrock wells were analyzed for VOCs and inorganics; some wells were also analyzed for treatability parameters (BOD, COD, alkalinity, TOC).

- Overburden wells sampled included: (a) wells MW-103 and MW-102D at the debris pile/septic system no. 2 leachfield area; (b) well MW-2S at the former septic system no. 2 former tank location; (c) wells MW-104 and MW-105S at the septic system no. 3 location; and (d) MW-Box, MW-Spill, MW-1EPS, MW-3EPS, MW-4EPS, MW-5EPS, MW-106S, and MW-107 at the chemical storage building area.

- Phase II RI laboratory analytical results for the overburden/shallow groundwater wells show groundwater contamination consists of VOCs; SVOCs were not detected. Overburden/shallow groundwater VOC results are as follows for each area:

  - Debris Pile/Septic System No. 2 Leachfield: VOCs were 1,1-DCA (1 μg/L) and xylenes (130 μg/L).

  - Septic System No. 2 Former Tank Location: VOCs were 1,1-DCE (10 μg/L), 1,1-DCA (56 μg/L), and 1,1,1-TCA (100 μg/L).

  - Septic System No. 3: VOCs were 1,1-DCA (11 μg/L) and 1,1,1-TCA (2 μg/L).

  - Chemical Storage Building Area: VOCs were chloroethane (up to 5 μg/L), 1,1-DCE (up to 400 μg/L), 1,1-DCA (up to 420 μg/L), 1,2-DCE (up to 12 μg/L), 1,2-DCA (up to 10 μg/L), 1,1,1-TCA (up to 2,600 μg/L), TCE (up to 18 μg/L), PCE (up to 2 μg/L), and 1,1,2-TCA (up to 2 μg/L).

- Bedrock wells sampled included (a) upgradient well MW-101D; (b) wells MW-5, MW-102S, and MW-109 at the debris pile/septic system no. 2 leachfield area; (c) well MW-108 at the former septic system no. 2 former tank location; (d) well MW-105D at the septic system no. 3 location; (e) MW-106D at the chemical storage building area; and (f) downgradient wells MW-4, MW-6, MW-110, MW-111, MW-112, and MW-113.

- Phase II RI laboratory analytical results for the bedrock wells show bedrock groundwater contamination consists of VOCs; inorganics were also detected at concentrations exceeding background. VOC results are as follows for each area:

  - Upgradient Groundwater: VOCs are non-detect in MW-101D.

  - Debris Pile/Septic System No. 2 Leachfield: VOCs were vinyl chloride (traces); chloroethane (up to 8 μg/L), 1,1-DCE (up to 100 μg/L), 1,1-DCA (up to 1400 μg/L), 1,2-DCE (up to 4 μg/L), chloroform (up to 2 μg/L), 1,2-DCA (up to 2 μg/L), 2-butanone (up to 13 μg/L), 1,1,1-TCA (up to 1,800 μg/L), and TCE (up to 7 μg/L).

  - Septic System No. 2 Former Tank Location: VOCs were 1,1-DCE (4 μg/L), 1,1-DCA (8 μg/L), and 1,1,1-TCA (15 μg/L) and TCE (9 μg/L). These concentrations are less than those detected in the Phase I RI sampling of the nearby Becker water supply well No. 2.

  - Septic System No. 3: VOCs were 1,1-DCA (4 μg/L) and 1,1,1-TCA (3 μg/L).

  - Chemical Storage Building Area: VOCs were chloroethane (310 μg/L), 1,1-DCE (2,200 μg/L) 1,1-DCA (up to 7,100 μg/L), 1,2-DCE (2,000 μg/L), 2-Butanone (900 μg/L), 1,1,1-TCA (20,000 μg/L) and TCE (1,800 μg/L).

- Downgradient Groundwater: VOCs were vinyl chloride (up to 15 μg/L), chloroethane (up to 3 μg/L), 1,1-DCE (up to 69 μg/L), 1,1-DCA (up to 410 μg/L), 1,2-DCE (up to 140 μg/L), 1,1,1-TCA (up to 120 μg/L), TCE (up to 30 μg/L) and PCE (up to 24 μg/L).

8.1.2 Fate and Transport

The fate and transport analysis concentrated on site-related VOCs, PAHs, phenols, phthalates, and inorganics migrating from on-site sources to groundwater, shallow groundwater, surface water, and sediment. Dissolved phase transport of contaminants is considered the most important contaminant migration pathway.

The physico-chemical properties of VOCs, PAHs, and phthalates were evaluated to assess whether biodegradation or biologic transformation, adsorption, volatilization, or dissolution were the most important fate processes. Biodegradation and biotransformation were identified as the most important controls on reducing VOC concentrations. Adsorption was identified as the most important fate process controlling the distribution of PAHs, phenols, and phthalates.

Assessment of fate processes for inorganics was qualitative. Low-oxygen (reducing) conditions were identified as responsible for the dissolution and transport of inorganics from site sources to groundwater and surface water. Precipitation of iron oxides in surface water was identified as the dominant fate process for inorganics resulting in their concentration in sediments in drainages on and adjacent to the site. Other important inorganics (primary metallic elements such as arsenic, cadmium, and zinc) are either co-precipitated with iron and manganese oxides or adsorbed to precipitating oxides.

A conceptual model was developed for the site which illustrates that VOC contaminants migrate from the various sources at the site as dissolved phase contamination in groundwater. Contaminated groundwater discharges at seeps along the drainages on-site and along Catskill Creek and Thorp Creek.

8.1.3 Baseline Risk Assessment

The baseline RA used information collected in the RI to assess the risks posed by the Becker site to public health and the environment.

8.1.3.1 Baseline Public Health Risk Assessment. The public health RA was prepared during the Phase I RI in accordance with USEPA (1989b) and NYSDEC (1989a) guidance documents (M&E, 1992c). CPCs identified for the Becker site include VOCs, SVOCs, and inorganics. Hypothetical exposure scenarios were developed to model the ways that people could be exposed to chemicals associated with the site. Exposure scenarios evaluated during Phase I are child and adult exposures to soil, sediment, surface water, and groundwater.

The RA performed during Phase I shows carcinogenic risk estimates and the noncarcinogenic HIs closely approximate or are below the NYSDOH and USEPA target risk guidelines of 10^{-6} for carcinogenic risks and 1 for noncarcinogenic risks for the following scenarios:

- exposure to surface soil
- exposure to surface water
- exposure to sediment

The Phase I RA shows risks associated with the following scenarios are above the NYSDOH carcinogenic risk guidelines and the USEPA carcinogenic target risk range:

- exposure to groundwater (exceeding 10^{-4} for adult and child exposures)

As a component of the Phase II RI, the results of the Phase I RI were reassessed. The Phase II qualitative assessment identified that all risk scenarios from Phase I for all media likely underestimate actual site risks. This is because Phase II data include many more samples representative of soil and groundwater contamination at and downgradient of the site. Because of the higher concentrations and numbers of chemicals exceeding soil, sediment, surface water, and groundwater chemical-specific ARARs, there is the potential that all scenarios would exceed NYSDOH and USEPA carcinogenic and noncarcinogenic risk criteria.

8.1.3.2 Ecological Risk Assessment. The ecological RA consisted of evaluation of the existing environment (including site description, resource characterization, and hazard threshold identification) and qualitative assessment of potential impacts. Media of ecological concern at the site are: surface soil, surface water, and sediments. The remaining media (groundwater and subsurface soil) are unlikely to result in an exposure pathway for ecological receptors. With the exception of several inorganic nutrients and inorganics with maximum concentrations below background concentrations, all VOCs, SVOCs, and inorganics detected in the three media of concern were considered to be CPCs for the ecological RA.

Comparison of the contaminant concentrations detected in the three media of ecological concern at the site with NYS and federal toxicity criteria indicated that ecological receptors may suffer adverse effects from exposure to contaminated media.

8.2 CONCLUSIONS

An evaluation of the hydrogeologic regime and the conceptual model for the Becker site indicates the following:

- The groundwater flow direction from the site is toward Catskill and Thorp Creeks east of the site.
- Contaminated bedrock and overburden groundwater discharges to on- and off-site drainages.
- The predominant contaminant transport pathway is dissolved phase transport in groundwater and surface water.

Media and chemicals of potential concern to public health are:

- Groundwater: VOCs, including the solvents 1,2-DCA, 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, 1,1,1-TCA, TCE, PCE, vinyl chloride, chloroethane, xylenes, 2-butanone, and acetone.

- Surface and Subsurface Soil: VOCs (solvents listed above for groundwater and ethylbenzene and toluene), phenols, phthalates, PAHs, cadmium, and zinc.

- Surface Water and Sediment: VOCs (solvents) phthalates, BEHP, and cadmium, copper, and zinc.

Media and chemicals of potential concern to ecological receptors are:

- Surface water: VOCs (solvents) and inorganics.
- Sediment: VOCs (solvents) and cadmium, copper, and zinc.
- Surface Soil: VOCs (solvents), phthalates, PAHs and cadmium, lead, and zinc.

Remedial action objectives to eliminate, reduce, or control risk from contaminated media are based on the results of the public health and ecological RAs, and are discussed further in the FS.

ABB-ES	ABB Environmental Services
ARARs	applicable or relevant and appropriate requirements
ASP	analytical services protocol
AWQC	Ambient Water Quality Criteria
Becker	Becker Electronics Manufacturing Corporation
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BOD	biological oxygen demand
BW	basal water
CCAS	Coast-to-Coast Analytical Services
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm/sec	centimeter per second
COD	chemical oxygen demand
CPC	chemical of potential concern
CRQL	Contract Required Quantitation Limit
CWA	Clean Water Act
DCA	dichloroethane
DCE	dichloroethene
DHWR	Division of Hazardous Waste Remediation
DO	dissolved oxygen
EPS	Environmental Products and Services, Inc.
ESE	Environmental Science and Engineering
eV	electron volt
E3I	Energy and Environmental Engineering, Inc.
FS	feasibility study
ft/ft	feet per foot
GC/MS	gas chromatography/mass spectrometry
gpd	gallons per day
gpm	gallons per minute
GPR	ground-penetrating radar

HBA	habitat-based assessments
HI	Hazard Index
HPLC	high performance liquid chromotography
HSA	hollow stem auger
ID	inside diameter
iH	horizontal gradient
in. Hg	inches of mercury
IRM	Interim Remedial Measure
iV	vertical gradient
K	hydraulic conductivity
K_{oc}	organic carbon partition coefficent
M&E	Metcalf & Eddy, Inc.
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MEK	methyl ethyl ketone (2-butanone)
met	meteorological monitoring
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL/min	milliliters per minute
MSL	mean sea level
MW	monitoring well
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NIOSH	National Institute of Occupational Safety and Health
No., no.	number
NTUs	nephelometric turbidity units
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2/LEL	oxygen/lower explosive limit
OSHA	Occupational Safety Health Administration
OSWER	Office of Solid Waste and Emergency Response

PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
psi	pounds per square inch
PT	packer test
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RG	remediation goals
RI	Remedial Investigation
RL	regulatory limits
RQD	rock quality designation
S	storage coefficient
SARA	Superfund Amendment and Reauthorization Act
SCGs	Standards, Criteria, and Guidelines
SD	sediment
SDWA	Safe Drinking Water Act
SP	spontaneous potential
SPDES	State Pollutant Discharge Elimination System
SPR	single-point resistance
sq. ft.	square feet
SVOC	semivolatile organic compound
SW	surface water
T	transmissivity
TAGM	Technical Administrative Guidance Memorandum
TBC	to be considered
TCA	trichloroethane

TCE	trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TIC	tentatively identified compound
TOC	total organic carbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
UCL	upper confidence level
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
WA	Work Assignment
WSW	water supply well
$\mu g/kg$	microgram per kilogram
$\mu g/L$	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
16N	sixteen-inch normal resistivity

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